Plant Germplasm Registration Notice*

The Plant Germplasm Registration Committee of ICAR in its XXI[th] meeting held on May 18, 2010 at the National Bureau of Plant Genetic Resources, New Delhi, approved the registration of following 115 germplasm lines out of 206 proposals considered. The information on registered germplasm is published with the purpose to disseminate the information to respective breeders for utilization of these genetic stocks in their crop improvement programmes. Upon request, the developer(s)/author(s) is/are obliged to distribute the material for crop improvement programme of National Agricultural Research System.

1. AKAW-3717 (IC0582907; INGR10001), a Wheat (*Triticum aestivum* L.) Germplasm with Tolerance to Drought and Heat

NR Potdukhe and SG Bharad

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Nearly 22.5 m ha area is under bread and durum wheat in North-West, North-East and central India, where early or late heat stress or both affects wheat productivity. Stagnant wheat production in recent years is partly due to climatic factors including heat stress characterized by an increasing trend in average temperature during winter months (Rane *et al.,* 2000; Nagarajan 2005). With an objective of development of short duration temperature insensitive wheat varieties with tolerance to terminal heat, a cross between germplasm line HW-2035 and NI-5439 was performed at Wheat Research Unit, Dr Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola. Further generations of cross HW-2035 x NI-5439 were advanced as per pedigree selection breeding method. After stabilization of material, it was contributed in DHTSN during the year 2006-07, to judge its performance under high temperature both at early and terminal growth stages and moisture stress throughout the crop period.

Morpho-agronomic Characteristics

Growth habit of the genotype AKAW-3717 is erect and coleoptiles, leaf sheaths and auricles are free from anthocyanine pigmentation. Flag leaf length and breadth is medium and it requires average 62 days for ear emergence. Waxiness on flag leaf sheath is strong and medium on leaf blade. Average plant height is 65 cm. Ear head length and density is medium with white colored awns of medium length. Amber colored grains are medium in size and are having about 38.0 g/1000 grain weight with semi-hard grain texture. Data on grain yield (g/plot), Morphological

Table 1. Grain yields (g/plot) performance, rank as revealed by pooled analysis

Rank	Genotype	Sagar	Hisar	Kanpur	Pune	Indore	Karnal	Kota	Bardoli	Dharwad	Dhanduka
A	19th DHTSN, 2006–07										
1	HI–1544	333.4	511.0	192.9	551.1	–	–	–	–	–	66.5
2	AKAW–3717	364.9	374.3	214.4	591.9	–	–	–	–	–	61.1
	Gen. Mean	346.1	398.7	174.8	356.6	–	–	–	–	–	64
	CD at 5%	91.2	70.3	50.0	–	–	–	–	–	–	9.6
B	20th DHTSN, 2007–08										
1	NI–5439	445.1	339.3	249.6	475.0	548.7	162.0	925.0	–	–	–
18	AKAW–3717	517.7	324.9	234.7	462.5	395.8	132.5	418.5	–	–	–
	Gen. Mean	358.6	230.2	229.1	424.8	385.0	139.4	594.5	–	–	–
	CD at 5%	87.3	63.2	127.1	121.0	91.6	Ns	60.1	–	–	–
C	21st DHTSN, 2008–09										
1	AKAW–3717	440.0	430.0	129.0	208.0	335.5	456.1	410.0	395.0	368.0	–
2	HI–1564	440.0	322.5	117.5	218.0	253.5	471.0	457.5	400.0	272.0	–
	Gen. Mean	284.5	287.1	119.3	152.4	253.7	412.8	398.3	359.2	311.5	–
	CD at 5%	183.9	66.3	6.28	73.13	58.8	189.3	0	58.35	31.0	–

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Table 2. Ancillary data of breeding trials NIVT–5A, 02–03 & 04–05 and AVT (RF–TS), 05–06

Character	Trial name& year	AKAW–3717	NI–5439	LOK–1	HW–2004	AKDW–2997–16	MACS–1967
Days to heading	NIVT–5A, 2002–03	111	105	103	104	–	–
	NIVT–5A, 2004–05	88	84	–	95	–	–
	AVT (RF), 2005–06	62	59	–	–	62	56
	Mean	87.0	83.0	103.0	99.5	62.0	56.0
Days to Maturity	NIVT–5A, 2002–03	154	151	144	155	–	–
	NIVT–5A, 2004–05	145	140	–	145	–	–
	AVT (RF), 2005–06	102	102	–	–	104	99
	Mean	134.0	131.0	144.0	150.0	104.0	99.0
Plant height (cm)	NIVT–5A, 2002–03	95	90	86	103	–	–
	NIVT–5A, 2004–05	89	84	–	104	–	–
	AVT (RF), 2005–06	65	66	–	–	60	65
	Mean	83.0	80.0	86.0	103.5	60.0	65.0
1000 Grain wt (g)	NIVT–5A, 2002–03	33	34	45	38	–	–
	NIVT–5A, 2004–05	26	26	–	35	–	–
	AVT (RF), 2005–06	38	38	–	–	41	49
	Mean	32.3	32.6	45.0	36.5	41.0	49.0

A: Amber; W: White; Ey: Easy; M: Medium; SO: Soft; SH: Semi hard; H: hard

Table 3. Reaction against rusts and KB diseases under field conditions (Artificial inoculations)

Varieties	Stem rust South		Leaf rust South		Leaf rust North		Stripe rust North		KB (%)
	HS	ACI	HS	ACI	HS	ACI	HS	ACI	HS
NIVT–5A, 2002–03									
AKAW–3717	60S	22.3	60S	8.6	TS	0.8	80S	40.0	45.0
NI–5439	50S	26.3	70S	36.7	60S	23.6	80S	50.0	62.8
LOK–1	80S	29.0	80S	41.7	60S	18.7	80S	44.2	10.0
HW–2004	20MR	2.2	TMR	0.1	10MS	2.0	5S	1.2	13.0
INFECTOR	100S	63.3	100S	71.1	90S	74.3	80S	60.0	63.0
NIVT–5A, 2004–05									
AKAW–3717	50S	19.9	40S	8.4	10MS	1.3	100S	81.7	15.2
NI–5439	80S	30.9	60S	32.3	60S	21.7	100S	71.3	31.8
LOK–1	–	–	–	–	–	–	–	–	–
HW–2004	20MS	3.8	10MR	1.0	0	0.0	40S	10.0	50.8
INFECTOR	100S	74.3	100S	80.0	80S	78.3	100S	88.3	28.1
AVT (RF), 2005–06									
AKAW–3717	60S	28.0	20S	4.3	TS	0.1	80S	64.0	80.4
INFECTOR	80S	68.0	80S	58.8	80S	67.5	80S	52.0	76.0

R: Resistant; MR: Moderately resistant; MS: Moderately susceptible; S: Susceptible

Table 4. Quality characteristics in trials NIVT–5A, 02–03 & 04–05 and AVT (RF–TS), 05–06

S. No.	Quality characters	AKAW–3717			NI–5439		
		2002–03	2004–05	2005–06	2002–03	2004–05	2005–06
A	Grain characters						
	Texture	SO–SH	H	SO–SH	SO–SH	A–W	SO–SH
	1000 grain Wt (g)	33	38	38	37	34	38
	Grain colour	A	A	A	A	A–W	A
B	Quality characters						
	i) Protein content (%)	12	13	8.97	12.3	12.2	9.25
	ii) Grain appearance score	5.2	4.8	5.1	5.2	5.5	5.5
	iii) Sedimentation value (kg/hl)	43.5	49	48	45.1	47	52
	iv) Hectolitre weight (kg/ha)	77	76.4	80.4	74.8	76.4	81.2
	v) HMW (GLU–1 Score)	–	–	6	–	–	6

characters, reaction to rust and kernel bunt disease and quality characteristics is presented in Table 1, 2 & 3. Data source utilized is AICW&BIP Progress Reports 2002-03 to 2008-09.

The genotype AKAW-3717 developed at Wheat Research Unit, PDKV-Akola is tested in DHTSN continuously for three years (2006-07, 2007-08, 2008-09). Nursery trial was conducted at 5 locations during 2006-07, 7 locations during 2007-08 and at 9 locations during 2008-09. Trials were conducted in

two replications and each genotype was raised on plots with 2 rows of 2 m row length with 30 cm space between two rows. The crop was sown with pre-sowing irrigation only when germination was likely to be affected by soil moisture deficit, no irrigation was provided after germination and the crop growth was dependent on stored soil moisture or rainfall.

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2. V 373 or JKMH-175-4 (IC0584057; INGR10002), a Maize (*Zea mays* L.) Germplasm with High Test Weight and Good Combining Potential

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3. *Atharga Kempu Jola* (IC0584056; INGR10003), a Sorghum (*Sorghum bicolor*) landrace for Good Flaking

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Atharga Kempu Jola is the rabi adapted sorghum landrace variety of *Kadabina Jola* being grown in Northern dry zone of Karnataka. The earhead and seed coat of this variety is red in colour and hence farmers call this as Kempu (i.e. Red) Jola (Sajjanar *et al*., 2009). It is suitable for certain traditional food preparations like *Kadabu*, a steamed product and hence the name *Kadabina Jola (*Hemalatha *et al*., 2008*)*. The specific functional characterstics of its grains that make distinct from other varieties is its high gelatinization property in grain flour. This property makes its suitability for flaking and various novel recipes. The flakes of this variety directly made from grains were of good quality in terms of taste, texture, colour and flavor.

Atharga Kempu Jola was collected from farmer's fields of Atharga Village of Bijapur district in North Karnataka and is being conserved at All India Co-ordinated Sorghum Improvement Project, Regional Agricultural Research Station, Bijapur, University of Agricultural Sciences, Dharwad (AICSIP Annual Reports, 2002-03 and 2004-05 of RARS, Bijapur). Further selections were made by pure line selection method.

The variety is adapted to *rabi* season, is late flowering (79-82 days) and tall (180-210 cm) having semi-compact panicle, pink coloured glumes, red colouration in leaves and on stem at maturity and slightly elliptical, medium bold, smooth, lustrous, dark red coloured grains and its flour sticky. The variety was evaluated along with popular roti making variety M35-1 and other varieties during *rabi* 2005 & 2006 at Bijapur. The results revealed that *Atharga Kempu Jola* was statistically on par with M35-1 for grain yield, panicle weight, panicle length, panicle breadth and number of primaries. Flakes of these varieties evaluated for flakes yield and quality parameters. Colour and size of the flakes were observed visually and recorded. It revealed that *Atharga Kempu Jola* recorded high values for flake length, breadth and volume compared to M35-1. The flakes of this variety were long, elliptical, uniformly shaped, thin, attractive red coloured, tasty and well accepted. Comparatively high grain yield, flake yield (%) and flakes quality recorded by variety *Atharga Kempu Jola* indicated its suitability for commercial exploitation in flaking. Preliminary analysis for micronutrients in grains showed

two replications and each genotype was raised on plots with 2 rows of 2 m row length with 30 cm space between two rows. The crop was sown with pre-sowing irrigation only when germination was likely to be affected by soil moisture deficit, no irrigation was provided after germination and the crop growth was dependent on stored soil moisture or rainfall.

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3. *Atharga Kempu Jola* (IC0584056; INGR10003), a Sorghum (*Sorghum bicolor*) landrace for Good Flaking

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that this variety recorded higher Iron (3.33 ppm) and zinc (1.83) content compared to M 35-1 (1.71 ppm and 1.4 ppm, respectively) (Keshav Reddy, 2007). The flakes can be tailor made to suit to different needs in terms of nutrients as well as taste. The flour/semolina can be suitable substitute for wheat & rice flour in many dishes of North and South India like *dosa, idli, upama, tikka, cutlet, parota, pakoda, burfi* etc., It is recommended for its cultivation in Northern dry zone of Karnataka during rabi season. The cultivation practices recommended for rabi sorghum for this region may be followed.

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4. DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59 (IC0584513 - IC0584518 ; INGR10004-INGR10009), Sorghum (*Sorghum bicolor*) Germplasm Lines with Resistance to Grain Mould

SS Ambekar, MY Kamtar, K Ganesamurthy, RB Ghorade, Usha Saxena, Pooranchand, JD Jadav, S Audilakshmi, IK Das, TG Nageshwar Rao and N Seetharama

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The DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59, grain mould resistance lines were developed from crosses involving 8 grain mould susceptible parental B lines and 7grain mould resistant germplasm lines by pedigree method. The F_1s were raised at Parbhani, and F_2 and F_3 at AICSIP multi-locations. Over locations, three hundred F_3 selections were made and further evaluated (F_4) at three centers. The superior selections were advanced to F_6 and again evaluated at DSR. Superior performing lines for grain mold resistance were DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59. The grain mold resistant lines, DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52 are derived from a cross between elite restorer Indore 12 and grain mold resistant line IS 25017. DSR-GMN-41 was selected at Akola, DSR-GMN-42 at Parbhani, DSR-GMN-46 at Surat, and DSR-GMN-52 at Hyderabad. DSR. DSR-GMN-58 is a derivative of a cross between SRT26, grain mold tolerant line from Surat, and IS25017, a grain mold resistant source from Sudan. DSR-GMN-59 is derived from a cross, GMRP 9 × IS 25017, where GMRP 9 is a grain mold resistant variety from Parbhani, and IS 25017 a grain mold resistant genetic stock from Sudan. These lines in F_4 to F_6 were evaluated for grain mould resistance.

Morpho-agronomic Characteristics

380 segregants in F_4 were evaluated during 2006 in augmented design at three locations. The field grade score at physiological maturity ranged from 3.4 to 5.6 and field grade score at normal maturity ranged from 4.5 to 7.7. The resistant check, B 58586 scored 4.5 FGS at physiological maturity and normal maturity. The susceptible check, 296 B scored 5.0 at physiological maturity and 7.7 at normal maturity. During 2007, out of 23 derivatives, 12 were on par (scored 3.1 to 4.4) with resistant check, B 58586 (3.2 score). During 2008

two replications and each genotype was raised on plots with 2 rows of 2 m row length with 30 cm space between two rows. The crop was sown with pre-sowing irrigation only when germination was likely to be affected by soil moisture deficit, no irrigation was provided after germination and the crop growth was dependent on stored soil moisture or rainfall.

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The DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59, grain mould resistance lines were developed from crosses involving 8 grain mould susceptible parental B lines and 7grain mould resistant germplasm lines by pedigree method. The F_1s were raised at Parbhani, and F_2 and F_3 at AICSIP multi-locations. Over locations, three hundred F_3 selections were made and further evaluated (F_4) at three centers. The superior selections were advanced to F_6 and again evaluated at DSR. Superior performing lines for grain mold resistance were DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59. The grain mold resistant lines, DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52 are derived from a cross between elite restorer Indore 12 and grain mold resistant line IS 25017. DSR-GMN-41 was selected at Akola, DSR-GMN-42 at Parbhani, DSR-GMN-46 at Surat, and DSR-GMN-52 at Hyderabad. DSR. DSR-GMN-58 is a derivative of a cross between SRT26, grain mold tolerant line from Surat, and IS25017, a grain mold resistant source from Sudan. DSR-GMN-59 is derived from a cross, GMRP 9 × IS 25017, where GMRP 9 is a grain mold resistant variety from Parbhani, and IS 25017 a grain mold resistant genetic stock from Sudan. These lines in F_4 to F_6 were evaluated for grain mould resistance.

Morpho-agronomic Characteristics

380 segregants in F_4 were evaluated during 2006 in augmented design at three locations. The field grade score at physiological maturity ranged from 3.4 to 5.6 and field grade score at normal maturity ranged from 4.5 to 7.7. The resistant check, B 58586 scored 4.5 FGS at physiological maturity and normal maturity. The susceptible check, 296 B scored 5.0 at physiological maturity and 7.7 at normal maturity. During 2007, out of 23 derivatives, 12 were on par (scored 3.1 to 4.4) with resistant check, B 58586 (3.2 score). During 2008

that this variety recorded higher Iron (3.33 ppm) and zinc (1.83) content compared to M 35-1 (1.71 ppm and 1.4 ppm, respectively) (Keshav Reddy, 2007). The flakes can be tailor made to suit to different needs in terms of nutrients as well as taste. The flour/semolina can be suitable substitute for wheat & rice flour in many dishes of North and South India like *dosa, idli, upama, tikka, cutlet, parota, pakoda, burfi* etc., It is recommended for its cultivation in Northern dry zone of Karnataka during rabi season. The cultivation practices recommended for rabi sorghum for this region may be followed.

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4. DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59 (IC0584513 - IC0584518 ; INGR10004-INGR10009), Sorghum (*Sorghum bicolor*) Germplasm Lines with Resistance to Grain Mould

SS Ambekar, MY Kamtar, K Ganesamurthy, RB Ghorade, Usha Saxena, Pooranchand, JD Jadav, S Audilakshmi, IK Das, TG Nageshwar Rao and N Seetharama

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The DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59, grain mould resistance lines were developed from crosses involving 8 grain mould susceptible parental B lines and 7grain mould resistant germplasm lines by pedigree method. The F_1s were raised at Parbhani, and F_2 and F_3 at AICSIP multi-locations. Over locations, three hundred F_3 selections were made and further evaluated (F_4) at three centers. The superior selections were advanced to F_6 and again evaluated at DSR. Superior performing lines for grain mold resistance were DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59. The grain mold resistant lines, DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52 are derived from a cross between elite restorer Indore 12 and grain mold resistant line IS 25017. DSR-GMN-41 was selected at Akola, DSR-GMN-42 at Parbhani, DSR-GMN-46 at Surat, and DSR-GMN-52 at Hyderabad. DSR. DSR-GMN-58 is a derivative of a cross between SRT26, grain mold tolerant line from Surat, and IS25017, a grain mold resistant source from Sudan. DSR-GMN-59 is derived from a cross, GMRP 9 × IS 25017, where GMRP 9 is a grain mold resistant variety from Parbhani, and IS 25017 a grain mold resistant genetic stock from Sudan. These lines in F_4 to F_6 were evaluated for grain mould resistance.

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Table1. Performance of superior derivatives in F_4 to F_6 for grain mould resistance

Generation–year	F_4– 2006											F_5– 2007				F_6– 2008
	PH	DF	D–PM	D–NM	FGS PM	FGS PM	FGS PM	FGS PM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM
Entry	Av	Av	Av	Av	Coi	Hyd	Par	Av	Hyd	Par	Av	Hyd	Coi	Par	Av	Hyd
GMN 41	164	74	104	115	3.06	3.78	4.32	3.8	5.4	5.04	5.2	3	3.6	2.7	3.1	2
GMN 42	166	74	103	115	6.66	3.42	4.32	4.9	5.04	5.04	5	4	3.6	3	3.3	2.5
GMN 46	196	71	100	112	5.76	3.42	4.32	4.5	5.4	4.14	4.9	3	3.6	2.7	3.2	2
GMN 47	189	71	103	114	3.96	3.42	3.42	3.6	6.3	3.24	4.9	3	6.6	3.3	4.4	2
GMN 49	205	73	104	114	4.86	4.14	3.78	4.3	5.94	4.14	5	4	6	2.7	4.1	2
GMN 52	185	70	101	110	2.88	3.24	3.6	3.2	4.68	4.68	4.7	3	3.6	4.2	3.5	2.5
GMN 58	210	66	98	109	8.1	2.7	3.42	4.7	5.94	3.78	4.9	3	4.2	3	3.4	2.5
GMN 59	199	69	99	111	5.4	2.7	3.42	3.8	5.76	4.68	5.2	3	4.2	2.7	3.5	5.5
GMN 60	149	72	101	113	8.1	3.6	5.22	5.6	3.96	6.48	5.2	4	9	3	5.2	3
GMN 63	192	71	101	115	4.68	3.24	3.6	3.8	5.76	4.5	5.2	4	3.6	2.7	3.3	2
B 58586	167	77	100	112	3.42	5.58	4.5	4.5	3.78	5.22	4.5	4	3.6	2.7	3.2	2
296 B	179	79	103	115	6.3	2.16	6.84	5	7.92	7.56	7.7	9	6.6	8.4	8	7
CD (p=0.05)	95	26	39	44	1.62	3.42	3.42	2.7	5.4	3.24	4.3	1.2	1	0.8	1.2	2.9

PH = plant height (cm), DF= days to flowering, D–PM= days to physiological maturity, D–NM = days to normal maturity, FGS PM = field grade score physiological maturity, FGS NM = field grade score normal maturity, FGS = field grade score on the scale of 1 to 9 where 1 is highly resistant and 9 is highly susceptible, and AV = Average

also, the same 12 derivatives performed superiorly by scoring FGS from 2.0 to 3.0 as against 2.0 of B 58586. The multi-location evaluation from F_2 to F_6 helped to select superior derivatives for grain mould, which are agronomically superior to the resistance check, B 58586. The DSR-GMN-41, DSR-GMN-42, DSR-GMN-46, DSR-GMN-52, DSR-GMN-58, and DSR-GMN-59 were having grain mold resistance on par with resistant source. DSR-GMN-41 (GMN-41) is early duration grain mould resistant line; DSR-GMN-42 (GMN-42) is Grain mould resistant line with greyed yellow grain; DSR-GMN-46 (GMN-46) is tall grain mould resistant line; DSR-GMN-52 (GMN-52) is grain mould resistant line having yellow white grain; DSR-GMN-58 (GMN-58) is tall grain mould resistant line with long panicle,DSR-GMN-59 (GMN-59) is grain mould resistant with circular grain shape

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5. MS3054 A & B, MS3060 A &B, MS3061 A & B, MS3095 A & B, MS3143 A & B, MS3146 A & B, MS3183 A & B, MS3216 A & B, and MS3228 A & B (IC0584519-IC0584536; INGR10010-INGR10018), Sorghum (*Sorghum bicolor*) Male Sterile Lines with Superior Grain Yields

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Generation–year	F_4– 2006											F_5– 2007				F_6– 2008
	PH	DF	D–PM	D–NM	FGS PM	FGS PM	FGS PM	FGS PM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM	FGS NM
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B 58586	167	77	100	112	3.42	5.58	4.5	4.5	3.78	5.22	4.5	4	3.6	2.7	3.2	2
296 B	179	79	103	115	6.3	2.16	6.84	5	7.92	7.56	7.7	9	6.6	8.4	8	7
CD (p=0.05)	95	26	39	44	1.62	3.42	3.42	2.7	5.4	3.24	4.3	1.2	1	0.8	1.2	2.9

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Table1. Performance of new MS lines for grain yield and ancillary data

Backcross no	Pant Height (cm)			Days to Flower			Panicle Length (cm)			No. of Primary branches			Grain Yield (g/plant)		
	2005	2006	AV	2005	2006	AV	2005	2006	AV	2005	2006	AV	2005	2006	AV
3054	211	182	196	75	75	75	20	34.6	27.5	58.7	50.48	54.6	54.5	126.7	90.6
3060	152	147	149	75	73	74	35	40.3	37.7	77.5	66.64	72.1	66.5	78.6	72.6
3061	171	166	169	68	70	69	30	32.3	31.1	64.5	57.44	61.0	66.5	75.6	71.1
3095	289	222	255	70	77	73.5	33	37.1	35.0	72.1	58.64	65.4	87.5	95.6	91.6
3143	163	159	161	78	78	78	22	29.7	25.9	72.7	55.36	64.0	63.3	81.4	72.4
3146	154	156	155	76	77	76.5	23	29.9	26.4	67.3	43.96	55.6	81.3	74.4	77.9
3183	160	156	158	72	74	73	25	30.1	27.6	63.7	46.32	55.0	66.3	76.3	71.3
3216	171	135	153	67	70	68.5	26	27.3	26.7	47	47.92	47.5	66	78.3	72.2
3228	188	173	181	72	72	72	25	25.9	25.6	59.4	55.52	57.5	65	78.3	71.7
296 B	134	130.83	133	76.8	76	76.4	31	33.5	32.1	101.6	61.05	81.3	50.8	57.0	53.9
CD (p=0.05)	70	67.5		3	3.1		5.3	5.2		19.3	26.1		18.2	23.0	

grain mould resistant line IS 25017. MS 3143 and MS3146 were developed from a cross between 463B and variety SPV 475. MS3183 was developed from a cross between AKMS 14 B and grain mold resistant line IS 25017; MS 3216 from a cross between grain mold resistant line SPGM 94009 and a variety SPV 1231 and MS 3228 from a multiple cross among MS line 2219 B, SPV 462 and IS 18475. Two hundred MS lines and checks were grown in augmented design during rainy season of 2005 and 2006 at DSR and were evaluated for plant height, days to flowering, panicle length, primary branches, panicle weight, and grain yield.

Morpho-agronomic Characteristics

The MS lines showed large variation for all the characters studied. MS3054 is a tall MS line with 196cm height and takes 75 days to flower. MS3060 a superior line with medium dwarf height (149 cm tall), medium late flowering (74 days) and has very long panicle (38 cm). MS3061 is medium in stature (169cm) and medium in flowering (69 days) and has long panicle (31cm). MS3095 is a very tall MS line(255 cm) and medium duration for flowering (74 days) (Table 1). The MS line has a long panicle (35 cm) and greyed yellow grain. MS 3143: MS line is medium tall (161 cm) and medium late duration type (78 days). MS 3146 is 155 cm tall plant and takes 77 days for flowering. MS3183 is medium in stature (158 cm), takes 73 days to flower and has medium length panicle (28cm) and short pedicel. MS3216 is of medium height (153 cm), and medium early for flowering (69 days). MS3228 is 181cm tall and takes 72 days for flowering with grain shape circular in dorsal view and elliptical in profile view.

MS3054 A & B, MS3060 A &B, MS3061, MS3095, MS3143 A & B, MS3146 A & B, MS3183 A & B, MS3216 A & B, and MS3228 showed significant superiority for grain yield over the check 296 B (Audilakshmi et al. 2009). MS3054 has 91 g/plant of grain yield; MS3060 has 73 g; MS3061 has 71 g; MS3095 yields 92 g; MS 3143, MS3216, and MS3228 yield 72 g; MS 3146 has 78 g; MS3183 yields 71 g/plant as compared to 54 g/plant of 296 B, check (Table 1).

Reference

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6. BANG – 4/5 (IC0569319: INGR10019), a Guar (*Cyamopsis tetragonoloba*) Germplasm with Branched as well as all Node Cluster Bearing Habit

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Guar [*Cyamopsis tetragonoloba* (L.) Taub.] is an annual drought hardy leguminous crop cultivated mainly in semi-arid and arid tracts of India for the galactomannan gum extracted from its endosperm. With increasing constrain in the production of guar, breeders continually look for new and diverse germplasm with specific traits to enhance crop productivity. New plant types with unique characters and altered growth habit

Table1. Performance of new MS lines for grain yield and ancillary data

Backcross no	Pant Height (cm)			Days to Flower			Panicle Length (cm)			No. of Primary branches			Grain Yield (g/plant)		
	2005	2006	AV	2005	2006	AV	2005	2006	AV	2005	2006	AV	2005	2006	AV
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3061	171	166	169	68	70	69	30	32.3	31.1	64.5	57.44	61.0	66.5	75.6	71.1
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Guar [*Cyamopsis tetragonoloba* (L.) Taub.] is an annual drought hardy leguminous crop cultivated mainly in semi-arid and arid tracts of India for the galactomannan gum extracted from its endosperm. With increasing constrain in the production of guar, breeders continually look for new and diverse germplasm with specific traits to enhance crop productivity. New plant types with unique characters and altered growth habit

will play an important role in improving the crop yield. A wide range of variability has been reported for several morphological characters in guar (Gopala Krishnan and Dwivedi, 2007). In the branched plant types namely erect branching (EB) and branching (B) (Hymowitz, 1963), the cluster bearing habit reported is either alternate/ irregular. But there have not been a single report on germplasm/ genotype possessing any type of branching behaviour producing clusters in every node (branched as well as all node cluster bearing habit in a single genotype).

For the first time, a unique guar genotype, BANG-4/5 (branched all node cluster bearing guar – 4/5; IC0569319), with branched as well as all node cluster bearing guar habit have been developed. This genotype was developed from a spontaneous mutant identified from the guar germplasm selection IC421844-4/P_1 (with basal branching as well as all node bearing habit) through further selection.

BANG - 4/5 is a photo-insensitive, branched as well as all node cluster bearing guar genotype possessing basal branching habit with four primary and four secondary branches and all node cluster bearing habit (both in main stem as well as branches). On an average, it produces 15 clusters in the main stem and 63 clusters/ plant. The mean number of pods/ plant of this genotype is 188.2 with an average per plant seed yield of 12.2 g. BANG-4/5 (IC0569319) produces higher number of clusters produced per plant, thereby improving the pods produced per plant as well as the yield. This genotype can be used in guar improvement programme for enhancing yield.

References

Gopala Krishnan S and NK Dwivedi (2007) Genetic stocks of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] – assessment and utilization. *J.Arid Legumes* **4(2)**: 121-126.

Hymowitz T (1963) Studies on guar – *Cyamopsis tetragonoloba* (L.) Taub. Ph.D. diss. Oklahoma State Univ., Stillwater, OK 74078, USA, pp 87-89.

7. IC51174 - P_1 (IC0574580: INGR10020), a Guar (*Cyamopsis tetragonoloba*) Germplasm with Shortened Internode

Gopala Krishnan S* and NK Dwivedi

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Guar [*Cyamopsis tetragonoloba* (L.) Taub.] is an annual drought hardy leguminous crop cultivated mainly in semi-arid and arid tracts of India. Guar breeders are in need of diverse germplasm with specific traits to enhance its productivity. New plant types with unique characters and altered growth habit will play an important role in improving the crop yield. A wide range of variability has been reported for several morphological characters in guar (Gopala Krishnan and Dwivedi, 2007). Normally, the unbranched (single stemmed) guar genotypes are tall and there have not been a single report on dwarf genetic stock in guar.

For the first time, a unique guar genotype, IC0574580, with dwarf plant habit and shortened internode (< 1.5 cm) has been developed. This genotype was isolated from a spontaneous mutant showing dwarf plant habit with shortened internodes in the guar germplasm, IC51174. This genotype is dwarf in stature with a mean plant height of 48.6 cm. The dwarf stature is due to shortened internodes (< 1.5 cm) compared to longer internode (> 2.5 cm) in normal guar genotypes. It is photo-insensitive, single stemmed (unbranched), broad leaved and are highly resistant to lodging due to compact growth habit and sturdy stem. They possess all node cluster bearing habit with higher number of clusters/ plant and pods/ cluster and as result, higher harvest index. This dwarf genetic stock of guar can be used in guar improvement for breeding high yielding input responsive, semi-dwarf varieties of gaur.

Reference

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For the first time, a unique guar genotype, IC0574580, with dwarf plant habit and shortened internode (< 1.5 cm) has been developed. This genotype was isolated from a spontaneous mutant showing dwarf plant habit with shortened internodes in the guar germplasm, IC51174. This genotype is dwarf in stature with a mean plant height of 48.6 cm. The dwarf stature is due to shortened internodes (< 1.5 cm) compared to longer internode (> 2.5 cm) in normal guar genotypes. It is photo-insensitive, single stemmed (unbranched), broad leaved and are highly resistant to lodging due to compact growth habit and sturdy stem. They possess all node cluster bearing habit with higher number of clusters/ plant and pods/ cluster and as result, higher harvest index. This dwarf genetic stock of guar can be used in guar improvement for breeding high yielding input responsive, semi-dwarf varieties of gaur.

Reference

Gopala Krishnan S and NK Dwivedi (2007) Genetic stocks of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] - assessment and utilization. *J. Arid Legumes* **4(2)**: 121-126.

8. IPA 16 F (IC0574574; INGR10021), a Pigeonpea (*Cajanus cajan*) Germplasm with Resistance to *Fusarium* Wilt, Donor for Resistance to Sterility Mosaic Disease of Pigeon Pea

F Singh, IP Singh, ND Majumder and PK Katiyar
Indian Institute of Pulses Research, Kanpur-208 024, Uttar Pradesh
(E-mail: farindra.singh@rediffmail.com)

IPA 16 F has been registered for its resistance to most dreaded diseases of pigeonpea i.e. *Fusarium* wilt and sterility mosaic (Anonymous, 2005; 2006; 2007). It is a selection from pigeonpea germplasm line JKH/SSC-3/18. It has been developed following the selection method of breeding at Indian Institute of Pulses Research, Kanpur.

Morpho-agronomic Characteristics of IPA 16 F

Growth habit	Spreading
Plant type	Non–determinate
Stem colour	Green
Base flower colour	Yellow
Pattern of streaks	Medium sparse
Pod colour	Mixed (Green with black stripes)
Seed colour	Light brown
Days to 50% flowering	159
Days to 75% maturity	256
Plant Height (cm)	181
100 Seed weight (g)	12.1

Multilocational evaluation of IPA 16 F was carried out in Initial Varietal Trial (IVT Long duration pigeonpea) in 2005-06 and Advance Varietal Trial (AVT Long duration pigeonpea) in 2006-07 under AICRP on Pigeonpea. In IVT it was evaluated at six locations and average yield was 1874 Kg/ha (Anonymous, 2006). In AVT it was evaluated at five locations and average yield was 1208 Kg/ha (Anonymous, 2007).

Associated Characters

IPA 16F is of long duration. Its resistance can be transferred through conventional breeding in popular varieties of long duration pigeonea which are being grown in North East Plain Zone of India.

References

Anonymous (2005) Annual Report of AICRP on Pigeonpea. Indian Institute of Pulses Research, Kanpur, 231p.

Anonymous (2006) Annual Report of AICRP on Pigeonpea. Indian Institute of Pulses Research, Kanpur, 239p.

Anonymous (2006) Annual Report of AICRP on Long duration pigeonpea. Indian Institute of Pulses Research, Kanpur, 43p.

Anonymous (2007) Annual Report of AICRP on Pigeonpea. Indian Institute of Pulses Research, Kanpur, 255p.

Anonymous (2007) Annual Report of AICRP on Long duration pigeonpea. Indian Institute of Pulses Research, Kanpur, 52p.

9. IPA 8 F (IC0574575; INGR10022), a Pigeonpea (*Cajanus cajan*) Germplasm with Resistance to Sterility Mosaic Disease of Pigeon Pea

F Singh, IP Singh, ND Majumder and PK Katiyar
Indian Institute of Pulses Research, Kanpur-208 024, Uttar Pradesh
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IPA 8 F has been registered for its resistance to one of the important diseases of pigeon pea *i.e.* sterility mosaic (Anonymous, 2006, 2007, 2008). It is a selection from pigeon pea germplasm line ICP 13673. It has been developed following the selection method of breeding at Indian Institute of Pulses Research, Kanpur.

Morpho-agronomic Characteristics of IPA 8 F

Growth habit	Spreading
Plant type	Non– determinate
Stem colour	Green
Base flower colour	Yellow
Pattern of streaks	Medium sparse
Pod colour	Dark purple
Seed colour	Mottled
Days to 50% flowering	159
Days to 75% maturity	264
Plant Height (cm)	212.6
100 Seed weight (g)	12.3

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Growth habit	Spreading
Plant type	Non–determinate
Stem colour	Green
Base flower colour	Yellow
Pattern of streaks	Medium sparse
Pod colour	Mixed (Green with black stripes)
Seed colour	Light brown
Days to 50% flowering	159
Days to 75% maturity	256
Plant Height (cm)	181
100 Seed weight (g)	12.1

Multilocational evaluation of IPA 16 F was carried out in Initial Varietal Trial (IVT Long duration pigeonpea) in 2005-06 and Advance Varietal Trial (AVT Long duration pigeonpea) in 2006-07 under AICRP on Pigeonpea. In IVT it was evaluated at six locations and average yield was 1874 Kg/ha (Anonymous, 2006). In AVT it was evaluated at five locations and average yield was 1208 Kg/ha (Anonymous, 2007).

Associated Characters

IPA 16F is of long duration. Its resistance can be transferred through conventional breeding in popular varieties of long duration pigeonea which are being grown in North East Plain Zone of India.

References

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Morpho-agronomic Characteristics of IPA 8 F

Growth habit	Spreading
Plant type	Non– determinate
Stem colour	Green
Base flower colour	Yellow
Pattern of streaks	Medium sparse
Pod colour	Dark purple
Seed colour	Mottled
Days to 50% flowering	159
Days to 75% maturity	264
Plant Height (cm)	212.6
100 Seed weight (g)	12.3

Multi-locational evaluation of IPA 8 F was carried out in Initial Varietal Trial (IVT long duration pigeonpea) in 2005-06 and Advance Varietal Trial (AVT long duration pigeonpea) in 2006-07 under AICRP on Pigeonpea. In IVT it was evaluated at six locations and average yield was 2004 Kg/ha (Anonymous, 2006). In AVT it was evaluated at five locations and average yield was 965 Kg/ha (Anonymous, 2007).

Associated Characters

IPA 8F is of long duration. Its resistance can be transferred through conventional breeding in popular varieties of long duration pigeonea which are being grown in North East Plain Zone of India.

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10. IPA 15F (IC0574576; INGR10023), a Pigeonpea (*Cajanus cajan*) Germplasm with Resistance to Sterility Mosaic Disease

F Singh, IP Singh, ND Majumder and PK Katiyar

Indian Institute of Pulses Research, Kanpur-208 024, Uttar Pradesh

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IPA 15 F has been registered for its resistance to one of the important diseases of pigeonpea i.e. sterility mosaic (Anonymous, 2006; 2007; 2008). It is a selection from pigeonpea germplasm line PBJ/SSC -2/33. It has been developed following the selection method of breeding at Indian Institute of Pulses Research, Kanpur.

Morpho-agronomic Characteristics of IPA 15 F

Growth habit	Erect & Compact
Plant type	Non– determinate
Stem colour	Green
Base flower colour	Yellow
Pattern of streaks	Sparse
Pod colour	Mixed (Green with black stripes)
Seed colour	Cream
Days to 50% flowering	159
Days to 75% maturity	263
Plant Height (cm)	200
100 Seed weight (g)	12.6

IPA 15 F was only evaluated for its resistance to sterility mosaic disease and morpho-agronomic traits.

Associated Characters

IPA 15F is of long duration. Its resistance can be transferred through conventional breeding in popular varieties of long duration pigeonea which are being grown in North East Plain Zone of India.

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11. IPA204 (IC0574577; INGR10024) a Pigeonpea (*Cajanus cajan*) Germplasm with Wilt Resistant line of Long-duration Pigeonpea

AK Choudhary and IP Singh

Indian Institute of Pulses Research, Kanpur-208024, UttarPradesh

(E-mail: akiipr23@yahoo.com)

Pigeonpea [*Cajanus cajan* (L.) Millsp] is the second most important grain legume after chickpea in India. The main concern, however, is stability in production, which is highly affected by pigeonpea wilt especially in North-East Plains, Central and Peninsular India. The Disease is caused by a soil borne fungus, *Fusarium*

Multi-locational evaluation of IPA 8 F was carried out in Initial Varietal Trial (IVT long duration pigeonpea) in 2005-06 and Advance Varietal Trial (AVT long duration pigeonpea) in 2006-07 under AICRP on Pigeonpea. In IVT it was evaluated at six locations and average yield was 2004 Kg/ha (Anonymous, 2006). In AVT it was evaluated at five locations and average yield was 965 Kg/ha (Anonymous, 2007).

Associated Characters

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IPA 15 F has been registered for its resistance to one of the important diseases of pigeonpea i.e. sterility mosaic (Anonymous, 2006; 2007; 2008). It is a selection from pigeonpea germplasm line PBJ/SSC -2/33. It has been developed following the selection method of breeding at Indian Institute of Pulses Research, Kanpur.

Morpho-agronomic Characteristics of IPA 15 F

Growth habit	Erect & Compact
Plant type	Non– determinate
Stem colour	Green
Base flower colour	Yellow
Pattern of streaks	Sparse
Pod colour	Mixed (Green with black stripes)
Seed colour	Cream
Days to 50% flowering	159
Days to 75% maturity	263
Plant Height (cm)	200
100 Seed weight (g)	12.6

IPA 15 F was only evaluated for its resistance to sterility mosaic disease and morpho-agronomic traits.

Associated Characters

IPA 15F is of long duration. Its resistance can be transferred through conventional breeding in popular varieties of long duration pigeonea which are being grown in North East Plain Zone of India.

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Multi-locational evaluation of IPA 8 F was carried out in Initial Varietal Trial (IVT long duration pigeonpea) in 2005-06 and Advance Varietal Trial (AVT long duration pigeonpea) in 2006-07 under AICRP on Pigeonpea. In IVT it was evaluated at six locations and average yield was 2004 Kg/ha (Anonymous, 2006). In AVT it was evaluated at five locations and average yield was 965 Kg/ha (Anonymous, 2007).

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Morpho-agronomic Characteristics of IPA 15 F

Growth habit	Erect & Compact
Plant type	Non– determinate
Stem colour	Green
Base flower colour	Yellow
Pattern of streaks	Sparse
Pod colour	Mixed (Green with black stripes)
Seed colour	Cream
Days to 50% flowering	159
Days to 75% maturity	263
Plant Height (cm)	200
100 Seed weight (g)	12.6

IPA 15 F was only evaluated for its resistance to sterility mosaic disease and morpho-agronomic traits.

Associated Characters

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udum. The incidence of wilt alone causes 20-25% yield losses in the North-East plains (Dhar and Reddy, 1999). The best way to deal with this disease is to grow cultivars with built-in resistance to the causal organism. None of the existing varieties and land races under cultivation in North-East plains appears to be resistant to wilt disease. This calls for development and release of resistant types to ensure stability of production in this zone. The present paper deals with a genotype IPA204 which has shown broad and stable resistance to the wilt pathogen besides having very good yield potential.

IPA204 was derived from a cross, Bahar x 'Ac 314-314' following pedigree method of selection. It has compact plant type and indeterminate growth habit. Plants are tall (1.75-2.0 m) with green stem colour. Standard (outer petal) is golden yellow without any streaks on either side. Pods are green with black stripes. Seeds are medium bold (12 g/100 seeds) and light brown in colour. Based on its agronomic performance in station trial at IIPR, Kanpur, it was put to AICRP (pigeonpea) initial varietal trial (IVT) for assessment of its performance over the ruling check varieties of long-duration pigeonpea such as Bahar, 'Narendra Arhar-1, and the like during the year 2004-05. Keeping its good performance in IVT (>5% superiority over the best check), it was decided to assess its wilt reaction in wilt-sick nursery of AICRP on pigeonpea located in almost all pigeonpea-growing regions of the country. The wilt reaction of IPA204 was assayed at a total of 24 locations (3, 10, 5, and 6 locations during 2005-06, 2006-07, 2007-08, and 2008-09, respectively). At each location, it was replicated twice along with other test entries keeping an inter-row and plant-to-plant spacing at 75 cm and 20 cm, respectively. At each location, at least one susceptible check (such as Bahar, 'ICP 2376', etc.) was also put along with the test entries; however, the same check was not used at all the locations. Data on per cent plant mortality/replication were recorded at flowering, full podding, and harvesting stages. The mean per cent mortality has been presented in the Table 1.

It is obvious from Table 1 that mean plant mortality (%) in 'IPA204' ranged from 0.00 (at Badnapur during 2006-07) to 27.25 (at IIPR, Kanpur during 2008-09). The wilt reaction of this entry varied from resistant (16 locations) to moderately resistant (8 locations). In the North-East Plain Zone (Dholi, Faizabad and Kanpur) and Central India (Badnapur, Rahuri, Bharuch, Khargone and Akola), the wilt reaction was similar, that is, from resistant to moderately resistant. However, in

Table1. Wilt reaction of 'IPA204' in wilt–sick nursery at different locations

Year	Location	LSI	% infection (susceptible check)	% infection (IPA204)	Wilt reaction of IPA204
2005–06	Dholi	72.3	74.9 ('Bahar')**	6.1	Resistant*
	Badnapur	36.1	100.0 ('ICP 2376')	4.3	Resistant
	Rahuri	34.8	—	19.3	Moderately Resistant
2006–07	Rahuri	74.7	100.0 ('ICP 2376')	16.4	Moderately Resistant
	Bharunch	32.4	—	4.0	Resistant
	Khargone	25.0	67.0 ('ICP 2376')	5.8	Resistant
	Badnapur	45.4	100.0 ('ICP 2376')	0.0	Resistant
	ICRISAT	60.8	100.0 ('ICP 2376')	2.6	Resistant
	Warangal	32.1	63.1 ('ICP 2376')	6.1	Resistant
	Gulbarga	63.2	100.0 ('PT 221')	4.2	Resistant
	Dholi	49.1	90.0 ('Bahar')	12.0	Moderately Resistant
	Faizabad	41.6	100.0 ('Bahar')	6.0	Resistant
	Akola	44.3	—	13.0	Moderately Resistant
2007–08	Dholi	29.4	90.0 ('ICP 2376')	8.0	Resistant
	Gulbarga	39.2	100.0 ('ICP 2376')	7.6	Resistant
	Rahuri	45.4	100.0 ('ICP 2376')	8.3	Resistant
	Badnapur	30.7	93.5 ('ICP 2376')	19.4	Moderately Resistant
	ICRISAT	29.7	95.8 ('ICP 2376')	9.3	Resistant
2008–09	Badnapur	18.5	100.0 ('ICP 2376')	14.3	Moderately Resistant
	Dholi	20.8	80.7 ('ICP 2376')	10.3	Moderately Resistant
	Gulbarga	17.1	96.7 ('ICP 2376')	3.8	Resistant
	Rahuri	33.9	100.0 ('ICP 2376')	8.1	Resistant
	ICRISAT	25.6	100.0 ('ICP 2376')	4.8	Resistant
	IIPR, Kanpur	21.8	91.8 ('ICP 2376')	27.3	Moderately Resistant

*Disease reaction quantified on the basis of acceptable scale used by pathologists (resistant: up to 10% wilted plants; moderately resistant: >10 – 30% wilted plants)

**Susceptible check in parentheses

South India (ICRISAT, Warangal, and Gulbarga), the test entry showed exclusively resistant reaction during all the three years. Keeping its uniform and stable resistant reaction, it was recommended as potential donor for wilt resistance in the Annual Group Meet on Pigeonpea (2009).

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12. IPA234 (IC0574578; INGR10025) a Pigeonpea (*Cajanus cajan*) Germplasm, with Resistance to Sterility Mosaic Disease

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Pigeonpea [*Cajanus cajan* (L.) Millsp.] suffers from a number of diseases, viz., *Phytophthora* blight, *Fusarium* wilt and sterility mosaic disease (SMD). SMD is caused by an unknown virus and spreads through a mite, *Aceria cajani*. This disease sometimes leads to total yield losses as affected plants do not flower and set pods at all. It accounts for 10-15% yield reduction in North-East Plain Zone (NEPZ) (UP and Bihar), Central Zone (CZ) (Maharashtra) and South Zone (SZ) (TN and Karnataka). The best way to deal with the problem of this disease is to breed lines with built-in resistance to the pathogen. This may ensure stability in pigeonpea production. The present paper deals with a genotype IPA234 which has shown broad and stable resistance to the SMD besides having very good yield potential.

IPA234, which belongs to late pigeonpea group, was derived from a cross, T-7 x WRP-1 following pedigree method of selection. The chief morphological and reproductive characteristics of this genotype include loose canopy, indeterminate growth habit, green stem colour, yellow standard (petal) colour, green pods with thin black stripes, light brown seed colour, medium plant height (165 cm), large seed (>10 g/100 seeds) and long maturity period (245 days). Based on its agronomic performance in station trial at IIPR, Kanpur, it was put to AICRP (pigeonpea) for overall agronomic and pathological assessments over the ruling check varieties of long-duration pigeonpea. It was tested for resistance to SMD for the consecutive three years (2005-06, 2006-07 and 2007-08) at a total of 19 locations. At each location, it was replicated twice along with other test entries keeping an inter-row and plant-to-plant spacing at 75 cm and 20 cm, respectively. At each location, 'ICP8863' was used as the susceptible check. Data on mean per cent infection has been presented in the Table 1.

It showed resistance reaction at Dholi and Varanasi (NEPZ) and Rahuri (CZ) in all the three years. The SMD reaction in the South Zone was variable. Resistance, moderate resistance and susceptible reactions were observed at ICRISAT, Tamil Nadu and Bangalore, respectively during 2006-07 and 2007-08. It indicated the presence of three distinct variants of the virus in the SZ. In AICRP yield trials (IVT and AVT-I during 2006-07 and 2007-08, respectively), the grain yield of IPA234 was comparable to those of ruling check varieties, Bahar and Narendra Arhar-1. Therefore, this genotype IPA234 may be used as a donor for resistance to sterility mosaic disease especially in North East plains. Alternatively, it may be cultivated

Table1. SMD reaction of 'IPA234' in SMD nursery at different locations.

Year	Location	LSI	% infection (susceptible check)	% infection (IPA234)	SMD reaction of (IPA234)
2005–06	Dholi	27.2	72.3 ('ICP8863')**	10.0	Resistant*
	Varanasi	59.0	— ('ICP8863')	6.3	Resistant
	Rahuri	38.3	— ('ICP8863')	7.1	Resistant
2006–07	Dholi	65.8	100.0 ('ICP8863')	8.3	Resistant
	Varanasi	65.0	100.0 ('ICP8863')	0.0	Resistant
	Rahuri	52.5	— ('ICP8863')	2.4	Resistant
	Pant Nagar	65.7	— ('ICP8863')	0.0	Resistant
	ICRISAT	30.9	100.0 ('ICP8863')	0.0	Resistant
	Coimbatore	24.2	— ('ICP8863')	27.7	Moderately resistant
	Bangalore	77.5	100.0 ('ICP8863')	88.3	Susceptible
2007–08	Dholi	38.9	100 ('ICP8863')	7.7	Resistant
	Varanasi	41.0	100 ('ICP8863')	0.0	Resistant
	Rahuri	29.3	100 ('ICP8863')	9.2	Resistant
	ICRISAT	16.2	92.3 ('ICP8863')	4.2	Resistant
	Coimbatore	24.2	41.4 ('ICP8863')	25.0	Moderately resistant
	Bangalore	86.4	100 ('ICP8863')	84.5	Susceptible

*disease reaction quantified on the basis of acceptable scale used by pathologists (resistant: up to 10% infection; moderately resistant: >10 – 30% infection)

**Susceptible check in parentheses

in endemic areas (Bihar) just to minimize the risk of total yield loss.

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13. JJK-2000-220 (IC0280837; INGR10026), French bean (*Phaseolus vulgaris*) Germplasm, with Long and Broad Poded Pole type habit

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This French bean (Pole type habit) germplasm IC 280837 was procured from Officer-In-Charge, NBPGR, Regional Station Vellanikkara, Trissur, Kerala. It was collected from village Alampatty, district Idukki of Kerala state. On the basis of single plant selection from bulk it was found promising for its long and broad pods used as dual purpose i.e. tender pods as vegetable and matured seeds as pulse.

Morpho-agronomic Characteristics

Being pole type habit, the plant height ranges from 185 cm-280 cm. Pods are long in size, smooth and broad. The pod length is 23 cm-25 cm and width is 1.5 cm-2.1 cm. Pod shape is flat, flower colour is white and seed colour is also bright white. The number of grains per pods are 5 to 9. The seed length and width is 14.7 x 7.6 mm. 100 grain weight is 32-40 grams. The number of pods per plant are 18-30. The tender green pod yield per plant is 230 grain to 300 grains. The grain yield per plant is 50-75 g. The material was received in 2004 and it was evaluated during kharif 2005, 06 and 2007 alongwith a large number of exotic and indigenous bean germplasm at NBPGR, Regioanl Station Bhowali. Among all the germplasm lines as well as checks it was found superior to all. (Annual report 2006-07; Muneem *et. al.,* 2009).

Associated Characters and Cultivated Practices

Generally it has been observed that white seeded beans are more prone to diseases like *Cercospora* leaf spot, Zonate leaf spot, Anthracnose, yellow

mosaic virus, mosaic virus and powdery mildew. This IC280837 was found continuously free from diseases as compare to checks and other lines. As the plants are quite large in height they can be used as green fodder for domestic cattle. The pods are also large in size and width they are also used by domestic cattle after shelling the grains. This germplasm can be grown successfully in Northern hills by the local farmers, without using huge amount of fungicides and insecticides.

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14. NS/08/047 (IC0564627; INGR10027), a Linseed (*Linum usitatissium*) Germplasm with High Oleic Acid Content in Seed (32.0%)

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Linseed or flax (*Linum usitatissimum* L.) belongs to the family Linaceae under the genus *Linum*, which is reported to have about 100 species distributed globally. Linseed is under cultivation since ancient times for its fibre and seed and occupies a prominent place among the oilseed crops owing to its various uses and special qualities. The seeds are a rich source of drying oil of edible nature and are the most potent source of omega-3 fatty acid, the desirable cholesterol for healthy living.

Oleic acid is a monounsaturated fatty acid naturally found in plant and animal products. It is an omega-nine fatty acid and considered as one of the healthiest sources of fat in the diet. Scientific research indicates that this healthy fat helps prevent a wide range of medical problems, including cardiovascular diseases, adrenoleukodystrophy, hypertension etc. Identification of linseed germplasm accessions with high oleic acid facilitates dietary supplementation of the fatty acid in the human nutrition through seed. Eighty four accessions of linseed collected from Andhra Pradesh and Maharashtra, India were analyzed for fatty acid composition on a gas chromatograph (Agilent 6890) equipped with a flame ionization detector (FID) on a split injector system. Oleic acid ranged from 18.1 - 32% with the local check varieties J-23-10 and RLC-6 recording 29.7% and 28.1%, respectively. From the literature (Nagaraj, 2009), the range of Oleic acid reported was between 16.53% and 27.10%. The linseed accession IC564627 collected from Gangawar, Nyalkal Mandal of Medak district, Andhra Pradesh found to contain high Oleic acid in the seed with 32.0% (Sivaraj *et al.,* 2009). The morpho-agronomic characteristics of the linseed accession IC564627 are given in the Table 1.

Table1. Morpho–agronomic Characteristics of linseed germplasm accession IC564627

Descriptor	Descriptor State
Plant growth habit	Bushy branching
Plant height (cm)	50.0
Flower size	Medium
Flower shape	Funnel form
Petal colour	Violet–blue
Petal aestivation	Semi–twisted
Stamen filament colour	Colour less
Anther colour	Blue
Capsule size	Medium
Shape of capsule tip	Pointed
100 seed weight (g)	0.78
Seed length (mm)	5.02
Seed width (mm)	2.61
Seed thickness (mm)	1.07
Oil content (%)	34
Palmitic acid (%)	5.9
Oleic acid (%)	32
Stearic acid (%)	8.2
Linoleic acid (%)	13.8
Linolenic acid (%)	39.5
Arachidic acid (%)	0.3
Behenic acid (%)	0.3

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mosaic virus, mosaic virus and powdery mildew. This IC280837 was found continuously free from diseases as compare to checks and other lines. As the plants are quite large in height they can be used as green fodder for domestic cattle. The pods are also large in size and width they are also used by domestic cattle after shelling the grains. This germplasm can be grown successfully in Northern hills by the local farmers, without using huge amount of fungicides and insecticides.

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14. NS/08/047 (IC0564627; INGR10027), a Linseed (*Linum usitatissium*) Germplasm with High Oleic Acid Content in Seed (32.0%)

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Linseed or flax (*Linum usitatissimum* L.) belongs to the family Linaceae under the genus *Linum*, which is reported to have about 100 species distributed globally. Linseed is under cultivation since ancient times for its fibre and seed and occupies a prominent place among the oilseed crops owing to its various uses and special qualities. The seeds are a rich source of drying oil of edible nature and are the most potent source of omega-3 fatty acid, the desirable cholesterol for healthy living.

Oleic acid is a monounsaturated fatty acid naturally found in plant and animal products. It is an omega-nine fatty acid and considered as one of the healthiest sources of fat in the diet. Scientific research indicates that this healthy fat helps prevent a wide range of medical problems, including cardiovascular diseases, adrenoleukodystrophy, hypertension etc. Identification of linseed germplasm accessions with high oleic acid facilitates dietary supplementation of the fatty acid in the human nutrition through seed. Eighty four accessions of linseed collected from Andhra Pradesh and Maharashtra, India were analyzed for fatty acid composition on a gas chromatograph (Agilent 6890) equipped with a flame ionization detector (FID) on a split injector system. Oleic acid ranged from 18.1 - 32% with the local check varieties J-23-10 and RLC-6 recording 29.7% and 28.1%, respectively. From the literature (Nagaraj, 2009), the range of Oleic acid reported was between 16.53% and 27.10%. The linseed accession IC564627 collected from Gangawar, Nyalkal Mandal of Medak district, Andhra Pradesh found to contain high Oleic acid in the seed with 32.0% (Sivaraj *et al.,* 2009). The morpho-agronomic characteristics of the linseed accession IC564627 are given in the Table 1.

Table1. Morpho–agronomic Characteristics of linseed germplasm accession IC564627

Descriptor	Descriptor State
Plant growth habit	Bushy branching
Plant height (cm)	50.0
Flower size	Medium
Flower shape	Funnel form
Petal colour	Violet–blue
Petal aestivation	Semi–twisted
Stamen filament colour	Colour less
Anther colour	Blue
Capsule size	Medium
Shape of capsule tip	Pointed
100 seed weight (g)	0.78
Seed length (mm)	5.02
Seed width (mm)	2.61
Seed thickness (mm)	1.07
Oil content (%)	34
Palmitic acid (%)	5.9
Oleic acid (%)	32
Stearic acid (%)	8.2
Linoleic acid (%)	13.8
Linolenic acid (%)	39.5
Arachidic acid (%)	0.3
Behenic acid (%)	0.3

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Sivaraj N, N Sunil, SR Pandravada, V Kamala, Vinod Kumar, BVSK Rao, RBN Prasad and KS Varaprasad (2009) DIVA-GIS Approaches for diversity assessment of fatty acid composition in linseed, *Linum usitatissimum* L. germplasm collections from peninsular India. *J. Oilseeds Res.* **26**: 13-15.

15. NS/08/102 (IC0564681; INGR10028), a Linseed (*Linum usitatissium*) Germplasm as Source of High Oil Content in Seed (42.6%)

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Linseed or flax is a member of the genus *Linum* belonging to the family Linaceae. The crop is native to the region extending from the Mediterranean to India. India is one of the major countries of linseed cultivation with an annual production of about 1, 67, 000 metric tonnes. The dried seeds are a rich source of oil and omega-3 fatty acid, the desirable cholesterol for healthy living. Scientific research indicates that omega-3 which is a healthy polyunsaturated fatty acid prevents a wide range of medical problems, including cardiovascular diseases, depression, asthma and rheumatoid arthritis. Linseed oil is also used to bind wood dust, cork particles and other materials in manufacturing of Linoleum used for floor covering. It is used in wood putty and as a carrier in oil paints as well.

Given the increasing importance of linseed, to augment the germplasm, an exploration was conducted in parts of Andhra Pradesh and Maharashtra during March, 2008 which resulted in the collection of 84 accessions. These germplasm collections were characterized for their oil content using solvent extraction methods and fatty acid profile by gas chromatography. While the normal expression of oil content in linseed varies from 30-35% (Nagaraj, 2009) to 40-42% (Gill, 1989), a promising linseed germplasm accession (IC564681) with high oil (42.6%) and omega-3 content (54.8%) was identified from the germplasm (Sivaraj *et al*., 2009).

The presence of high oil content and high omega-3 in a single genotype is indeed a significant finding having a bearing on the genetic improvement of this oilseed crop for the above two important traits and also for recommending it as a dietary supplement. This particular genotype which is characterized by blue anthers which are very uncommon may also serve as a morphological marker for wilt resistance (Green, 1995) and this accession might be having natural resistance to wilt as well.

The morpho-agronomic description of linseed germplasm accession IC0564681 is as follows:

Descriptor	Descriptor State
Plant growth habit	Bushy branching
Plant height (cm)	54.6
Flower size	Medium (18 mm)
Flower shape	Funnel form
Petal colour	Light violet–blue
Petal aestivation	Semi–twisted
Stamen filament colour	Colour less
Anther colour	Blue
Capsule size	Bold (8.8 mm)
Capsule tip shape	Pointed
100–seed weight (g)	0.79
Seed length (mm)	4.92
Seed width (mm)	2.59
Seed thickness (mm)	1.05
Oil content (%)	42.6
Palmitic acid (%)	5.6
Stearic acid (%)	6.6
Oleic acid (%)	20.5
Linoleic acid (%)	12.1
Linolenic acid (Omega–3) (%)	54.8

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16. NRCGCS 77 (IC0582472; INGR10029), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Late Leaf Spot, Early Leaf Spot, Rust and *Alternaria* Leaf Blight

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NRCGCS 77 (INGR10029; IC0582472) was selected from advanced generation of cross (CT 7-1 x SB 11) × *A. diogoi*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth habit, produces 50% flowering in 29 days after sowing (DAS) and matures in 103 DAS during rainy season. The genotype produces an average pod yield of 109.7 g per square metre with 72% shelling out turn. Pods are slightly constricted, moderately beaked and deeply reticulated; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 48 g and contain 50.5% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 2.8 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 15.1% for peanut bud necrosis disease (PBND) and 13.7% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

17. NRCGCS 85 (IC0582473; INGR10030), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Late Leaf Spot, Early Leaf Spot, Rust and *Alternaria* Leaf Blight

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NRCGCS 85 (INGR10030; IC0582473) was selected from advanced generation of cross (CT 7-1 x SB 11) x *A. kretschmeri.* The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth habit, produces 50% flowering in 25 days after sowing (DAS) and matures in 107 DAS during rainy season. The genotype produces an average pod yield of 84.3 g /m^2 with 74% shelling out turn. Pods are slightly constricted, moderately beaked and deeply reticulated; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 45.6 g and contain 52% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 2.0 for early leaf spot and 3.0 for late leaf spot on a modified 9-point scale, and an incidence of 4.0% for peanut bud necrosis disease (PBND) and 8.0% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype can be used as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

18. NRCGCS 86 (IC0582474; INGR10031), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Late Leaf Spot, Early Leaf Spot, Rust and *Alternaria* Leaf Blight

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NRCGCS 86 (INGR10031; IC0582474) was selected from advanced generation of cross (CT 7-1 x SB 11) X *A. correntina*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth habit, produces 50% flowering in 26 days after sowing (DAS) and matures in 116 DAS during rainy season. The genotype produces an average pod yield of 84.5 g/m^2 with 73% shelling out turn. Pods are slightly constricted and moderately beaked as well as reticulated; mostly two seeded with rose colour kernels. Kernels are small in size with hundred kernel mass of 32 g and contain 51.5% oil. The severity of foliar diseases in the genotype under field conditions are 2.0 for rust, 3.2 for early leaf spot and 3.8 for late leaf spot on a modified 9-point scale, and an incidence of 14.7% for peanut bud necrosis disease (PBND) and 8.3% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

19. NRCG 14326 (INGR 10032; IC 0548192), NRCG 14336 (INGR 10033; IC 0582477), NRCG 14350 (INGR 10034; IC 0582478), NRCG 14409 (INGR 10035; IC 0582479), Groundnut (*Arachis hypogaea* L.) Germplasm, Spanish Bunch Germplasm Accessions with Fresh Seed Dormancy

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Groundnut is an important oilseed crop of India grown in about 5.0 million ha during *kharif* and 1.0 million ha in *rabi*-summer seasons. The crop has four botanical varieties, Spanish bunch (Subspecies *fastigiata* var. *vulgaris*), Valencia (Subspecies *fastigiata* var. *fastigiata*), Virginia bunch and Virginia runner (Subspecies *hypogaea* var. *hypogaea*). The Spanish and Valencia genotypes have short life cycle and non-dormant seeds while those of Virginia types have long life cycle and dormant seeds. In India, Spanish types are predominantly grown in semi-arid regions where the growing seasons are short or are grown in multiple cropping sequences. Untimely rains either in *kharif* or in *rabi*-summer seasons prior to or immediately after harvest can cause seeds of Spanish and Valencia types to sprout *in situ* in the ground. In the semi-arid tropics, which account for 60% of the global production such situations are frequent and losses in yield and quality are substantial (Upadhyaya and Nigam, 1999). To avoid these losses during harvest it is essential to breed varieties having fresh seed dormancy up to 2-3 weeks duration. Before formulation of suitable breeding strategies, identification of sources of fresh seed dormancy are very essential. Reported sources of fresh seed dormancy especially among the Spanish bunch germplasm remain very few in literature.

18. NRCGCS 86 (IC0582474; INGR10031), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Late Leaf Spot, Early Leaf Spot, Rust and *Alternaria* Leaf Blight

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NRCGCS 86 (INGR10031; IC0582474) was selected from advanced generation of cross (CT 7-1 x SB 11) X *A. correntina*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth habit, produces 50% flowering in 26 days after sowing (DAS) and matures in 116 DAS during rainy season. The genotype produces an average pod yield of 84.5 g/m^2 with 73% shelling out turn. Pods are slightly constricted and moderately beaked as well as reticulated; mostly two seeded with rose colour kernels. Kernels are small in size with hundred kernel mass of 32 g and contain 51.5% oil. The severity of foliar diseases in the genotype under field conditions are 2.0 for rust, 3.2 for early leaf spot and 3.8 for late leaf spot on a modified 9-point scale, and an incidence of 14.7% for peanut bud necrosis disease (PBND) and 8.3% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

19. NRCG 14326 (INGR 10032; IC 0548192), NRCG 14336 (INGR 10033; IC 0582477), NRCG 14350 (INGR 10034; IC 0582478), NRCG 14409 (INGR 10035; IC 0582479), Groundnut (*Arachis hypogaea* L.) Germplasm, Spanish Bunch Germplasm Accessions with Fresh Seed Dormancy

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Groundnut is an important oilseed crop of India grown in about 5.0 million ha during *kharif* and 1.0 million ha in *rabi*-summer seasons. The crop has four botanical varieties, Spanish bunch (Subspecies *fastigiata* var. *vulgaris*), Valencia (Subspecies *fastigiata* var. *fastigiata*), Virginia bunch and Virginia runner (Subspecies *hypogaea* var. *hypogaea*). The Spanish and Valencia genotypes have short life cycle and non-dormant seeds while those of Virginia types have long life cycle and dormant seeds. In India, Spanish types are predominantly grown in semi-arid regions where the growing seasons are short or are grown in multiple cropping sequences. Untimely rains either in *kharif* or in *rabi*-summer seasons prior to or immediately after harvest can cause seeds of Spanish and Valencia types to sprout *in situ* in the ground. In the semi-arid tropics, which account for 60% of the global production such situations are frequent and losses in yield and quality are substantial (Upadhyaya and Nigam, 1999). To avoid these losses during harvest it is essential to breed varieties having fresh seed dormancy up to 2-3 weeks duration. Before formulation of suitable breeding strategies, identification of sources of fresh seed dormancy are very essential. Reported sources of fresh seed dormancy especially among the Spanish bunch germplasm remain very few in literature.

Hence, a study was carried out to identify promising sources in summer 2008 and *kharif* 2008 in 64 diverse Spanish bunch germplasm accessions along with two Spanish bunch non-dormant check varieties, JL 24 and GG 2 for fresh seed dormancy under laboratory conditions. Significant differences were observed among the genotypes for days taken for complete germination and per cent of germination. Both the check varieties exhibited 100% germination within 4 weeks. Seeds of two accessions, NRCGs 14350 and 14409 did not germinate even after 60 days of incubation indicating the presence of long dormancy period while the two other accessions, NRCGs 14326 and 14336, exhibited a dormancy period up to 40 days. The oil content in these accessions was also high (about 50%) and matured around 115 days.

References

Upadhyaya HD and SN Nigam (1999) Inheritance of Fresh Seed Dormancy in Peanut. *Crop Sci.* **39:** 98-101.

20. NRCGCS 21 (IC0583387; INGR10036), Ground nut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Early Leaf Spot

SK Bera[1], Vinod Kumar[3], G Sunkad[2], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS 21 (INGR10036; IC0583387) was selected from advanced generation of cross CT7-1 x SBXI. This genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth habit, produces 50% flowering in 28 days after sowing (DAS) and matures in 114 DAS during rainy season. The genotype produces an average pod yield of 104.3g /m^2 with 73% shelling out turn. Pods are slightly constricted and moderately beaked; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 85 g and contain 50% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.4 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 9.3% for peanut bud necrosis disease (PBND) and 6.5% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis disease, stem rot, early leaf spot, rust, late leaf spot and *Alternaria* leaf blight.

21. NRCGCS 83 (IC0583388; INGR10037), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

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NRCGCS 83 (INGR10037; ID-IC0583388) was selected from advanced generation of cross (CT7-1 × SB XI) × *A. diogoi*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth

Hence, a study was carried out to identify promising sources in summer 2008 and *kharif* 2008 in 64 diverse Spanish bunch germplasm accessions along with two Spanish bunch non-dormant check varieties, JL 24 and GG 2 for fresh seed dormancy under laboratory conditions. Significant differences were observed among the genotypes for days taken for complete germination and per cent of germination. Both the check varieties exhibited 100% germination within 4 weeks. Seeds of two accessions, NRCGs 14350 and 14409 did not germinate even after 60 days of incubation indicating the presence of long dormancy period while the two other accessions, NRCGs 14326 and 14336, exhibited a dormancy period up to 40 days. The oil content in these accessions was also high (about 50%) and matured around 115 days.

References

Upadhyaya HD and SN Nigam (1999) Inheritance of Fresh Seed Dormancy in Peanut. *Crop Sci.* **39:** 98-101.

20. NRCGCS 21 (IC0583387; INGR10036), Ground nut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Early Leaf Spot

SK Bera[1], Vinod Kumar[3], G Sunkad[2], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS 21 (INGR10036; IC0583387) was selected from advanced generation of cross CT7-1 x SBXI. This genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth habit, produces 50% flowering in 28 days after sowing (DAS) and matures in 114 DAS during rainy season. The genotype produces an average pod yield of 104.3g /m^2 with 73% shelling out turn. Pods are slightly constricted and moderately beaked; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 85 g and contain 50% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.4 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 9.3% for peanut bud necrosis disease (PBND) and 6.5% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis disease, stem rot, early leaf spot, rust, late leaf spot and *Alternaria* leaf blight.

21. NRCGCS 83 (IC0583388; INGR10037), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

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NRCGCS 83 (INGR10037; ID-IC0583388) was selected from advanced generation of cross (CT7-1 × SB XI) × *A. diogoi*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth

Hence, a study was carried out to identify promising sources in summer 2008 and *kharif* 2008 in 64 diverse Spanish bunch germplasm accessions along with two Spanish bunch non-dormant check varieties, JL 24 and GG 2 for fresh seed dormancy under laboratory conditions. Significant differences were observed among the genotypes for days taken for complete germination and per cent of germination. Both the check varieties exhibited 100% germination within 4 weeks. Seeds of two accessions, NRCGs 14350 and 14409 did not germinate even after 60 days of incubation indicating the presence of long dormancy period while the two other accessions, NRCGs 14326 and 14336, exhibited a dormancy period up to 40 days. The oil content in these accessions was also high (about 50%) and matured around 115 days.

References

Upadhyaya HD and SN Nigam (1999) Inheritance of Fresh Seed Dormancy in Peanut. *Crop Sci.* **39:** 98-101.

20. NRCGCS 21 (IC0583387; INGR10036), Ground nut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Early Leaf Spot

SK Bera[1], Vinod Kumar[3], G Sunkad[2], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS 21 (INGR10036; IC0583387) was selected from advanced generation of cross CT7-1 x SBXI. This genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth habit, produces 50% flowering in 28 days after sowing (DAS) and matures in 114 DAS during rainy season. The genotype produces an average pod yield of 104.3g /m^2 with 73% shelling out turn. Pods are slightly constricted and moderately beaked; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 85 g and contain 50% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.4 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 9.3% for peanut bud necrosis disease (PBND) and 6.5% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis disease, stem rot, early leaf spot, rust, late leaf spot and *Alternaria* leaf blight.

21. NRCGCS 83 (IC0583388; INGR10037), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS 83 (INGR10037; ID-IC0583388) was selected from advanced generation of cross (CT7-1 × SB XI) × *A. diogoi*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has erect growth

habit, produces 50% flowering in 28 days after sowing (DAS) and matures in 112 DAS during rainy season. The genotype produces an average pod yield of 96.9 g/m^2 with 75% shelling out turn. Pods have moderate constriction and beak; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 44.0 g and contain 51% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust and 5.0 for late leaf spot on a modified 9-point scale, and an incidence of 3.6% for peanut bud necrosis disease (PBND) and 10.3% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

22. NRCGCS 124 (IC0583389; INGR10038), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

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NRCGCS 124 (INGR10038; IC0583389) was selected from advanced generation of cross (CT7-1 x SBXI) x *A. kretschmetri*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has semi spreading (decumbent-3) growth habit, produces 50% flowering in 25 days after sowing (DAS) and matures in 112 DAS during rainy season. The genotype produces an average pod yield of 58.4 g/m^2 with 76% shelling out turn. Pods are moderately beaked and reticulated; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 38 g and contain 48.5% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.5 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 8.7% for peanut bud necrosis disease (PBND) and 13% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

23. NRCGCS 180 (IC0583390; INGR10039), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS 180 (INGR10039; IC0583390) was selected from advanced generation of cross J 11×*A. cardenansii*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has spreading (decumbent-2) growth habit, produces 50% flowering in 35 days after sowing (DAS) and matures in 123 DAS during rainy season. The genotype produces an average pod yield of 65.8 g/m^2 with 74% shelling out turn. Pods are prominently beaked and reticulated; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 38.9 g and contain 51% oil. The severity of foliar diseases in the genotype under field conditions

habit, produces 50% flowering in 28 days after sowing (DAS) and matures in 112 DAS during rainy season. The genotype produces an average pod yield of 96.9 g/m^2 with 75% shelling out turn. Pods have moderate constriction and beak; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 44.0 g and contain 51% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust and 5.0 for late leaf spot on a modified 9-point scale, and an incidence of 3.6% for peanut bud necrosis disease (PBND) and 10.3% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

22. NRCGCS 124 (IC0583389; INGR10038), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

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NRCGCS 124 (INGR10038; IC0583389) was selected from advanced generation of cross (CT7-1 x SBXI) x *A. kretschmetri*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has semi spreading (decumbent-3) growth habit, produces 50% flowering in 25 days after sowing (DAS) and matures in 112 DAS during rainy season. The genotype produces an average pod yield of 58.4 g/m^2 with 76% shelling out turn. Pods are moderately beaked and reticulated; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 38 g and contain 48.5% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.5 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 8.7% for peanut bud necrosis disease (PBND) and 13% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

23. NRCGCS 180 (IC0583390; INGR10039), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS 180 (INGR10039; IC0583390) was selected from advanced generation of cross J 11×*A. cardenansii*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has spreading (decumbent-2) growth habit, produces 50% flowering in 35 days after sowing (DAS) and matures in 123 DAS during rainy season. The genotype produces an average pod yield of 65.8 g/m^2 with 74% shelling out turn. Pods are prominently beaked and reticulated; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 38.9 g and contain 51% oil. The severity of foliar diseases in the genotype under field conditions

habit, produces 50% flowering in 28 days after sowing (DAS) and matures in 112 DAS during rainy season. The genotype produces an average pod yield of 96.9 g/m^2 with 75% shelling out turn. Pods have moderate constriction and beak; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 44.0 g and contain 51% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust and 5.0 for late leaf spot on a modified 9-point scale, and an incidence of 3.6% for peanut bud necrosis disease (PBND) and 10.3% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

22. NRCGCS 124 (IC0583389; INGR10038), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrsihnan[1]
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NRCGCS 124 (INGR10038; IC0583389) was selected from advanced generation of cross (CT7-1 x SBXI) x *A. kretschmetri*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has semi spreading (decumbent-3) growth habit, produces 50% flowering in 25 days after sowing (DAS) and matures in 112 DAS during rainy season. The genotype produces an average pod yield of 58.4 g/m^2 with 76% shelling out turn. Pods are moderately beaked and reticulated; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 38 g and contain 48.5% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.5 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 8.7% for peanut bud necrosis disease (PBND) and 13% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

23. NRCGCS 180 (IC0583390; INGR10039), Groundnut (*Arachis hypogaea*) Germplasm, a source of Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Spot, Alternaria Leaf Blight

SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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are 2.0 for rust, 4.3 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 12.4% for peanut bud necrosis disease (PBND) and 2.5% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

24. NRCGCS 222(IC0583391; INGR10040), Groundnut (*Arachis hypogaea*) Germplasm, a Source Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Blight, Early Leaf Spot and Alternaria Leaf Blight

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NRCGCS 222 (INGR10040; IC0583391) was selected from advanced generation of cross (C364×PBDR 25) × A. *kemfmercadoi*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has semi spreading (decumbent-3) growth habit, produces 50% flowering in 30 days after sowing and matures in 121 DAS during rainy season. The genotype produces an average pod yield of 49.8 g per square metre with 60% shelling out turn. Pods are highly reticulated and slightly constricted; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 37.5 g and contain 45% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.0 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 12.4% for peanut bud necrosis disease and 9.9% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

25. NRCG-11846 (INGR10041; IC0583392), Groundnut (*Arachis hagenbeckii* Benth) Germplasm, with High Fodder Bio-Mass (2.4 ton/ha/year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Useful for Pasture Development, High Crude Fibre (31.2%) and Ash (11.7%) Contents

NRCG-11847 (INGR10042; IC0583393), Groundnut (*Arachis glabrata* Benth) Germplasm, with High Fodder Bio-Mass (3.8 Ton/Ha/Year), Suitable under Wasteland Conditions, Perennial in Nature; Useful for Pasture Development, High Protein Content (16.9%)

NRCG-17205 (INGR10045; IC0583396) Groundnut (*Arachis prostrata* Benth) Germplasm, with High Fodder Bio-Mass (3.6 Ton/Ha/Year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Suitable for Pasture Development, Binds Soil through Tough Rhizomes, High Protein Content (14.2%) and Iron Content (0.7%).

are 2.0 for rust, 4.3 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 12.4% for peanut bud necrosis disease (PBND) and 2.5% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

24. NRCGCS 222(IC0583391; INGR10040), Groundnut (*Arachis hypogaea*) Germplasm, a Source Resistance to PBND (Peanut bud necrosis diseases), Stem Rot, Tolerant to Late Leaf Blight, Early Leaf Spot and Alternaria Leaf Blight

SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
[1]Directorate of Groundnut Research, PB-05, Ivenagar Road, Junagadh-362 001, Gujarat
[2]University of Agricultural Science, Raichur-584 102, Karnataka
[3]National Research Centre for Litchi, Muzaffarpur-842 002, Bihar
(E-mail: rathnakumar@nrcg.res.in)

NRCGCS 222 (INGR10040; IC0583391) was selected from advanced generation of cross (C364×PBDR 25) × A. *kemfmercadoi*. The genotype was developed by pedigree selection from interspecific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has semi spreading (decumbent-3) growth habit, produces 50% flowering in 30 days after sowing and matures in 121 DAS during rainy season. The genotype produces an average pod yield of 49.8 g per square metre with 60% shelling out turn. Pods are highly reticulated and slightly constricted; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 37.5 g and contain 45% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 5.0 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 12.4% for peanut bud necrosis disease and 9.9% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis diseases, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

25. NRCG-11846 (INGR10041; IC0583392), Groundnut (*Arachis hagenbeckii* Benth) Germplasm, with High Fodder Bio-Mass (2.4 ton/ha/year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Useful for Pasture Development, High Crude Fibre (31.2%) and Ash (11.7%) Contents

NRCG-11847 (INGR10042; IC0583393), Groundnut (*Arachis glabrata* Benth) Germplasm, with High Fodder Bio-Mass (3.8 Ton/Ha/Year), Suitable under Wasteland Conditions, Perennial in Nature; Useful for Pasture Development, High Protein Content (16.9%)

NRCG-17205 (INGR10045; IC0583396) Groundnut (*Arachis prostrata* Benth) Germplasm, with High Fodder Bio-Mass (3.6 Ton/Ha/Year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Suitable for Pasture Development, Binds Soil through Tough Rhizomes, High Protein Content (14.2%) and Iron Content (0.7%).

are 2.0 for rust, 4.3 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 12.4% for peanut bud necrosis disease (PBND) and 2.5% for stem rot with almost immunity to *Alternaria* leaf blight disease has been recorded. The genotype has been identified as donor for multiple disease resistance in groundnut for peanut bud necrosis, stem rot, late leaf spot, rust and *Alternaria* leaf blight.

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NRCG-11847 (INGR10042; IC0583393), Groundnut (*Arachis glabrata* Benth) Germplasm, with High Fodder Bio-Mass (3.8 Ton/Ha/Year), Suitable under Wasteland Conditions, Perennial in Nature; Useful for Pasture Development, High Protein Content (16.9%)

NRCG-17205 (INGR10045; IC0583396) Groundnut (*Arachis prostrata* Benth) Germplasm, with High Fodder Bio-Mass (3.6 Ton/Ha/Year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Suitable for Pasture Development, Binds Soil through Tough Rhizomes, High Protein Content (14.2%) and Iron Content (0.7%).

NRCG-17206 (INGR10046; IC0583397), Groundnut (*Arachis marginata* Gardner) Germplasm, with High Fodder Bio-Mass (3.2 ton/ha/year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Suitable for Pasture Development, Binds Soil through Tough Rhizomes, High Protein Content (16.8%) and Iron Content (0.7%).

AL Rathnakumar[1], T Radhakrishnan[1], SK Bera[1], HB Lalwani[1], Nilesh Joshi[2] and Sugad Singh[1]

[1]*Directorate of Groundnut Research, Junagadh-362 001, Gujarat*

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Among the mostly utilized wild species of groundnut for fodder purposes, members of the section *Rhizomatosae,* and *Extranervosae* are more common in China, Africa and South America while in Australia few species of the section *Caulorhizae* have been released as forage varieties. These species are perennial and characterized by the presence of rhizomes (in case of *Caulorhizae* it is seeds) there by making the propagation easy.

Hence, a systematic evaluation has been carried out with four high biomass yielding perennial species of the section *Rhizomatosae* (*A. glabrata and A. hagenbeckii;* both are robust tetraploid species) and section *Extranervosae* (*A. marginata and A. prostrata*) for five fodder quality traits including biomass under wasteland conditions in the experimental farm area of Directorate of Groundnut Research, Junagadh, Gujarat. After four years of their establishment, the average dry matter yield (Table 1) was in the range of 2.4 ton/ha/year (*A. hagenbeckii*) to 3.8 ton/ha/year (*A. glabrata*) followed by *A. prostrata* (3.6 ton/ha/year) in two cuttings indicating their potential as a source of fodder under wasteland conditions. In addition, these species produce dense and thick rhizomes (about 1.5 ton/ha/year), which act as a soil binder and thus indicating the usefulness in high rainfall regions and slopes to prevent soil erosion. The crude protein content (N content x 6.25) was the in the range of 11.1% (*A. hagenbeckii*) to 16.9%. (*A.glabrata*). Nutrients important for lactation in animals like Calcium (>2.0%) and iron (≥0.5%) were also high in these four species. Rumen microbes usually require a minimum of 7.0% of crude protein for effective digestion of the feed. The higher protein content coupled with high calcium and iron contents present in the above species indicated the nutritional superiority of the four species to be used as forage under wasteland conditions.

Table 1. Biomass yield and fodder quality in four promising wild *Arachis* species of the section *Rhizomatosae*

Wild Species	Biomass yield ton/ha/year	Leaf:twig ratio	Protein (%)	Ca (%)	Fe (%)
A. hagenbekii	2.4	1:1.3	11.1	2.3	0.80
A. glabarata	3.8	1:1.3	16.9	2.6	0.50
A. prostrata	3.6	1:1.3	14.2	2.1	0.70
A. marginata	3.2	1:2.3	16.8	2.9	0.70

References

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SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCG-11847 (INGR10042; IC0583393), Groundnut (*Arachis glabrata* Benth) Germplasm, with High Fodder Bio-Mass (3.8 Ton/Ha/Year), Suitable under Wasteland Conditions, Perennial in Nature; Useful for Pasture Development, High Protein Content (16.9%)

NRCG-17205 (INGR10045; IC0583396) Groundnut (*Arachis prostrata* Benth) Germplasm, with High Fodder Bio-Mass (3.6 Ton/Ha/Year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Suitable for Pasture Development, Binds Soil through Tough Rhizomes, High Protein Content (14.2%) and Iron Content (0.7%).

NRCG-17206 (INGR10046; IC0583397), Groundnut (*Arachis marginata* Gardner) Germplasm, with High Fodder Bio-Mass (3.2 ton/ha/year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Suitable for Pasture Development, Binds Soil through Tough Rhizomes, High Protein Content (16.8%) and Iron Content (0.7%).

AL Rathnakumar[1], T Radhakrishnan[1], SK Bera[1], HB Lalwani[1], Nilesh Joshi[2] and Sugad Singh[1]

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Wild Species	Biomass yield ton/ha/year	Leaf:twig ratio	Protein (%)	Ca (%)	Fe (%)
A. hagenbekii	2.4	1:1.3	11.1	2.3	0.80
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SK Bera[1], G Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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A. marginata	3.2	1:2.3	16.8	2.9	0.70

References

Cook BG and IC Crosthwaite (1994). Utilization of *Arachis* species as forage. In: The Groundnut Crop: A scientific basis for improvement. J Smart (ed), Chapman and Hall, London, pp 624-663.

26. NRCG-12035 (INGR 10043; IC 0583394), Groundnut (*Arachis appressipila* Krapov. and WC Gregory) Germplasm, with High Fodder Bio-Mass (1.8 Ton/Ha/Year), Suitable Even Under Wasteland Conditions, Seed Forming, Semi-Perennial; Suitable for Pasture Development, Protein Content (14.8%)

NRCG-12990 (INGR 10044; IC 0583395), Groundnut (A*rachis pintoi* Krapov and WC Gregory) Germplasm, with High Fodder Bio-Mass (2.7 Ton/Ha/Year), Suitable Even Under Wasteland Conditions, Perennial in Nature; Suitable for Pasture Development, Protein Content (12.1%) and Iron Content (0.5%)

AL Rathnakumar[1], T Radhakrishnan[1], SK Bera[1], HB Lalwani[1], Nilesh Joshi[2] and Sugad Singh[1]

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The science of tropical forages is in its infancy in comparison with that of temperate forages. It spans around a period of little more than 50 years, during which commercial forage legumes have been dawn from may genera, the most widely planted probably coming from *Centrosema*, *Macroptilium*, *Stylosanthes* and *Desmodium* (Cook and Crosthwaite, 1994). However, the genetic potential of these and other genera including *Arachis*, has been only partly exploited. Considerable contribution of *Arachis* to the pasture lands of South America, the USA and Australia is well recognized and the most of the pasture lands is occupied by Rhizoma peanuts. However, evaluation of the seed forming species of other section is quite rare across the world.

Hence, two seed forming perennial species *A. pintoi* Krap. and Greg. of the section *Caulorhizae* and *A. appressipila* Krapov and WC Gregory of the section *Procumbentes* were evaluated along with eight other species under wasteland conditions in the experimental farm area of Directorate of Groundnut Research, Junagadh, Gujarat. After four years of establishment, *A. pintoi* was found to be superior only in respect of biomass yield (2.7ton/ha/year in two cuttings) while for crude protein content (14.8%) and Ca (2.3%) were found to be high in *A. appressipila.* For two other fodder quality traits, leaf: twig ratio (1:1.6) and Fe content (0.5%), there was no difference between these two species (Table 1). However, the species, *A. pintoi* has stoloniferous roots at the nodes and anchor very well in the soil. It also has the advantage of producing profuse and large seeds when compared with *A. appressipila.* These two species may be used in pasture development in wastelands

Table1. Biomass yield and fodder quality in two promising seed forming wild *Arachis* species

Wild Species	Biomass Yield ton/ha/year	Leaf:twig ratio	Protein (%)	Ca (%)	Fe (%)
A. appresipila (NRCG 12035)	1.8	1:1.6	14.8	2.3	0.5
A. pintoi (NRCG 12990)	2.7	1:1.6	12.1	2.1	0.5

References

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27. Mutant No. 1022 (IC0582890; INGR10047), Sesame (*Sesamum indicum* L.) Germplasm, with High Lignin and Improved Nutraceutical Traits

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Lignans such as sesamin, sesamlin and γ-tocopherol from sesame seeds play an important role in plant defense such as antifedant as well as potent anti-oxidants and insecticides. Sesamin is the most abundant lignan in sesame seed. It shows anti hypertensive, anti inflammatory and anti allergic effect (Jeng and Hou, 2005). This compound is also effective in preventing an increase in the serum triacylglycerol level following ethanol consumption in the rats (Akimoto, 1993). The cholesterol lowering effect of sesame has also been shown in humans (Hirata, 1996)

Induced mutagenesis with gamma radiation and chemical mutagen was employed in sesame (*Sesamum indicum* L.) to enhance the genetic variability for higher seed yield and seed quality components. Some of the isolated mutants for higher seed yield with improved test weight and colour were subjected for analysis of nutraceutical components.

ANOVA among the induced mutants indicated very highly significant variation between mutants and their interaction.The induced mutant lines were found to be promising for seed yield. Out of 49 mutants, top ten mutants were selected in the order of their merit for the lignan profiles are presented below.

Mutant No.1022 recorded significantly higher total lignan content of 14.23 g/kg as against the parent (5.79 g/kg), that accounts for 145.76% improvement over the parent, DS-1. Incidentally, the same mutant recorded high amount of sesamin (10.46 g/kg) which is an important and major lignan content as against the parent DS-1 with 3.59 g/kg. The top four induced mutants (No.1022, 23, 191 and 983) recorded the total lignan content of more than double compared to the parent DS-1 (5.79 g/kg). These mutant lines can be further utilized in inter-mutant hybridization / recurrent irradiation for enhancing the lignan profiles for their better health benefit. Since, these mutant lines are having higher proportions of lignan they can be better exploited for their anti-diabetic and anti-hypertension benefits.

Table 1. Lignan profiles of selected induced mutant lines

Mutant lines	Sesamin (g /kg oil)	Sesamolin (g /kg oil)	γ–toco-pherol	Total
1022	10.46	3.18	0.59	14.23
23	9.15	3.77	0.62	13.54
191	9.13	2.66	0.77	12.56
983	8.32	2.98	0.55	11.85
365	8.03	2.34	0.54	10.91
383	7.15	2.53	0.72	10.40
949	7.56	1.90	0.62	10.08
946	6.34	3.13	0.57	10.04
699	6.42	2.68	0.53	9.63
5004	7.05	1.91	0.62	9.58
DS–1 (Parent)	3.59	1.68	0.52	5.79
Mean	5.44	1.92	0.58	–
CD (5%)	0.702	0.277	0.039	–

References

Akimoto K (1993) Protective effect of sesamin against liver damage caused by alcohol or carbon tetra chloride in rodents. *Ann. Nutr. Meabol.* **37:** 218-224.

Hirata I (1996) Hypocholesteromic effect of sesame lignan in humans. *Atherosclerosis*. **122:** 135-136.

Jeng KCG and RCW Hou (2005) Sesamin and sesamolin: Natures therapeutic lignans. *Current Enzyme Inhibition*. **I**: 11-20.

28. NRC GS-1 (IC0582897; INGR10048), a Rapeseed (*Brassica napus*) Germplasm, with Early Flowering and Dwarf Plant Type

SS Meena, Rajbir Yadav, Arvind Kumar, VV Singh, KH Singh and AK Misra
Directorate of Rapeseed-Mustard Research, Bharatpur-321 303, Rajasthan
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Gobhi sarson (*Brassica napus*) is an introduction from European countries and basically a crop of long duration and is of high yield potential. However, in India, Indian mustard is grown predominantly largely because of its inherent capacity to tolerate the drought stress. However, with the expansion of irrigation facilities, most of the

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mustard in India is now grown under irrigated condition and therefore, a plant type suited for irrigated condition can be a mean for further increase in yield potential of rapeseed-mustard. Beside, high yield potential of *Brassica napus*, it is fortunately resistant against all the available racial flora of white rust and also has high oil content. Keeping these into consideration, a number of varieties like GSL-1, GSL-2 and a hybrid Hyola- 401 was released for cultivation in Punjab and Himanchal Pradesh where winters are comparatively longer. These varieties and hybrid could not become popular largely because of their long duration and tall growth habit.

An inter-specific hybridization, programme, therefore, was initiated at NRCRM, Bharatpur, during 1999-2000 to introgress the desirable character of Gobhi sarson into Indian mustard and vice versa. From this hybridization, a dwarf and very early flowering genotype of *Brassica napus* was isolated, which was advanced to F_7 through selfing and a stable line is here proposed for registration.

It increases the yield potential in mustard by prolonging the reproductive phase in comparison to vegetative phase and the proposed line flowers in 32-35 days and maturing in 135-40 days is the right kind of donor. Beside this, it is dwarf in height and therefore can find favor with the farmers directly in the Himanchal Pradesh region.

The earlier registered germplasm by Teri Gaurav (Double low) is direct introduction and the selection from *Brassica napus*. The proposed line, however, is a product of inter-specific hybridization and therefore, likely to posses many advantegous traits of *Brassica juncea* and, therefore, likely to have more benefit by utilization in the breeding programme. Moreover, this can add to the very limited diversity available for plant height in the germplasm collection of *Brassica napus*. The detail of the genotype NRC-GS-1 is given below along with figures.

Characteristics	NRC GS–1	BEC 107	NRCG 11
Days to Flowering	32–35 (34)	45–49 (47)	55–65 (60)
Days to maturity	130–135 (138)	134–139 (135)	145–152 (149)
Plant height	70–80 (75)	123–135 (130)	144–151 (147)
Primary branches	3–4 (3.6)	5–7 (6.4)	4–5 (4.8)
Siliquae on main shoot	20–24 (22.8)	35–40 (38.900	45–53 (49.6)
Seeds per siliquae	18–20 (18.9)	12–14 13.4)	19–21 (20.4)
1000–seed weight(g)	2.86	4.23	3.21
Oil content (%)	37.6	38.6	39.2

Figures in parentheses showing mean value.

29. NRCKR-304 (IC 0582898, INGR 10049), Mustard (*Brassica carinata*) Germplasm, with Early Maturity, Long Main Shoot and Bold Seed

VV Singh[1], Rajbir Yadav[2], Arvind Kumar[3], SS Meena[1], KH Singh[1] and AK Misra[4]
[1]Directorate of Rapeseed Mustard Research, Sewar, Bharatpur-321 303, Rajasthan
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Karan Rai or Ethiopian mustard [*Brassica carinata* (A. Braun)] is a mustard crop suitable for rainfed and low moisture condition. A natural amphidiploid between *Brassica nigra* and *Brassica oleracea*, it is believed to be originated in Ethiopian high lands. Beside its tolerance to moisture stress, Karan rai is a reservoir of number of disease resistant genes to number of diseases prevalent in India like white rust, Alternaria blight and stem rot. Despite such advantages, this crop could not find favours with farmers largely because it is a very long duration crop along with other inherent defects like low test weight, short shoot length and long duration. Most of its agronomic features suit rain fed conditions with uneven plant stand. However, in India rapeseed-mustard is now largely grown on conserved moisture with one life saving irrigation and therefore, the variety should possess the characteristics which suit this kind of agronomy.

At NRCRM, Bharatpur, an inter specific hybridization programme was therefore, initiated during 1999-2000 to genetically improve Karan rai by introgressing the high yielding agronomic traits of *Brassica juncea* in the genetic background of *Brassica carinata*. One of the released varieties of Indian mustard, namely Varuna was crossed with a germplasm line BPKR 13 of *Brassica carinata*. Segregant were advanced

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Plant height	70–80 (75)	123–135 (130)	144–151 (147)
Primary branches	3–4 (3.6)	5–7 (6.4)	4–5 (4.8)
Siliquae on main shoot	20–24 (22.8)	35–40 (38.900	45–53 (49.6)
Seeds per siliquae	18–20 (18.9)	12–14 13.4)	19–21 (20.4)
1000–seed weight(g)	2.86	4.23	3.21
Oil content (%)	37.6	38.6	39.2

Figures in parentheses showing mean value.

29. NRCKR-304 (IC 0582898, INGR 10049), Mustard (*Brassica carinata*) Germplasm, with Early Maturity, Long Main Shoot and Bold Seed

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to F_7 generation and some stable lines of *Brassica carinata* were obtained which possesses some desirable characteristics such as long main shoot, bold seed, early duration and designated as NRCKR-304. This line is one step ahead of released Karan rai variety in many agronomic features and can act as donor for further improvement of *Brassica carinata* as well as *Brassica juncea*. The features of this stock are unique and no literature available to applicant shows these features.

Table 1. Salient features of NRCKR–304

Characteristics	NRCKR–304	Kiran (released variety of *Brassica carinata*)	Varuna (released variety of *Brassica juncea)*
Days to Flowering	43	84	48
Days to maturity	135	150	130
Plant height	163	170	155
Primary branches	6.4	9.8	5.2
Secondary branches	15.8	15.6	7.2
Fruiting zone length	107.8	52	70
Main shoot length	110	24	53
Siliquae on main shoot	40.2	24	40
Siliquae per plant	336	254	150
Seeds per siliquae	16.4	12.0	14.2
Thousand seed weight(g)	5.8	2.9	5.1

30. BPR-541- 4(IC0583386; INGR10050), Mustard (*Brassica juncea* l.) Germplasm, with High Water use Efficiency. Thermo-tolerance at Terminal Stage, Salinity Tolerance at Juvenile Stage

JS Chauhan[1], Maharaj Singh[1], KH Singh[1], Rajbir Yadav[2], AK Misra[3], VV Singh[1], SS Meena[1], ML Meena[1] and YP Singh

[1]Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321 303, Rajasthan
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High temperature is the second most important stress next to drought, which affects crop plant at any time and imposes severe limitation on crop growth and development. Flowering is the most sensitive stage for high temperature damage probably due to vulnerability during pollen development, anthesis and fertilization leading to reduced crop yield (Hall, 1992). In India prevalence of high temperature stress at terminal stage of Indian mustard is inevitable in substantial acreage due to delayed sowing after rice and mixed /intercropping with wheat. No donor source having tolerance of high temperature stress during terminal stage has been available in Indian mustard. Strain BPR-541-4 (IC 0583448) was developed from the cross MDOC 8×PCR 7 following pedigree method of selection at Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur (Rajasthan) showed thermo-tolerance during terminal stage in the experiments conducted at Hisar, Kanpur and Ludhiana under AICRPRM during 2007-08 and 2008-09. Of the 6 locations (pooled over years), it showed consistently low (<20%) reduction in seed yield at 5 locations. It also showed tolerance to saline conditions during juvenile stage in experiments conducted at Hisar, Karnal and Kanpur during 2007-08 and Hisar, Karnal, Kanpur and S.K.Nagar during 2008-09. The tolerance to salinity (12 dS/m) was characterized on the basis of per cent reduction in seedling emergence and dry weight. This germplasm showed less reduction in seedling emergence (< 10%) and dry weight (< 15%) at 4 out of 7 locations.

BPR 541-4 was also identified to posses high water use efficiency (WUE) during bolting and full flowering stage on the basis of lower $\Delta^{13}C$ (18.5%) than the check Varuna (21.1%) and Rohini (22.1%) under irrigated conditions and also higher seed yield/ plant than Varuna (29.3%) and Rohini (12.7%). On the basis of gas exchange parameters, BPR-541-4 also showed 50.6% and 52.0% higher WUE over Varuna and Rohini, respectively, under irrigated conditions with 29.3% and 12.7% higher seed yield/plant. Under rainfed conditions it had 21.6% higher WUE and 24.3% higher yield than check RH-819. It is tall and has medium maturity, medium size seeds and high oil content (Table 1).

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High temperature is the second most important stress next to drought, which affects crop plant at any time and imposes severe limitation on crop growth and development. Flowering is the most sensitive stage for high temperature damage probably due to vulnerability during pollen development, anthesis and fertilization leading to reduced crop yield (Hall, 1992). In India prevalence of high temperature stress at terminal stage of Indian mustard is inevitable in substantial acreage due to delayed sowing after rice and mixed /intercropping with wheat. No donor source having tolerance of high temperature stress during terminal stage has been available in Indian mustard. Strain BPR-541-4 (IC 0583448) was developed from the cross MDOC 8×PCR 7 following pedigree method of selection at Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur (Rajasthan) showed thermo-tolerance during terminal stage in the experiments conducted at Hisar, Kanpur and Ludhiana under AICRPRM during 2007-08 and 2008-09. Of the 6 locations (pooled over years), it showed consistently low (<20%) reduction in seed yield at 5 locations. It also showed tolerance to saline conditions during juvenile stage in experiments conducted at Hisar, Karnal and Kanpur during 2007-08 and Hisar, Karnal, Kanpur and S.K.Nagar during 2008-09. The tolerance to salinity (12 dS/m) was characterized on the basis of per cent reduction in seedling emergence and dry weight. This germplasm showed less reduction in seedling emergence (< 10%) and dry weight (< 15%) at 4 out of 7 locations.

BPR 541-4 was also identified to posses high water use efficiency (WUE) during bolting and full flowering stage on the basis of lower $\Delta^{13}C$ (18.5%) than the check Varuna (21.1%) and Rohini (22.1%) under irrigated conditions and also higher seed yield/ plant than Varuna (29.3%) and Rohini (12.7%). On the basis of gas exchange parameters, BPR-541-4 also showed 50.6% and 52.0% higher WUE over Varuna and Rohini, respectively, under irrigated conditions with 29.3% and 12.7% higher seed yield/plant. Under rainfed conditions it had 21.6% higher WUE and 24.3% higher yield than check RH-819. It is tall and has medium maturity, medium size seeds and high oil content (Table 1).

Table1. Morphological characters of BPR–541–4

Plant height (cm)	200.0 (200–210)
Days to maturity	135.0 (130–145)
Primary branches/plant(no.)	7.7 (7–9)
Secondary branches/plant (no.)	11.7 (10–13)
Main shoot length (cm)	70.0 (65–73)
Siliquae on main shoot (no.)	41.4 (41–43)
Siliqua length (cm)	6.9 (5.6–7.0)
Seeds/siliqua (no.)	16.6 (15.8–17.2)
1000–seeds weight (g)	4.4 (4.2–4.6)
Total dry matter/plant (g)	52.2 (48–56)
Harvest index (%)	30.9 (28–33)
Oil content (%)	42.2 (41–43)
Protein content (%)	19.4 (19.2– 19.8)

Reference

Hall AE (1992) Breeding for heat tolerance. *Plant Breed. Rev.* **10:** 129-168.

31. BPR-543-2 (IC0583448; INGR10051), Mustard (B*rassica juncea* L.) Germplasm, with High Water Use Efficiency and Thermo-tolerance at Juvenile Stage

JS Chauhan[1], Maharaj Singh[1], KH Singh[1], Rajbir Yadav[2], AK Misra[3], VV Singh[1], SS Meena[1], ML Meena[1] and YP Singh

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Water use efficiency (WUE), ability of the plant to produce dry matter / unit of water is an important character especially under drought and also showed positive correlation with seed yield (Singh *et al.* 2007). No donor source for this character has been available in Indian mustard. The identified germplasm, BPR 543-2 (IC 0583386) was developed from the cross TM 2 x PCR 9202 following pedigree method of selection at Directorate of Rapeseed-Mustard, Sewar, Bharatpur (Rajasthan). It had 40% higher WUE ($\Delta^{13}C$ =18.1%) during bolting and full flowering stage than check Varuna ($\Delta^{13}C$ =21.1%) and Rohini ($\Delta^{13}C$ =22.1%) with 23.2% higher seed yield/plant over Varuna and 7.4% over Rohini under irrigated conditions, while under rainfed conditions it showed 23.0% higher WUE($\Delta^{13}C$ =18.2%) over best check RH-819 ($\Delta^{13}C$ =22.4%) with 10.6% higher seed yield. It showed consistently low seedling (< 20 %) mortality at high temperature (45± 1^0C) during juvenile stage in the experiments conducted at Hisar, Kanpur, Ludhiana and Bharatpur under AICRPRM during 2007-08 and 2008-09 and also identified as tolerant of high temperature.It matured in 125 days with an average height of 192 cm. It had medium size seeds with high oil content (Table 1)

Table1. Morphological characters of BPR–543–2

Plant height (cm)	192 (100–195)
Days to maturity	125 (120–135)
Primary branches/plant(no.)	6.3 (6–7)
Secondary branches/plant (no.)	10.7 (9–12)
Main shoot length (cm)	76.7 (70–80)
Siliquae on main shoot (no.)	54.7 (51–58)
Siliqua length (cm)	6.5 (6.2–7.0)
Seeds/siliqua (no.)	15.8 (14.3–16.8)
1000–seeds weight (g)	4.7 (4.4–5.0)
Total dry matter/plant (g)	51.5 (48–55)
Harvest index (%)	30.8 (29–32)
Oil content (%)	41.8 (41–42)
Protein content (%)	19.9 (19–20.5)

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32. NRC106 (IC0582899, INGR10052) and IC210 (IC0582900; INGR10053), Soybean (*Glycine max*) Germplasm, Lines with High Oleic Acid Content and Early Maturity

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The fatty acid composition of conventional soybean cultivars shows 11% palmitic acid (C16:0), 3% stearic acid (C18:0), 23 % oleic acid (C18:1), 53% linoleic acid (C18:2) and 8% linolenic acid (C18:3). Poor oxidative stability of soybean oil has been ascribed to its high unsaturated fatty acids content. Susceptibility of a fatty acid molecule to oxidation increases with the increasing number of unsaturations. Oleic acid with only single double bond is the least susceptible fatty acid of three major unsaturated fatty acids *viz.* oleic acid, linoleic acid and linolenic acid. This has been substantiated by the study of Fatemi and Hammond (1980) which showed a ratio of 21.6:10.3:1 for the rate of oxidation for linolenic acid, linoleic acid and oleic acid. In vegetable oil industry, the oxidative stability is improved artificially by employing partial hydrogenation; however, this process is not only cost-ineffective but also results in the formation of trans fats, which are atherogenic and diabetogenic (Lichtenstein *et al.,* 2003). Therefore, globally, soybean genotypes with high oleic acid content are being searched and developed which can deliver oil which is oxidatively stable and hence obviates the need of process of partial hydrogenation (Kumar *et al.,* 2004).

At Directorate of Soybean Research, Indore, 2100 germplasm lines were screened for fatty acid profile under the AP Cess funded Scheme using gas chromatography. NRC106 a soybean germplasm line developed at Directorate of Soybean Research by selection from the germplasm line EPS472 was found to contain average oleic acid to the magnitude of 41.9 % over three years at Indore. The genotype is a determinate soybean plant with an average height of 40cm. Days-to-50% flowering and days-to-maturity was 38 and 86 days, respectively. Average number of pods/plant and seeds/pod were 35.3 and 2.65, respectively. Weight of 100 seeds was 11.72g and the yield potential of this genotypes is 21.0 qt/ha. Similarly, IC210, a soybean genotype, has also been zeroed in for high oleic acid content with the average value of 42.7% for this fatty acid over three consecutive years. The germplasm line, which is an indigenous collection, has a determinate plant type with an average height of 43 cm. Days-to-50% flowering and days-to-maturity were 37 and 84 days, respectively. Average number of pods per plant was 30.0, while average number of seeds per pod was 2.7. Weight of 100 seeds was 11.25 g. Agronomic trials at DSR, Indore showed a yield potential of 18.3 q per ha for this genotype. More importantly, both the genotypes were tolerant to any major insect-pest attack. The genotypes are of immense importance for vegetable oil industry as the oil extracted need not be partially hydrogenated for improved oxidative stability.

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33. NRC101 (IC0582901; INGR10054) and NRC102 (IC582902; INGR10055), Soybean (*Glycine max*) Germplasm, Free from Kunitz Trypsin Inhibitor Polypeptide

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Kunitz trypsin inhibitor is an anti-nutritional factor present in soybean seed which limits the food uses of soybean. The anti-nutritional factor needs to be inactivated by heat treatment during processing. However, heat treatment insolubilizes the much-valued soy proteins and more importantly, can cause the loss of essential amino acids (Anderson 1992; Rio-Iriarte and Barnes 1996). Besides, the heat inactivation increases the cost of processing. Furthermore, in India, soybean is often recommended to mix with wheat (1:9) for making *chapati* flour. This necessitates the boiling of beans for best possible inactivation of kunitz trypsin inhibitor before grinding with wheat, which is an extra effort at household level and incurs 25% of energy cost at the industry level. The elimination of kunitz inhibitor at genetic level thus will be an important contribution for enhancement of soybean in food uses (Kumar *et al.,* 2010).

The authors have used an exotic germplasm accession PI542044 as the source of null kunitz inhibitor allele and transferred it to early duration popular cultivar Samrat. The selection of *ti* plants in the segregating generation was through SSR marker Satt 228. The homozygous recessive F_8 lines thus developed shows marked improvement in agronomic features over unadapted germplasm parent. NRC101 and NRC102 flowered in 29 and 33 days and reached harvest maturity in 81 and 89 days, respectively. The yield of NRC101 and NRC102 is 19.5 and 21.9 q/ha, respectively, which is at par with the adapted parent Samrat. NRC101 has a semi-determinate plant-type with 35 cm plant height, while NRC102 has a determinate type of plant with plant height 33.5 cm. Germination percentage of NRC101 and NRC102 was found to be 91 and 82%, respectively. These lines will be very useful as a source of null kunitz inhibitor allele in improved agronomic background as pre-breeding lines. The germplasm lines developed can be very useful in the enhancement of soybean in food uses. Besides, both the genotypes possess the desirable trait of earliness.

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34. NRC105 (IC0512375; INGR10056), Soybean (*Glycine max*) Germplasm – A Vegetable type

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Consumption of green seeds of soybean seeds at immature stage is an alternative mode of availing health benefits from soybean. The tender green seeds are a rich source of protein, energy, minerals, vitamins and antioxidative value (Rao *et al.,* 2010; Kumar *et al.,* 2010; Shanmugasundaram and Yan 2004) and can be cooked as vegetable similar to the tender seeds of chick pea and green pea. There are special genotypes which can be used for vegetable purposes. The green seeds of these genotypes are different in taste from conventional soybean types. Vegetable soybean has been consumed in many South-East Asian countries since a long time. It is known as *edamame* in Japan, *mao dou* in China and *poot kong* in Korea,

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however, in India vegetable soybean is a relatively new concept (Kumar *et al* 2003). At Directorate of Soybean Research, soybean genotype NRC105 has been developed for vegetable purpose by selection from the segregating population of ACCGC99009-25-9-1-3GC95024-2-1xR75. The genotype reaches its picking stage of R6 i.e. when the pod cavity is completely filled and the pod shell not yet turned yellow (Fehr *et al* 1971) in 65 days after sowing. The green seeds shelled from the pods at R6 stage are sweet (8% sucrose content) and tender with 100 green seeds weight as high as 60.2g. The genetic potential of pod yield and green seed yield is 8.2 and 3.9 tonnes per ha, respectively.

The plant of NRC105 is determinate in growth with average height of 35.9 cm and flowers in 28 days. Average number of branches per plant, pods per plant and green seeds per pod were: 2-3, 21 and 2.7, respectively. The genotype attains complete maturity in 80 days with 100-seed weight of 33.0 g and an average yield of 16.0 qts/ha. Mature seeds give 82% germination. The whole pods can be boiled with a pinch of salt and the green seeds can be consumed as snack or cooked similar to the green pea and chick pea at household level. Alternatively, the green seeds can be stored at -25 °C for later use.

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35. CISA-2(GMS) (IC0538548; INGR10057), Cotton (*Gossypium arboreum*) Germplasm, a Spontaneous Sterile Mutant having Yellow Open Flower with Red Petal Spot and Green Plant Body

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CISA-2 – a spontaneous sterile mutant having yellow flower with red petal and green plant has been registered with Registration No. INGR10057 and National Identity No. IC 0538548. The new GMS line is having open flowering which facilitates easy crossing whereas the earlier reported lines have closed flowers which creates problem in crossing.

The original male sterile mutant plant was observed from the seed multilocation plot CISA-2 (*G. arboreum* race *bengalense*) at Central Institute for Cotton Research, Regional Station, Sirsa during 2000-01. It was maintained by its counter fertile plant having the same traits except sterility. During 2001-01 and 2002-03 its stability was studied. Genetic basis of character was studied in F_2 and BC_1 from cross between male sterile plant observed in CISA 2 and the fertile plant. After its confirmation the genetics and gene identification was studied in detail by making crosses between identified male sterile plant of CISA 2 and of heterozygous male fertile plants of DS-5 (GMS) having genetic constitution aMS_1ams_1 .The segregation ratio of 3:1 was observed and the Chi square test confirmed the 3:1 ratio. Therefore the new GMS line is governed by a different pair of allele named as 'ams_2ams_2' for complete male sterility condition and the heterozygous F_1(male fertile) is designated as aMs_2ams_2.

Among the cultivated cotton species, diploid cottons have wide adaptability and are relatively tolerant to biotic and abiotic stresses. Conventional *desi* hybrids have been developed and released for commercial cultivation; however, significant coverage under these hybrids has not been achieved. Conventional hybrid seed production in *G. arboreum* cotton is not feasible

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Among the cultivated cotton species, diploid cottons have wide adaptability and are relatively tolerant to biotic and abiotic stresses. Conventional *desi* hybrids have been developed and released for commercial cultivation; however, significant coverage under these hybrids has not been achieved. Conventional hybrid seed production in *G. arboreum* cotton is not feasible

due to small size of the bud and weak peduncle and because of high wages of labour, short duration of flowering period. On the other hand, India became the pioneer country in the world in 1971 with the release of first hybrid H 4 of *G. hirsutum* cotton. The hybrid cotton technology as expected made a quantum increase in production and productivity in the country after the release of intra-hirsutum hybrids. The success in development of hybrids in *desi* cotton depends on availability of male sterile lines and good combining parent that gives the standard heterosis over the available conventional hybrids. And also the hybrid seed production in *G. arboreum* cotton based on genetic male sterility (GMS) system is more convenient and useful than conventional system of hand emasculation and pollination. Reduction in cost of hybrid seed is also possible by the use of genetic male sterility. Therefore the male sterile line CISA-2(GMS) can be used commercially for production of hybrid seed in *G. arboreum* cotton.

36. ABGMS (CSHN) (IC 0584053; INGR 10058), Cotton (*Gossypium arboreum*) Germplasm, a Genetic Male Sterile Line of Cotton with Curved Stigma

Suman Bala Singh[1], AM Badigannavar[2], IS Kategiri[2], BM Khadi[2] and KR Kranthi[1]

[1] Central Institute of Cotton Research, PBNo-2, PO-Shankar Nagar, Nagpur-440 010, Maharashtra

[2]University of Agricultural Sciences, Dharwad-580 005, Karnataka

(E-mail: sumanbalasingh2005@yahoo.com)

ABGMS is a genetic male sterile line belonging to race *Latifolium* of *G. hirsutum* cultivated species of cotton. It was developed through mutagen treatment of Abadhita variety at UAS, Dharwad followed by single plant selection and testing for stability of the characters (sterility and curved nature of the stigma) at CICR, Nagpur and UAS, Dharwad. Treatment of 10 kR of gamma rays in combination of 0.2 % ethyl methane sulfonate was the best combination. All the male sterile plants of this line possessed curved stigma.

Morpho-agronomic Characters

ABGMS is a compact plant type with short internodes, small to medium hairy, dark green leaves with one extra- floral nectary on mid rib. The flowers possess light yellow petals with yellow claws and 5 nectaries at the base of the petals. Stigma in sterile plants is curved while it is straight in the male fertile plants. The bracteoles are free with 5-7 serrations and 2-3 nectaries. Bolls are oval shaped, medium size and densely pitted.

Associated Characters and Cultivation Practices

The curved nature of the stigma is beneficial for tenacity of high density of pollen grains. The unique feature is visible right from the bud stage thus helping in roguing out fertile plants at the early crop stage thereby helpful in maintaining the plant population in hybrid seed production plots.

The fibre quality of this line is very good with 2.5% span length of 26 mm, fibre strength of 21 g/tex at 3.2 mm gauge, ginning percentage of 36% and strength to length ratio of 0.81.

It is also tolerant to bollworm and white fly.

38. CINA - 333 (IC 0583996; (INGR10059), Cotton (*Gossypium arboreum*) Germplasm, with High Seed Cotton Yield Potential, High Volume of Capsule/Boll and Long Claw of Petals

Punit Mohan[1], KR Kranthi[1], Harish Kumbhalkar[1] and Anjali Kak[2]

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CINA-333 (High Seed Cotton Yield cultivar of *Gossypium arboreum*, race-*Bengalense*) has been developed at Central Institute for Cotton Research, Nagpur through pedigree method of breeding. Cultivar CINA-333 has been evaluated in National Evaluation Trial of All India Coordinated Cotton Improvement Project (AICCIP) in 2005-06 at North, Central and South Zones, respectively. The cultivar CINA-333 recorded the highest Seed Cotton

due to small size of the bud and weak peduncle and because of high wages of labour, short duration of flowering period. On the other hand, India became the pioneer country in the world in 1971 with the release of first hybrid H 4 of *G. hirsutum* cotton. The hybrid cotton technology as expected made a quantum increase in production and productivity in the country after the release of intra-hirsutum hybrids. The success in development of hybrids in *desi* cotton depends on availability of male sterile lines and good combining parent that gives the standard heterosis over the available conventional hybrids. And also the hybrid seed production in *G. arboreum* cotton based on genetic male sterility (GMS) system is more convenient and useful than conventional system of hand emasculation and pollination. Reduction in cost of hybrid seed is also possible by the use of genetic male sterility. Therefore the male sterile line CISA-2(GMS) can be used commercially for production of hybrid seed in *G. arboreum* cotton.

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Morpho-agronomic Characters

ABGMS is a compact plant type with short internodes, small to medium hairy, dark green leaves with one extra- floral nectary on mid rib. The flowers possess light yellow petals with yellow claws and 5 nectaries at the base of the petals. Stigma in sterile plants is curved while it is straight in the male fertile plants. The bracteoles are free with 5-7 serrations and 2-3 nectaries. Bolls are oval shaped, medium size and densely pitted.

Associated Characters and Cultivation Practices

The curved nature of the stigma is beneficial for tenacity of high density of pollen grains. The unique feature is visible right from the bud stage thus helping in roguing out fertile plants at the early crop stage thereby helpful in maintaining the plant population in hybrid seed production plots.

The fibre quality of this line is very good with 2.5% span length of 26 mm, fibre strength of 21 g/tex at 3.2 mm gauge, ginning percentage of 36% and strength to length ratio of 0.81.

It is also tolerant to bollworm and white fly.

38. CINA - 333 (IC 0583996; (INGR10059), Cotton (*Gossypium arboreum*) Germplasm, with High Seed Cotton Yield Potential, High Volume of Capsule/Boll and Long Claw of Petals

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ABGMS is a compact plant type with short internodes, small to medium hairy, dark green leaves with one extra- floral nectary on mid rib. The flowers possess light yellow petals with yellow claws and 5 nectaries at the base of the petals. Stigma in sterile plants is curved while it is straight in the male fertile plants. The bracteoles are free with 5-7 serrations and 2-3 nectaries. Bolls are oval shaped, medium size and densely pitted.

Associated Characters and Cultivation Practices

The curved nature of the stigma is beneficial for tenacity of high density of pollen grains. The unique feature is visible right from the bud stage thus helping in roguing out fertile plants at the early crop stage thereby helpful in maintaining the plant population in hybrid seed production plots.

The fibre quality of this line is very good with 2.5% span length of 26 mm, fibre strength of 21 g/tex at 3.2 mm gauge, ginning percentage of 36% and strength to length ratio of 0.81.

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38. CINA - 333 (IC 0583996; (INGR10059), Cotton (*Gossypium arboreum*) Germplasm, with High Seed Cotton Yield Potential, High Volume of Capsule/Boll and Long Claw of Petals

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Yield in South Zone and ranked first in that zone. CINA-333 has been evaluated for Yield Potential and Fibre Quality Traits in Technology Mission on Cotton (TMC MM-1.1) in North, Central and South Zone respectively. The cultivar CINA-333 possesses high numbers of bolls with high volume. The Fruiting bodies/capsules/bolls were originated at very closer distance on sympodial branch. However, the above designated trait cannot be classified under cluster fruiting habit of the genetic stock. Because, fruiting bodies/bolls are not initiated/developed from a single initiation point. As the development of fruiting bodies at a closer distance and plants also retains the high number of bolls upto the maturity, it leads to high seed cotton yield. The genetic stock CINA-333 possesses the following economic characters viz, Average seed cotton yield (125 g/plant), Average boll weight (3.2 to 3.5 g.), Ginning outturn (35.7%), Seed Index (8.2 g.), Lint Index (3.8 g). The fibre properties parameter of the genetic stock CINA-333 are as under.

Staple length (mm)	:	28.5
Uniformity Ratio (%)	:	50.0
Micronaire (µg/inch)	:	4.2
Fibre bundle strength (g/tex)	:	20.3

1. The cultivar CINA- 333 can be utilized in breeding programme for development of high yielding varieties/ hybrids of arboreum cotton.
2. Long claw of petals can be used as a marker trait.

38. SLL-33 (IC 0583997; (INGR10060), Cotton (*Gossypium hirsutum*) Germplasm, with Single Leaf Lobe A Marker Trait

Punit Mohan[1], KR Kranthi[1], Anjali Kak[2] and BR Rode[1]
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Single leaf lobe is a marker character. Semi and deeply palmate leaf in *Gossypium hirsutum* are classified as okra type similar to the okra plant *Abelmosches esculentus.* However, single leaf lobe with rudimentary accessory lobe has been classified in super okra in *Gossypium.* The Genetic Stock SLL-33 single leaf lobe is having laciniate, starp shaped without rudimentary accessory lobe. The above designated trait is evolved from super okra leaf lobe and stability of trait was recorded over generations. The genetic stock SLL -33 possesses the following economic characters viz, Average seed cotton yield (58.3 g/plant), Average boll weight (3.7 g), Ginning outturn (35.7%), Seed Index (8.2 g.), Lint Index (3.8 g). The fibre properties are as under.

Staple length (mm)	:	27.3
Uniformity Ratio	:	58
Micronaire	:	4.7
Fibre bundle strength (g/tex)	:	21.9

Single leaf lobe is a stable marker character and can be utilized in breeding programme for development of varieties and hybrids with unique traits and can be identified easily at morphological level from other varieties and hybrids.

39. YPLL-29 (IC 0583998; INGR10061), Cotton (*Gossypium hirsutum*) Germplasm, with Yellow Pigmented Leaf Lobe a Marker Trait

Punit Mohan[1], KR Kranthi[1], Anjali Kak[2] and BR Rode[1]
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The cultivars/germplasm lines of red or pigmented plant body and leaf lobe are available in *G. hirsutum, G. barbadense, G. arboreum,* and *G. herbaceum* species. However, the yellow pigmented leaf lobe are not available in the above four species of *Gossypium.* The yellow pigmentation in genetic stock YPLL-29 appears in the nascent leaf primordial at the time of entry of reproductive phase of the above designated

Yield in South Zone and ranked first in that zone. CINA-333 has been evaluated for Yield Potential and Fibre Quality Traits in Technology Mission on Cotton (TMC MM-1.1) in North, Central and South Zone respectively. The cultivar CINA-333 possesses high numbers of bolls with high volume. The Fruiting bodies/capsules/bolls were originated at very closer distance on sympodial branch. However, the above designated trait cannot be classified under cluster fruiting habit of the genetic stock. Because, fruiting bodies/bolls are not initiated/developed from a single initiation point. As the development of fruiting bodies at a closer distance and plants also retains the high number of bolls upto the maturity, it leads to high seed cotton yield. The genetic stock CINA-333 possesses the following economic characters viz, Average seed cotton yield (125 g/plant), Average boll weight (3.2 to 3.5 g.), Ginning outturn (35.7%), Seed Index (8.2 g.), Lint Index (3.8 g). The fibre properties parameter of the genetic stock CINA-333 are as under.

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1. The cultivar CINA- 333 can be utilized in breeding programme for development of high yielding varieties/ hybrids of arboreum cotton.
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Yield in South Zone and ranked first in that zone. CINA-333 has been evaluated for Yield Potential and Fibre Quality Traits in Technology Mission on Cotton (TMC MM-1.1) in North, Central and South Zone respectively. The cultivar CINA-333 possesses high numbers of bolls with high volume. The Fruiting bodies/capsules/bolls were originated at very closer distance on sympodial branch. However, the above designated trait cannot be classified under cluster fruiting habit of the genetic stock. Because, fruiting bodies/bolls are not initiated/developed from a single initiation point. As the development of fruiting bodies at a closer distance and plants also retains the high number of bolls upto the maturity, it leads to high seed cotton yield. The genetic stock CINA-333 possesses the following economic characters viz, Average seed cotton yield (125 g/plant), Average boll weight (3.2 to 3.5 g.), Ginning outturn (35.7%), Seed Index (8.2 g.), Lint Index (3.8 g). The fibre properties parameter of the genetic stock CINA-333 are as under.

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Micronaire	:	4.7
Fibre bundle strength (g/tex)	:	21.9

Single leaf lobe is a stable marker character and can be utilized in breeding programme for development of varieties and hybrids with unique traits and can be identified easily at morphological level from other varieties and hybrids.

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genetic stock. The appearances of yellow pigment in leaves are maintained upto harvesting stage. The stability and uniformity of yellow pigmentation characters in leaf is of perpetual nature and it was observed over generations by the repeated course of sowing. The genetic stock YPLL-29 possesses the following economic characters viz, Average seed cotton yield (28.9 g/plant), Average boll weight (2.3 g), Ginning outturn (36.9%), Seed Index (6.5 g), Lint Index (3.5 g) and Boll Volume upto (17.6 cc). The genetic stock YPLL-29 possesses the following fibre properties.

Staple length (mm)	: 26.3
Uniformity Ratio	: 58.0
Micronaire	: 4.9
Fibre bundle strength (g/tex)	: 17.6

The genetic stock YPLL-29 yellow pigmented leaf lobe (Marker character) can be used in breeding programme for development of varieties/hybrids, which can be identified and distinguished from other cultivars of *Gossypium* at morphological level.

40. CSLL-59 (IC 0583999; INGR 10062), Cotton (*Gossypium hirsutum*) Germplam, with Cup Shaped Leaf Lobe a Marker Trait

Punit Mohan[1], KR Kranthi[1], Anjali Kak[2] and BR Rode[1]
[1] *Central Institute for Cotton Research, Post Bag No. 2, Post Shankar Nagar, Nagpur-440 010, Maharashtra*
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The Genetic Stock CSLL-59 (*Gossypium hirsutum,* race: *Latifolium) possesses* 3-5 lobed palmately broad cup shaped leaf. At flowering stage the peripheral region of leaf lobe gradually lead to vertical growth. The central portion of leaf lobe maintained the horizontal shape. Consequently the central lobe of leaf develop a depression and zone of elongation forming a cup like shape. The cup shape leaf lobe is unique and novel marker character and stable over generations. The above genetic stock possesses the economic characters *viz.*, Average seed cotton yield (32.9 g/plant), Average boll weight (3.5 g), Ginning outturn (36.8%), Seed Index (10.4 g), Lint Index (5.8 g), Boll volume upto (21.2 cc). The fibre properties parameter of the genetic stock CSLL-59 are as under.

Staple length (mm)	: 19.5
Uniformity Ratio	: 53
Micronaire	: 6.6
Fibre bundle strength (g/tex)	: 15.3

Cup shape leaf lobe is a marker trait and can be utilized in breeding programme for development of promising distinct varieties and hybrids with specific unique traits. The cup shape leaf lobes are unique, novel and distinct character. Therefore, further investigations are needed to study reactions to pests and diseases.

41. PT-2 (INGR 10063; IC 0584318), Shisham (*Dalbergia sissoo* Roxb.) Germplasm with Straightness of Main Stem with Few and Small Secondary Branches

K Gupta, SP Ahlawat, RV Kumar and A Datta
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Shisham is known internationally as a premier timber species of rose wood genus generally, shisham has spreading type canopy which suppress yield of lower storey crops significantly in agroforestry system as well as reduce the price of wood. At National Research Centre for Agroforestry (NRCAF), Jhansi, efforts were made to select germplasm which have straight bole with high wood volume for better return in agroforestry system as well as in pure plantation. To achieve the goal survey was made in January 1994 of Bundelkhand region for selection of plus trees and to collect their seeds. Selection was made on the basis of straightness, fast growth and clear bole height. Total 35 collections were made. Out of collected germplasm, 12-month old seedlings of 14 plus trees, two composites and one selection of

genetic stock. The appearances of yellow pigment in leaves are maintained upto harvesting stage. The stability and uniformity of yellow pigmentation characters in leaf is of perpetual nature and it was observed over generations by the repeated course of sowing. The genetic stock YPLL-29 possesses the following economic characters viz, Average seed cotton yield (28.9 g/plant), Average boll weight (2.3 g), Ginning outturn (36.9%), Seed Index (6.5 g), Lint Index (3.5 g) and Boll Volume upto (17.6 cc). The genetic stock YPLL-29 possesses the following fibre properties.

Staple length (mm)	: 26.3
Uniformity Ratio	: 58.0
Micronaire	: 4.9
Fibre bundle strength (g/tex)	: 17.6

The genetic stock YPLL-29 yellow pigmented leaf lobe (Marker character) can be used in breeding programme for development of varieties/hybrids, which can be identified and distinguished from other cultivars of *Gossypium* at morphological level.

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The Genetic Stock CSLL-59 (*Gossypium hirsutum,* race: *Latifolium) possesses* 3-5 lobed palmately broad cup shaped leaf. At flowering stage the peripheral region of leaf lobe gradually lead to vertical growth. The central portion of leaf lobe maintained the horizontal shape. Consequently the central lobe of leaf develop a depression and zone of elongation forming a cup like shape. The cup shape leaf lobe is unique and novel marker character and stable over generations. The above genetic stock possesses the economic characters *viz.*, Average seed cotton yield (32.9 g/plant), Average boll weight (3.5 g), Ginning outturn (36.8%), Seed Index (10.4 g), Lint Index (5.8 g), Boll volume upto (21.2 cc). The fibre properties parameter of the genetic stock CSLL-59 are as under.

Staple length (mm)	: 19.5
Uniformity Ratio	: 53
Micronaire	: 6.6
Fibre bundle strength (g/tex)	: 15.3

Cup shape leaf lobe is a marker trait and can be utilized in breeding programme for development of promising distinct varieties and hybrids with specific unique traits. The cup shape leaf lobes are unique, novel and distinct character. Therefore, further investigations are needed to study reactions to pests and diseases.

41. PT-2 (INGR 10063; IC 0584318), Shisham (*Dalbergia sissoo* Roxb.) Germplasm with Straightness of Main Stem with Few and Small Secondary Branches

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Shisham is known internationally as a premier timber species of rose wood genus generally, shisham has spreading type canopy which suppress yield of lower storey crops significantly in agroforestry system as well as reduce the price of wood. At National Research Centre for Agroforestry (NRCAF), Jhansi, efforts were made to select germplasm which have straight bole with high wood volume for better return in agroforestry system as well as in pure plantation. To achieve the goal survey was made in January 1994 of Bundelkhand region for selection of plus trees and to collect their seeds. Selection was made on the basis of straightness, fast growth and clear bole height. Total 35 collections were made. Out of collected germplasm, 12-month old seedlings of 14 plus trees, two composites and one selection of

genetic stock. The appearances of yellow pigment in leaves are maintained upto harvesting stage. The stability and uniformity of yellow pigmentation characters in leaf is of perpetual nature and it was observed over generations by the repeated course of sowing. The genetic stock YPLL-29 possesses the following economic characters viz, Average seed cotton yield (28.9 g/plant), Average boll weight (2.3 g), Ginning outturn (36.9%), Seed Index (6.5 g), Lint Index (3.5 g) and Boll Volume upto (17.6 cc). The genetic stock YPLL-29 possesses the following fibre properties.

Staple length (mm)	: 26.3
Uniformity Ratio	: 58.0
Micronaire	: 4.9
Fibre bundle strength (g/tex)	: 17.6

The genetic stock YPLL-29 yellow pigmented leaf lobe (Marker character) can be used in breeding programme for development of varieties/hybrids, which can be identified and distinguished from other cultivars of *Gossypium* at morphological level.

40. CSLL-59 (IC 0583999; INGR 10062), Cotton (*Gossypium hirsutum*) Germplam, with Cup Shaped Leaf Lobe a Marker Trait

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(E-mail: punitmohan@gmail.com)

The Genetic Stock CSLL-59 (*Gossypium hirsutum,* race: *Latifolium) possesses* 3-5 lobed palmately broad cup shaped leaf. At flowering stage the peripheral region of leaf lobe gradually lead to vertical growth. The central portion of leaf lobe maintained the horizontal shape. Consequently the central lobe of leaf develop a depression and zone of elongation forming a cup like shape. The cup shape leaf lobe is unique and novel marker character and stable over generations. The above genetic stock possesses the economic characters *viz.*, Average seed cotton yield (32.9 g/plant), Average boll weight (3.5 g), Ginning outturn (36.8%), Seed Index (10.4 g), Lint Index (5.8 g), Boll volume upto (21.2 cc). The fibre properties parameter of the genetic stock CSLL-59 are as under.

Staple length (mm)	: 19.5
Uniformity Ratio	: 53
Micronaire	: 6.6
Fibre bundle strength (g/tex)	: 15.3

Cup shape leaf lobe is a marker trait and can be utilized in breeding programme for development of promising distinct varieties and hybrids with specific unique traits. The cup shape leaf lobes are unique, novel and distinct character. Therefore, further investigations are needed to study reactions to pests and diseases.

41. PT-2 (INGR 10063; IC 0584318), Shisham (*Dalbergia sissoo* Roxb.) Germplasm with Straightness of Main Stem with Few and Small Secondary Branches

K Gupta, SP Ahlawat, RV Kumar and A Datta
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Haryana Agricultural University, Haryana were planted along with control in two sites (cultivated land and degraded land) at Central Farm of NRCAF, Jhansi. Data on straightness was recorded on 5 point scaling (1= highly crooked, 5 = maximum straight) at the age of 2.5 years and visually observed upto 9.5 years. Data on tree height and diameter at breast height were recorded at the age of 9.5 years. Bole volume was calculated as per volume equation.

Table 1. Straightness scoring of clean bole of PT–2 at 2.5 years age

Year	PT–2	Check variety	% increase over check
1998 at site I	3.59	2.12	69.34
1998 at site II	4.42	2.00	121.00

Table 2. Bole volume (m^3ha^{-1}) of PT–2 at 9.5 years age

Year	PT–2	Check variety	% increase over check
1998 at site I	43.44	25.71	68.96
1998 at site II	20.59	12.31	67.26

Morpho-agronomic Characteristics

PT-2, selected near Saprar Dam, tehsil Mahuranipur, district Jhansi, is highly straight germplasm. This progeny obtained 3.59 and 4.42 score out of 5 at site I (cultivated land) and site II (degraded land), respectively (Table 1). While local race obtained 2.12 and 2.00 score in two sites, respectively. Percentage superiority in term of straightness was 69 and 121 at two sites, respectively. Wood volume estimated at the age of 9.5 year. PT-2 is 69% and 67% superior over local at site I and site II, respectively (Table 2)

Associated Characters and Cultivated Practices

Besides this, branches are short and less compared to local race. Crown is cylindrical, butt and pockets are absent. Bark is semi-smooth with shallow longitudinal fissures and dark in colour.

PT-2 is promising germplasm of shisham in Agroforestry system to obtain more return from the system as a whole.

42. NS/2009/042 (IC0571819; INGR10064), Bottle gourd (*Lagenaria siceraria* L.) Germplasm, a Rare and Unique Bottle Gourd Accession with Spindle Shaped Fruits with Hard Durable Rind

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Bottle gourd (*Lagenaria siceraria* L.) is one of the popular cucurbitaceous vegetable crops grown in India and other parts of the world. The bottle gourd is a warm season crop and grows best in tropical humid climate. Andhra Pradesh is endowed with rich genetic diversity in bottle gourd especially with varied fruit shape and size. While the immature fruits are used as a vegetable by the general population, the dried fruit shells of suitable shape and size apt for different household purposes are in extensive use exclusively by the tribal communities. The extent of available diversity for fruit shape in bottle gourd in India and elsewhere is reported in literature. During a collection mission undertaken in February 2009 in the Telangana region of Andhra Pradesh, the survey team stumbled upon a bottle gourd landrace of rare occurrence in Nagaram, Parakala Mandal of Warangal district having spindle shaped fruits. This landrace vernacularly referred as *Anapakaya/ Sorakaya* (Sivaraj *et al.*, 2009) has been assigned a collector number NS/2009/042 and an indigenous collector number IC571819.

The morpho-agronomic description is as follows: An annual, monoecious climber with robust, longitudinally furrowed stem, hairy, gland dotted; tendrils bifid; leaves 20-25 cm long, petiole with two glands at joints, lamina ovate with cordate base, dentate, lobed; flowers solitary axillary, calyx tube companulate, petals 5, free, white, woolly, 3-5 × 2.5-4.0 cm; male flowers on long peduncles, filaments 3, free, anthers white; female flowers on short robust peduncles, stigma-3, bifid. Fruit exhibits a unique spindle shape with hard durable rind (5.2 mm thickness). Other fruit and seed characters of the germplasm accession are: fruit length (33.0 cm), fruit circumference (51.0 cm), fruit width (25.3 cm), seed length (17.3 mm), seed width (6.3 mm) and 100-seed mass (13.5 g). Seeds are many, compressed, whitish grey in colour. Young fruits are green in colour turning to yellow and then to grey on maturity. The general

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Besides this, branches are short and less compared to local race. Crown is cylindrical, butt and pockets are absent. Bark is semi-smooth with shallow longitudinal fissures and dark in colour.

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recommended package of practices for bottle gourd could be followed for cultivation of this particular accession as well.

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43. Coll. No. V 90/P-92 (IC266417; INGR10065), a Black pepper (*Piper nigrum* L.) Germplasm with Oval Shaped Berries

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Black pepper (*Piper nigrum* L.) with a monocentric origin in a limited geographic area lying in tropical region with high rainfall on the western slopes and plateau region of southern Western Ghats has a short history as a crop but has longer commercial history as a forest produce. Cultivar diversity is richest in Kerala followed by Karnatatka. Around hundred cultivars have been reported from southern region of India. IC266417, collected from Ithikkara, Kollam, Kerala, India, a member of race-1 (*Kariyilanchi*) is registered for its unique oval shaped berries. The collections were divided subjectively into two races (race-1 and race-2) based on two associated characters such as berry shape and pace of colour change in ripening berries. On the basis of berry shape and the time taken for berry colour change in ripening berries, two distinct cultivar groups such as oval and spherical berry bearing types were identified. The size of berry varied in both cultivar groups. The first group hailing from southern Kerala contained seven accessions with oval berries, more pronounced and uniform yellow colour of mature berries and uniformly larger berries. The large berry size is commercially a useful character. The second group included ninety six accessions with round berry, less uniform yellow colour in mature berries and with highly varying berry size from small to large. This group is uniformly distributed all over in the pepper growing areas in Kerala and Karnataka and as wild in forest areas. The two races identified were named as '*Kariyilanchi*' for race-1 and '*Karimunda*' for the race-2 as these were representative common cultivars of black pepper in the region. Among these two races, race 2 is more common than race-1. The accession IC266417 is characterized by climbing plant growth habit, polymorphic branching type with production of many runners, glabrescent stem, horizontal lateral branches, ovate-elliptic leaves, wavy leaf margin, campylodromous leaf venation pattern, leaf hairs present all over, absence of leaf scales, flowers sessile and arranged free on spikes, filiform, less compact, glabrescent and fragrant spikes with medium sized berries turning slowly from green to red on maturity. The vine is 150 cm high, spike length 7.1 cm, 3 spikes/lateral branch, 24 spikes/vine, 5 bisexual flowers/spike, total berry weight 204 g, dry weight of berry 28.19%, 100 berry weight 10.75 g and volume 10.75 g.

44. YCMS-12A (IC0583131; INGR10066), a Sweet Pepper (*Capsicum annuum*) Germplasm with Male Sterility (Genetic), Bell Shaped Fruits and Non-Pungent Background

PR Kumar[1], SR Sharma[1], Chander Parkash[1], SK Yadav[2] and Reeta Bhatia[1]
[1]Indian Agricultural Research Institute, Regional Station, Katrain, Kullu Valley, Himachal Pradesh -175 129
[2]Division of Germplasm Evaluation, National Bureau of Plant Genetic Resources, New Delhi-110 012
(E-mail: ourprk@gmail.com)

Male sterile plants of hot pepper (ms-12) were obtained from PAU, Ludhiana in 2007 and planted at experimental farm of IARI, Regional Station, Katrain. This line contains *ms-509* gene (Pochard, 1970) which is recessive nuclear

recommended package of practices for bottle gourd could be followed for cultivation of this particular accession as well.

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Male sterile plants of hot pepper (ms-12) were obtained from PAU, Ludhiana in 2007 and planted at experimental farm of IARI, Regional Station, Katrain. This line contains *ms-509* gene (Pochard, 1970) which is recessive nuclear

gene controlling male sterility. The sterile plants were crossed with a number of lines of sweet pepper and a paprika variety viz., KtPl-19. An organoleptic comparison for pungency was carried out. It was found that one cross viz., ms-12 X Yellow Capsicum was the least pungent among the array of crosses. The second filial generation (F_2) seed of this cross was obtained by selfing. The F_2 generation was grown in glasshouse and screened for male sterility with help of microscopic test for pollen viability using acetocarmine stain. Out of 261 plants 63 were found to be male sterile. These sterile plants were pollinated with pollen of Yellow Capsicum (the recipient parent). Upon fruit setting an organoleptic test was again carried out to identify non-pungent plants if any. A total of 6 non-pungent plants were isolated out of which 3 plants bore bell shaped 3-4 lobed fruits and 3 plants had conical fruits. One of the 3 plants with bell shaped fruits had greener and larger fruits with greater resemblance with the recurrent parent. This single plant was used for further maintenance of male sterility in bell pepper background. This plant is now being maintained with the recurrent parent i.e., Yellow Capsicum since 2007. Two crops were taken each year, one in open field during summers and another in glass house during winters.

Morpho-agronomic characters

The plants bear a total of 14-16 pendant dark green 3-4 lobed fruits with an average weight of 70-75g. The average height of the plants is 45-55 cm. Plants possess moderate branching habit. In 2009 it was found that enough bee visit is there on flowers and each plant produces on an average more than 2500 seed amounting to more than 7 g seeds/plant, thus presenting a good prospect of hybrid seed production without deploying human labour for emasculation and pollination.

Associated Characters and Cultivation Practices

The fruits turn yellow on ripening, therefore, this line can be used for breeding hybrids with coloured fruits. The line is moderately tolerant to water logging and resistant to fusarium wilt. The nursery is sown in March in hills and transplanted to main field in May. It comes to flowering after 40-45 days of transplanting and first harvesting can be done after 65 days of transplanting. Ripened or coloured fruits can be harvested after 85 days of transplanting. Crop duration is longer and yield is higher under protected cultivation. The male sterile line can be multiplied using tissue culture technique also.

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45. IIHGR-5, IIHR-84-7-11 (IC0584125; INGR10067), a Gladioli (*Gladiolus grandiflorous*) Germplasm with floret colour: (Based on R.H.S. colour chart) Purple-violet (82.C) having Red-Purple (72.B) margin with Yellow-Green (154.D) blotch

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46. IIHRG-9, IIHR-87-7-11 (IC0584126; INGR10068), a Gladioli (*Gladiolus grandiflorous*) Germplasm with Floret Colour: (Based on RHS Colour chart) Yellow (4.C) having Yellow (6.C) Lower Lip with Red (39.A) blotch

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gene controlling male sterility. The sterile plants were crossed with a number of lines of sweet pepper and a paprika variety viz., KtPl-19. An organoleptic comparison for pungency was carried out. It was found that one cross viz., ms-12 X Yellow Capsicum was the least pungent among the array of crosses. The second filial generation (F_2) seed of this cross was obtained by selfing. The F_2 generation was grown in glasshouse and screened for male sterility with help of microscopic test for pollen viability using acetocarmine stain. Out of 261 plants 63 were found to be male sterile. These sterile plants were pollinated with pollen of Yellow Capsicum (the recipient parent). Upon fruit setting an organoleptic test was again carried out to identify non-pungent plants if any. A total of 6 non-pungent plants were isolated out of which 3 plants bore bell shaped 3-4 lobed fruits and 3 plants had conical fruits. One of the 3 plants with bell shaped fruits had greener and larger fruits with greater resemblance with the recurrent parent. This single plant was used for further maintenance of male sterility in bell pepper background. This plant is now being maintained with the recurrent parent i.e., Yellow Capsicum since 2007. Two crops were taken each year, one in open field during summers and another in glass house during winters.

Morpho-agronomic characters

The plants bear a total of 14-16 pendant dark green 3-4 lobed fruits with an average weight of 70-75g. The average height of the plants is 45-55 cm. Plants possess moderate branching habit. In 2009 it was found that enough bee visit is there on flowers and each plant produces on an average more than 2500 seed amounting to more than 7 g seeds/plant, thus presenting a good prospect of hybrid seed production without deploying human labour for emasculation and pollination.

Associated Characters and Cultivation Practices

The fruits turn yellow on ripening, therefore, this line can be used for breeding hybrids with coloured fruits. The line is moderately tolerant to water logging and resistant to fusarium wilt. The nursery is sown in March in hills and transplanted to main field in May. It comes to flowering after 40-45 days of transplanting and first harvesting can be done after 65 days of transplanting. Ripened or coloured fruits can be harvested after 85 days of transplanting. Crop duration is longer and yield is higher under protected cultivation. The male sterile line can be multiplied using tissue culture technique also.

References

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46. IIHRG-9, IIHR-87-7-11 (IC0584126; INGR10068), a Gladioli (*Gladiolus grandiflorous*) Germplasm with Floret Colour: (Based on RHS Colour chart) Yellow (4.C) having Yellow (6.C) Lower Lip with Red (39.A) blotch

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47. IIHRG-10, IIHR-87-22-1 (IC0584127; INGR10069), a Gladioli (*Gladiolus grandiflorous*) germplasm, with Resistance to *Fusarium* Wilt Disease cause by *Fusarium oxysporum f.*sp.*gladioli race 1*. Floret colour: (Based on R.H.S. Colour Chart) Red (46.D) having Red (45.B) margin and White line on tepals with Yellow (2.C) blotch

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48. IIHRP-2-28-1 (IC0584135; INGR10070) and IIHRP-3-18-2 (IC0584136; INGR10071) Rose (*Rosa hybrida*) Germplasm, with Shining Foliage, Unique Bicolor consisting Vermillion Red Shading towards Orient Pink; Less Thorns, Straight Stalk of Cut Flower Quality, Light Pink Flowers with Pointed Bud and High Centre

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IIHRP-2-28-1: In flower crops color combinations of flower and foliage adds to the aesthetic value of a genotype. IIHRP-2-28-1 was selected particularly for its aesthetic value with attractive flower color along with glossy foliage. It is a selected seedling from half sib progeny population of Folklore. This particular genotype is of importance as it has exhibited good yield capacity and with less number of thorns that are important features for cut flowers. Attractive

Table 1. Colours of selected genotypes on various petal parts according to RHS colour chart

Genotype	Front	Back	Tip	Centre	Basal	Colour group
IIHRP–2.28.1	41B	56C	41B	41B	158C	Red&Purple
IIHRP–3.18.2	155B	155B	155B	155B	155B	White

Table 2. Morphological characters of selected rose genotypes of IIHR in comparison with commercial varieties

Lines/ varieties	Stalk length	Bud length	Flower length	Flower width	Pedicel length	Petal Number
IIHRP–2.28.1	61.6	3.8	4.7	9.8	5.9	43.6
IIHRP–3.18.2	57.6	4.7	5.0	10.7	10.1	35.1
Carvetty	50.1	3.8	4.4	8.6	7.1	20.0
Diplomat	71.0	4.3	4.6	10.0	9.3	33.2
First Red	50.9	3.4	3.6	7.4	7.1	29.9
Konfetty	59.4	3.4	3.6	8.0	5.6	26.2
CD @5%	0.7	0.6	0.7	1.5	2.3	16.0
CV	0.6	12.8	8.4	13.4	15.5	16.5

Table 3. Number of thorns on various selected rose lines in comparison with commercial varieties (Thorns/10cm stalk)

Lines/ Varieties	Thorns (big)	Thorns (small)
IIHRP–3.18.2	0.8	0.0
IIHRP–2.28.1	2.0	0.0
Carvetty	4.0	4.4
Diplomat	10.6	8.0
First red	4.6	0.0
Konfetty	7.2	0.0
CD @5%	4.9	21.0

flower color and shining foliage with good branching pattern would make it a good option for production of pot plants that can be taken for interior as well as for landscape ornamental value.

Flowers of IIHRP-2-28-1 are bicolor and attractive. The advanced breeding line of rose IIHRP-2-28-1 is registered with NBPGR, with a registration number INGR no. 10070 for its unique bicolor consisting vermilion red shading towards orient pink with dark green glossy foliage. Flowers are born in clusters with long stalk. Flowers are of medium size with a flower bud length of 4.50-5 cm, with number of petals ranging from 35 to 40.

IIHRP-3-18-2: It is a selection from induced mutants of the variety 'Dr. GS Randhwa' at 80 Gy. IIHRP–3-18-2 was selected for its straight stalk and less thorns. It has exhibited high yield capacity along with qualities of cut flower. Attractive pink colored flower with pointed buds makes it viable for its potential utility as a cut flower. IIHRP-3-18-2 is registered with NBPGR, for its straight stalk and less thorns with the registration number, INGR No. 10071.

50. IIHRP-13 (IC0574579; INGR10072) Rose (*Rosa hybrida*) Germplasm with Fragrance and Field Tolerance to Thrips

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Thrips (*Scriptothrips dorsalis*) have become a major production constraint in rose cultivation. Characteristic feature of rose fragrance is being lost in modern varieties. IIHRP-13 is a fragrant rose line registered for its unique characteristics of fragrance and field tolerance to thrips. Salient characteristic features of the genotypes are i) The genotype has field tolerance to thrips and fragrance ii) IIHRP-13 was found promising for cultivation in open field for loose flower purpose (Table 1) iii) It has red colored fragrant flowers (RHS colour chart 61 C) under red purple category.

Rose breeding program at IIHR concentrates on developing varieties for commercial production having pest tolerance. As an outcome of this breeding program, out of several advanced lines developed, IIHR P-13 has been identified as superior genotype for higher yield over the ruling checks with filed tolerance to thrips. It has all the desired traits for cultivation in open field. IIHRP-13 is a selection from half sib progenies of rose variety 'Red Chief'.

Screening for thrips was done in polyhouse condition during maximum infestation under highest threshold level of thrips incidence. The accessions were scored in 1-10 scale, with 1 being highly resistant and 10 as highly susceptible based on severity of thrips damage. IIHRP-13 along with other advanced lines and two commercial varieties namely First Red and Grand gala as checks were scored for damage on various plant parts and also for whole plant.

Based on different plant parts of rose screened for resistance to thrips, *S.dorsalis*, IIHRP-13 showed significantly lower damage with reference to leaves (2.33), buds (2.66) and flowers (1.33). IIHRP-13 was considered to be field tolerant to thrips and with fragrant red flowers its registered as a valuable genetic stock.

Table1. Pooled means for yield and related characters

Genotypes	Plant height (cm)	No. of branches	Flower length (cm)	Flower diameter (cm)	Number of petals	Shelf life (days)	Pinch flower yield/plant/year
Wobourn Gold	77.4	4.87	4.41	8.29	25.89	4.70	123.2
IIHRP–15	83.7	5.31	4.02	6.44	23.33	5.33	136.6
Red Chief	80.8	5.26	5.69	8.33	31.00	5.55	52
IIHRP–13	111.9	5.15	5.02	8.62	34.56	4.78	82
Mulla Hybrid	93.7	4.19	5.72	11.14	54.56	3.78	52
Sophia Laurens	112.5	3.91	5.31	8.89	40.44	3.11	52
CD@5%	6.023	0.73	0.38	0.53	2.64	0.57	8.62
CD@1%	8.44	1.02	0.53	0.75	3.70	0.80	12.1

gene controlling male sterility. The sterile plants were crossed with a number of lines of sweet pepper and a paprika variety viz., KtPl-19. An organoleptic comparison for pungency was carried out. It was found that one cross viz., ms-12 X Yellow Capsicum was the least pungent among the array of crosses. The second filial generation (F_2) seed of this cross was obtained by selfing. The F_2 generation was grown in glasshouse and screened for male sterility with help of microscopic test for pollen viability using acetocarmine stain. Out of 261 plants 63 were found to be male sterile. These sterile plants were pollinated with pollen of Yellow Capsicum (the recipient parent). Upon fruit setting an organoleptic test was again carried out to identify non-pungent plants if any. A total of 6 non-pungent plants were isolated out of which 3 plants bore bell shaped 3-4 lobed fruits and 3 plants had conical fruits. One of the 3 plants with bell shaped fruits had greener and larger fruits with greater resemblance with the recurrent parent. This single plant was used for further maintenance of male sterility in bell pepper background. This plant is now being maintained with the recurrent parent i.e., Yellow Capsicum since 2007. Two crops were taken each year, one in open field during summers and another in glass house during winters.

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The fruits turn yellow on ripening, therefore, this line can be used for breeding hybrids with coloured fruits. The line is moderately tolerant to water logging and resistant to fusarium wilt. The nursery is sown in March in hills and transplanted to main field in May. It comes to flowering after 40-45 days of transplanting and first harvesting can be done after 65 days of transplanting. Ripened or coloured fruits can be harvested after 85 days of transplanting. Crop duration is longer and yield is higher under protected cultivation. The male sterile line can be multiplied using tissue culture technique also.

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48. IIHRP-2-28-1 (IC0584135; INGR10070) and IIHRP-3-18-2 (IC0584136; INGR10071) Rose (*Rosa hybrida*) Germplasm, with Shining Foliage, Unique Bicolor consisting Vermillion Red Shading towards Orient Pink; Less Thorns, Straight Stalk of Cut Flower Quality, Light Pink Flowers with Pointed Bud and High Centre

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flower color and shining foliage with good branching pattern would make it a good option for production of pot plants that can be taken for interior as well as for landscape ornamental value.

Flowers of IIHRP-2-28-1 are bicolor and attractive. The advanced breeding line of rose IIHRP-2-28-1 is registered with NBPGR, with a registration number INGR no. 10070 for its unique bicolor consisting vermilion red shading towards orient pink with dark green glossy foliage. Flowers are born in clusters with long stalk. Flowers are of medium size with a flower bud length of 4.50-5 cm, with number of petals ranging from 35 to 40.

IIHRP-3-18-2: It is a selection from induced mutants of the variety 'Dr. GS Randhwa' at 80 Gy. IIHRP–3-18-2 was selected for its straight stalk and less thorns. It has exhibited high yield capacity along with qualities of cut flower. Attractive pink colored flower with pointed buds makes it viable for its potential utility as a cut flower. IIHRP-3-18-2 is registered with NBPGR, for its straight stalk and less thorns with the registration number, INGR No. 10071.

50. IIHRP-13 (IC0574579; INGR10072) Rose (*Rosa hybrida*) Germplasm with Fragrance and Field Tolerance to Thrips

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Thrips (*Scriptothrips dorsalis*) have become a major production constraint in rose cultivation. Characteristic feature of rose fragrance is being lost in modern varieties. IIHRP-13 is a fragrant rose line registered for its unique characteristics of fragrance and field tolerance to thrips. Salient characteristic features of the genotypes are i) The genotype has field tolerance to thrips and fragrance ii) IIHRP-13 was found promising for cultivation in open field for loose flower purpose (Table 1) iii) It has red colored fragrant flowers (RHS colour chart 61 C) under red purple category.

Rose breeding program at IIHR concentrates on developing varieties for commercial production having pest tolerance. As an outcome of this breeding program, out of several advanced lines developed, IIHR P-13 has been identified as superior genotype for higher yield over the ruling checks with filed tolerance to thrips. It has all the desired traits for cultivation in open field. IIHRP-13 is a selection from half sib progenies of rose variety 'Red Chief'.

Screening for thrips was done in polyhouse condition during maximum infestation under highest threshold level of thrips incidence. The accessions were scored in 1-10 scale, with 1 being highly resistant and 10 as highly susceptible based on severity of thrips damage. IIHRP-13 along with other advanced lines and two commercial varieties namely First Red and Grand gala as checks were scored for damage on various plant parts and also for whole plant.

Based on different plant parts of rose screened for resistance to thrips, *S.dorsalis*, IIHRP-13 showed significantly lower damage with reference to leaves (2.33), buds (2.66) and flowers (1.33). IIHRP-13 was considered to be field tolerant to thrips and with fragrant red flowers its registered as a valuable genetic stock.

Table1. Pooled means for yield and related characters

Genotypes	Plant height (cm)	No. of branches	Flower length (cm)	Flower diameter (cm)	Number of petals	Shelf life (days)	Pinch flower yield/plant/year
Wobourn Gold	77.4	4.87	4.41	8.29	25.89	4.70	123.2
IIHRP–15	83.7	5.31	4.02	6.44	23.33	5.33	136.6
Red Chief	80.8	5.26	5.69	8.33	31.00	5.55	52
IIHRP–13	111.9	5.15	5.02	8.62	34.56	4.78	82
Mulla Hybrid	93.7	4.19	5.72	11.14	54.56	3.78	52
Sophia Laurens	112.5	3.91	5.31	8.89	40.44	3.11	52
CD@5%	6.023	0.73	0.38	0.53	2.64	0.57	8.62
CD@1%	8.44	1.02	0.53	0.75	3.70	0.80	12.1

47. IIHRG-10, IIHR-87-22-1 (IC0584127; INGR10069), a Gladioli (*Gladiolus grandiflorous*) germplasm, with Resistance to *Fusarium* Wilt Disease cause by *Fusarium oxysporum f.*sp.*gladioli race 1*. Floret colour: (Based on R.H.S. Colour Chart) Red (46.D) having Red (45.B) margin and White line on tepals with Yellow (2.C) blotch

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48. IIHRP-2-28-1 (IC0584135; INGR10070) and IIHRP-3-18-2 (IC0584136; INGR10071) Rose (*Rosa hybrida*) Germplasm, with Shining Foliage, Unique Bicolor consisting Vermillion Red Shading towards Orient Pink; Less Thorns, Straight Stalk of Cut Flower Quality, Light Pink Flowers with Pointed Bud and High Centre

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Rose is the most admired and adored aristocratic flower in India. Even before the entry of cut flower industry rose was being cultivated in public and private gardens. Present day commercial cultivation of cut roses is dependent upon varieties being imported from well established commercial breeders of temperate countries. Rose breeding program in India was concentrated on aesthetic appeal of flowers. With the expanding commercial cultivation of roses, the rose breeding objectives in India has shifted from garden roses to commercial cut flowers. Rose breeding program at Indian Institute of Horticulture Research, has resulted several progenies that are being evaluated for various desired characters. With the commercial cultivation of roses, it is essential to protect important lines developed in breeding program and needs to be safeguarded by registration.

IIHRP-2-28-1: In flower crops color combinations of flower and foliage adds to the aesthetic value of a genotype. IIHRP-2-28-1 was selected particularly for its aesthetic value with attractive flower color along with glossy foliage. It is a selected seedling from half sib progeny population of Folklore. This particular genotype is of importance as it has exhibited good yield capacity and with less number of thorns that are important features for cut flowers. Attractive

Table 1. Colours of selected genotypes on various petal parts according to RHS colour chart

Genotype	Front	Back	Tip	Centre	Basal	Colour group
IIHRP–2.28.1	41B	56C	41B	41B	158C	Red&Purple
IIHRP–3.18.2	155B	155B	155B	155B	155B	White

Table 2. Morphological characters of selected rose genotypes of IIHR in comparison with commercial varieties

Lines/ varieties	Stalk length	Bud length	Flower length	Flower width	Pedicel length	Petal Number
IIHRP–2.28.1	61.6	3.8	4.7	9.8	5.9	43.6
IIHRP–3.18.2	57.6	4.7	5.0	10.7	10.1	35.1
Carvetty	50.1	3.8	4.4	8.6	7.1	20.0
Diplomat	71.0	4.3	4.6	10.0	9.3	33.2
First Red	50.9	3.4	3.6	7.4	7.1	29.9
Konfetty	59.4	3.4	3.6	8.0	5.6	26.2
CD @5%	0.7	0.6	0.7	1.5	2.3	16.0
CV	0.6	12.8	8.4	13.4	15.5	16.5

Table 3. Number of thorns on various selected rose lines in comparison with commercial varieties (Thorns/10cm stalk)

Lines/ Varieties	Thorns (big)	Thorns (small)
IIHRP–3.18.2	0.8	0.0
IIHRP–2.28.1	2.0	0.0
Carvetty	4.0	4.4
Diplomat	10.6	8.0
First red	4.6	0.0
Konfetty	7.2	0.0
CD @5%	4.9	21.0

flower color and shining foliage with good branching pattern would make it a good option for production of pot plants that can be taken for interior as well as for landscape ornamental value.

Flowers of IIHRP-2-28-1 are bicolor and attractive. The advanced breeding line of rose IIHRP-2-28-1 is registered with NBPGR, with a registration number INGR no. 10070 for its unique bicolor consisting vermilion red shading towards orient pink with dark green glossy foliage. Flowers are born in clusters with long stalk. Flowers are of medium size with a flower bud length of 4.50-5 cm, with number of petals ranging from 35 to 40.

IIHRP-3-18-2: It is a selection from induced mutants of the variety 'Dr. GS Randhwa' at 80 Gy. IIHRP–3-18-2 was selected for its straight stalk and less thorns. It has exhibited high yield capacity along with qualities of cut flower. Attractive pink colored flower with pointed buds makes it viable for its potential utility as a cut flower. IIHRP-3-18-2 is registered with NBPGR, for its straight stalk and less thorns with the registration number, INGR No. 10071.

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Thrips (*Scriptothrips dorsalis*) have become a major production constraint in rose cultivation. Characteristic feature of rose fragrance is being lost in modern varieties. IIHRP-13 is a fragrant rose line registered for its unique characteristics of fragrance and field tolerance to thrips. Salient characteristic features of the genotypes are i) The genotype has field tolerance to thrips and fragrance ii) IIHRP-13 was found promising for cultivation in open field for loose flower purpose (Table 1) iii) It has red colored fragrant flowers (RHS colour chart 61 C) under red purple category.

Rose breeding program at IIHR concentrates on developing varieties for commercial production having pest tolerance. As an outcome of this breeding program, out of several advanced lines developed, IIHR P-13 has been identified as superior genotype for higher yield over the ruling checks with filed tolerance to thrips. It has all the desired traits for cultivation in open field. IIHRP-13 is a selection from half sib progenies of rose variety 'Red Chief'.

Screening for thrips was done in polyhouse condition during maximum infestation under highest threshold level of thrips incidence. The accessions were scored in 1-10 scale, with 1 being highly resistant and 10 as highly susceptible based on severity of thrips damage. IIHRP-13 along with other advanced lines and two commercial varieties namely First Red and Grand gala as checks were scored for damage on various plant parts and also for whole plant.

Based on different plant parts of rose screened for resistance to thrips, *S.dorsalis*, IIHRP-13 showed significantly lower damage with reference to leaves (2.33), buds (2.66) and flowers (1.33). IIHRP-13 was considered to be field tolerant to thrips and with fragrant red flowers its registered as a valuable genetic stock.

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Mulla Hybrid	93.7	4.19	5.72	11.14	54.56	3.78	52
Sophia Laurens	112.5	3.91	5.31	8.89	40.44	3.11	52
CD@5%	6.023	0.73	0.38	0.53	2.64	0.57	8.62
CD@1%	8.44	1.02	0.53	0.75	3.70	0.80	12.1

flower color and shining foliage with good branching pattern would make it a good option for production of pot plants that can be taken for interior as well as for landscape ornamental value.

Flowers of IIHRP-2-28-1 are bicolor and attractive. The advanced breeding line of rose IIHRP-2-28-1 is registered with NBPGR, with a registration number INGR no. 10070 for its unique bicolor consisting vermilion red shading towards orient pink with dark green glossy foliage. Flowers are born in clusters with long stalk. Flowers are of medium size with a flower bud length of 4.50-5 cm, with number of petals ranging from 35 to 40.

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Rose breeding program at IIHR concentrates on developing varieties for commercial production having pest tolerance. As an outcome of this breeding program, out of several advanced lines developed, IIHR P-13 has been identified as superior genotype for higher yield over the ruling checks with filed tolerance to thrips. It has all the desired traits for cultivation in open field. IIHRP-13 is a selection from half sib progenies of rose variety 'Red Chief'.

Screening for thrips was done in polyhouse condition during maximum infestation under highest threshold level of thrips incidence. The accessions were scored in 1-10 scale, with 1 being highly resistant and 10 as highly susceptible based on severity of thrips damage. IIHRP-13 along with other advanced lines and two commercial varieties namely First Red and Grand gala as checks were scored for damage on various plant parts and also for whole plant.

Based on different plant parts of rose screened for resistance to thrips, *S.dorsalis*, IIHRP-13 showed significantly lower damage with reference to leaves (2.33), buds (2.66) and flowers (1.33). IIHRP-13 was considered to be field tolerant to thrips and with fragrant red flowers its registered as a valuable genetic stock.

Table1. Pooled means for yield and related characters

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CD@5%	6.023	0.73	0.38	0.53	2.64	0.57	8.62
CD@1%	8.44	1.02	0.53	0.75	3.70	0.80	12.1

In India, Rose (*Rosa hybrida*) is one of the major flower crops grown in open field cultivation. Commercially rose is cultivated for its flowers and for production of rose oil, rose water, attar and gulkand. Thrips (*Scriptothrips dorsalis*) has become a major production constraint in rose cultivation. With the development of new rose varieties, characteristic feature of rose fragrance is being lost in modern varieties. Rose breeding program at Indian Institute of Horticulture Research has focused objective in combining biotic resistance with attractive color and fragrance. As an outcome of on going rose breeding projects at our institute, a promising line IIHRP-13 has been identified having moderate resistance to thrips and with fragrant flowers. IIHRP-13 is a selection from half sib progenies of rose genotype Red Chief. Evaluation of the genotype in open field and poly house has indicated moderate resistance to thrips. This line has been registered with NBPGR, New Delhi, as a valuable genetic stock with a registration number INGR No. 10072.

Screening for thrips was done in polyhouse condition during maximum infestation under highest threshold level of thrips incidence. The accessions were scored in 1-10 scale, with 1 being highly resistant and 10 as highly susceptible based on severity of thrips damage. IIHRP-13 along with other advanced lines and two commercial varieties namely First Red and Grand gala as checks were scored for damage on various plant parts and also for whole plant. Based on different plant parts of rose screened for resistance to thrips, *S.dorsalis*, IIHRP-13 showed significantly lower damage with reference to leaves (2.33), buds (2.66) and flowers (1.33). The genotype has yield potential of 80-100 flowers per plant per year

Table 2. Evaluation of IIHRP–13 in comparison with commercial varieties for thrips incidence

Advanced line	Damage Rating		
	Leaves	Buds	Flowers
IIHRP–13	2.33 (1.52)	2.66 (1.62)	1.33 (1.14)
First Red	5.66 (2.38)	5.66 (2.38)	2.66 (1.62)
Grand gala	7.00 (2.82)	8.00 (2.82)	4.33 (2.06)
CV (%)	9.5	11.12	13.09
CD at 0.05%	0.15	0.19	0.16

Salient Features of IIHRP-13

1. The genotype is moderately resistant to thrips. (Table 2)
2. It has red colored fragrant flowers. (RHS color chart No. 61 C under Red Purple group)
3. Suitable for open field cultivation with multiple utility as short stalk cut flower and loose flower.
4. With good seed setting ability IIHRP-13 is a valuable genetic stock in breeding program for incorporating fragrance and thrips resistance.
5. It is Hybrid Tea rose, with medium height and flowers of medium size borne as a solitary flower.

51. NRCO-42 (IC0574581; INGR10073), a Orchid (*Dendrobium* hybrid) Germplasm Phalaenopsis Type Hybrid, Broad and Flat Petals, Purple Colour and Big Size Flower

Ramgopal Devadas[1], SP Das[2], Pema C Bhutia[3], P Khatiwara[1], Kesang Lachungpa[3], P Subba[3], RC Upadhyaya[1], RP Medhi[1] and D Barman[1]

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India is largely depending on Southeast Asian countries for importing new Dendrobium hybrids for domestic cut flower marketing and commercial exports. The only synthesized Dendrobium hybrid in India, *D.* "A. Abraham" was developed by Tropical Botanical Garden and Research institute (TBGRI), Kerala in 1986 using *D.* 'Ng Eng Cheow' and *D.* 'Tay Swee Keng' as parents (Gupta *et al*., 2004). In order to fulfill the marketing requirements, the introduction of new variants and hybrids with new characters is invariably required that also helps indirectly to reduce the threatening pressure on their wild species and related genera. A new Dendrobium hybrid, NRCO-42 is developed using *Dendrobium* "Emma White"

In India, Rose (*Rosa hybrida*) is one of the major flower crops grown in open field cultivation. Commercially rose is cultivated for its flowers and for production of rose oil, rose water, attar and gulkand. Thrips (*Scriptothrips dorsalis*) has become a major production constraint in rose cultivation. With the development of new rose varieties, characteristic feature of rose fragrance is being lost in modern varieties. Rose breeding program at Indian Institute of Horticulture Research has focused objective in combining biotic resistance with attractive color and fragrance. As an outcome of on going rose breeding projects at our institute, a promising line IIHRP-13 has been identified having moderate resistance to thrips and with fragrant flowers. IIHRP-13 is a selection from half sib progenies of rose genotype Red Chief. Evaluation of the genotype in open field and poly house has indicated moderate resistance to thrips. This line has been registered with NBPGR, New Delhi, as a valuable genetic stock with a registration number INGR No. 10072.

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Grand gala	7.00 (2.82)	8.00 (2.82)	4.33 (2.06)
CV (%)	9.5	11.12	13.09
CD at 0.05%	0.15	0.19	0.16

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and *Dendrobium* "Pompadour" as female and male parents respectively. The crossing and *in-vitro* rising of progeny was performed during 2003-04 and flowering obtained in 2007-08 was evaluated. This double hybrid flowered with features of moth type Dendrobium (*D. phalaenopsis*-cane type) with bigger petals, overlapping petals and sepals (unlike *D. nobile*-cane types) and purple colored (RHS N78A) having whitish shade at base. Plants grow semi-erect and having slightly stout pseudo-stems (1.5 cm). *Leaves* – 3-7, narrow elliptic, 12-19 cm length, 2.5-2.9 cm width. *Inflorescence* – 22 to 28 cm long emerges from top portion of pseudo-stem with un-branched raceme. The flower size (6.9 cm x 7.7 cm), dorsal sepal size (4 cm x 1.8 cm), lateral sepal size (4.4 cm x 2 cm), petal size (4.4 cm x 3.8 cm) of the new hybrid, showed superiority over both the parents and check cultivar (*D*. "A. Abraham"). Colour enrichment of hybrid over male parent could be due to the parentage of the hybrids used in crossing program and their pedigree record (Devadas *et al*., 2009) and purple floral pigments of flower color of *D*. "Pompadour" were reported due to the presence of two rare anthocyanins (cyanidin 3-(6-malonylglucoside)-7,3'-di(6-sinapyglucoside) and demalonyl derivative and other flavonol glycosides (Williams *et al*., 2002). More numbers of flowers are recorded in female parent, *D*. "Emma White" than F_1 hybrid. The color of lip throat and column was whitish pink and white respectively in F_1 hybrid, and purple and deep purple with creamy white anther cap in check cultivar (*D*. "A. Abraham") respectively helped as phonological markers for recoding differences. Side lobes of lip in new hybrid (NRCO-42) were semi-arching over column, unlike broadly open in male parent and semi open in female parent. Pedigree record of both the parents indicated that the *D. phalaenopsis*, a native species to Australia and New Guinea was used extensively in development of modern hybrids of moth type (or) double humped Dendrobiums. This new hybrid (*D. phalaenopsis*-cane type cultivar) has preference over *D. nobile*-cane type cultivars, due to ever green nature with long branching flowering inflorescence, unlike flowers attached to canes, epiphytic and pendulous in latter case. More over, this hybrid can be used as cut flower, unlike *D. nobile*-cane type cultivars and related species of Asiatic origin (India, Southern China & Burma) that show semi-deciduous nature after flowering and require cool winter phase and cannot be used as cut flowers. This hybrid (NRCO-42) is adjudged as best paper in poster presentation for during 'National Conference of Floriculture for Livelihood and Profitability', 16-19 March, 2009 at IARI, New Delhi. All the characters described support the novelty in the new *D. phalaenopsis*-cane type *i.e.*, moth type hybrid, NRCO-42.

The efforts and dedication of Late Dr V Nagaraju, Ex-Principal Scientist (Horticulture), for raising the progeny is highly remembered and acknowledged.

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52. UHFHYP-I (IC0582480; INGR10074), UHFHYP-II (IC0582481; INGR10075) and UHFHYP-III (IC0582482; INGR10076), St.John's Wort (*Hypericum perforatum*) Germplasm with Semi-Erect, Oblong Lanceolate Leaf; Erect-Oblong Leaf; Prostrate (Decumbent) Obovate Leaf

R Raina, RC Rana, YP Sharma and Asrar-UI-Mustafa

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Hypericum perforatum (St John's Wort), locally known as Bassant and Dendhu in Hindi is chiefly valued as an antidepressant (Newall *et al*., 1924) attributed chiefly due to the active content hypericin present in almost all parts of the plant (Grieve, 1992). Besides, the herb is also used as an astringent, expectorant, diuretic

and *Dendrobium* "Pompadour" as female and male parents respectively. The crossing and *in-vitro* rising of progeny was performed during 2003-04 and flowering obtained in 2007-08 was evaluated. This double hybrid flowered with features of moth type Dendrobium (*D. phalaenopsis*-cane type) with bigger petals, overlapping petals and sepals (unlike *D. nobile*-cane types) and purple colored (RHS N78A) having whitish shade at base. Plants grow semi-erect and having slightly stout pseudo-stems (1.5 cm). *Leaves* – 3-7, narrow elliptic, 12-19 cm length, 2.5-2.9 cm width. *Inflorescence* – 22 to 28 cm long emerges from top portion of pseudo-stem with un-branched raceme. The flower size (6.9 cm x 7.7 cm), dorsal sepal size (4 cm x 1.8 cm), lateral sepal size (4.4 cm x 2 cm), petal size (4.4 cm x 3.8 cm) of the new hybrid, showed superiority over both the parents and check cultivar (*D*. "A. Abraham"). Colour enrichment of hybrid over male parent could be due to the parentage of the hybrids used in crossing program and their pedigree record (Devadas *et al*., 2009) and purple floral pigments of flower color of *D*. "Pompadour" were reported due to the presence of two rare anthocyanins (cyanidin 3-(6-malonylglucoside)-7,3'-di(6-sinapyglucoside) and demalonyl derivative and other flavonol glycosides (Williams *et al*., 2002). More numbers of flowers are recorded in female parent, *D*. "Emma White" than F_1 hybrid. The color of lip throat and column was whitish pink and white respectively in F_1 hybrid, and purple and deep purple with creamy white anther cap in check cultivar (*D*. "A. Abraham") respectively helped as phonological markers for recoding differences. Side lobes of lip in new hybrid (NRCO-42) were semi-arching over column, unlike broadly open in male parent and semi open in female parent. Pedigree record of both the parents indicated that the *D. phalaenopsis*, a native species to Australia and New Guinea was used extensively in development of modern hybrids of moth type (or) double humped Dendrobiums. This new hybrid (*D. phalaenopsis*-cane type cultivar) has preference over *D. nobile*-cane type cultivars, due to ever green nature with long branching flowering inflorescence, unlike flowers attached to canes, epiphytic and pendulous in latter case. More over, this hybrid can be used as cut flower, unlike *D. nobile*-cane type cultivars and related species of Asiatic origin (India, Southern China & Burma) that show semi-deciduous nature after flowering and require cool winter phase and cannot be used as cut flowers. This hybrid (NRCO-42) is adjudged as best paper in poster presentation for during 'National Conference of Floriculture for Livelihood and Profitability', 16-19 March, 2009 at IARI, New Delhi. All the characters described support the novelty in the new *D. phalaenopsis*-cane type *i.e.*, moth type hybrid, NRCO-42.

The efforts and dedication of Late Dr V Nagaraju, Ex-Principal Scientist (Horticulture), for raising the progeny is highly remembered and acknowledged.

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52. UHFHYP-I (IC0582480; INGR10074), UHFHYP-II (IC0582481; INGR10075) and UHFHYP-III (IC0582482; INGR10076), St.John's Wort (*Hypericum perforatum*) Germplasm with Semi-Erect, Oblong Lanceolate Leaf; Erect-Oblong Leaf; Prostrate (Decumbent) Obovate Leaf

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Hypericum perforatum (St John's Wort), locally known as Bassant and Dendhu in Hindi is chiefly valued as an antidepressant (Newall *et al*., 1924) attributed chiefly due to the active content hypericin present in almost all parts of the plant (Grieve, 1992). Besides, the herb is also used as an astringent, expectorant, diuretic

and in pulmonary and urinary troubles (Anonymous, 1959). St John's Wort oil (*oleum hyperici*), prepared by infusing fresh flowers in olive oil is used externally in the treatment of wounds, sores and swellings. It is distributed in Europe, North Africa, Siberia, West Asia, Temperate western Himalayas from Kashmir to Kumaon (Blatter, 1984). In Himachal Pradesh, it grows in shady and damp forests of Shimla and Kullu in sporadic patches (Collett, 1971).

This species is under cultivation in Germany, East Europe, Austria, Italy, France, Chile and USA (Franke *et al.,* 1999). In India, the herb is not under cultivation. For commercial cultivation to succeed, there would be need of better yielding strains which require complete understanding of its natural variability, breeding system and morphological markers associated with better strains. This is more so with regard to DUS (distinctiveness, uniformity and stability) criteria that have emerged in varietal/strain identification and also important in the context of IPR.

Morpho-Agronomic Characteristics

After extensive explorations in Himachal Pradesh, three distinct plant types based on morphological features in *Hypericum perforatum* were identified under ICAR AINRP on M&AP's center at Dr. Y.S.Parmar University of Horticulture & Forestry, Nauni-Solan. The chief diagnostic traits of these three plant types are presented in Table 1. These morphological features have been found to be stable after successive generations. Inbred seeds of these lines breed true and produce homogenous progeny.

Associated Characters and Cultivation Practices

Studies on the reproductive biology have revealed that the species is highly self compatible and pure lines can be produced through inbred seed. This apparently is the reason why the selected morphotypes breed true to type when raised through inbred seeds. These distinct and stable morphological traits can be used in varietal development programmes conforming to the DUS criteria.

Table 1. Distinguishing characteristics of the three identified morphotypes in *Hypericum perforatum*

Morphotypes	Morphological characters				
	Habit	Leaf shape	Flowering duration	50% flowering*	Leaf length/ breadth ratio (L/B)
UHFHYP–I (IC0582480; INGR10074)	Semi erect	Oblong lanceolate	100 days	3rd week of June	3.00 and above
UHFHYP–II (IC0582481; INGR10075)	Erect	Oblong	123 days	2nd week of June	~2.25
UHFHYP–III (IC0582482; INGR10076)	Prostrate (decumbent)	Obovate	77 days	4th week of June	~1.75

*Under Nauni/ Solan (1300m at msl) conditions

It is a sexually propagated species and nursery sowing should be done in November/December. Seedlings are ready for transplantation in the month of February /March.

Investigations are continuing at Dr. Y.S.Parmar University of Horticulture & Forestry, Nauni-Solan to assess the comparative performance in respect of total biomass yield and hypericin content with a view to develop a high yielding stain ensuring perpetuation of the characteristic morphological features of the selected strain which shall be helpful in strain identification, thus fulfilling the major requirement of DUS criteria.

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53. DMR 7 (IC0584583; INGR10077), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity and Resistance to Pink Borer

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Pink borer tolerant population named WNZPBTL 2 was developed at Directorate of Maize Research to derive resistant inbred lines. This population was subjected to inbreeding followed by ear-to-row selection. Every generation was screened under artificial epiphytotic conditions against Pink borer. After 8 generations of continuous inbreeding, a uniform inbred line was developed which was named as DMR 7 and this inbed was resistant to pink borer.

The four year data with respect to Pink borer reaction revealed that the line has shown consistently very high level of resistance against the susceptible check CM300. The mean leaf injury for Pink borer in DMR 7 ranged from 2.5 to 3.3 against the check CM 300 (6.2-8.2). Thus can be utilized as a source of stable resistance against this insect for development of insect free hybrids as the source of resistance to this insect are rarely available.

The line was evaluated for various morphological traits for three seasons i.e. from 2007-2009 at Hyderabad and DMR, Delhi. Based on this data, it reveals that the line has late maturing height with medium sized cob length. It takes 56 days for anthesis and 59 days to silk during kharif season. It has sparse tassel branches. The grain row arrangement is straight and has very attractive yellow flint grain colour. Different quality parameters revealed that DMR 7 contains >12% protein and >70% starch.

54. DMR 15 (IC0584584; INGR10078), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity, Good Combining Ability, Attractive Grain Colour and Temperate Origin

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DMR 15 was derived from NC 262 (temperate material). Tropicalized plant from NC 262 material was subjected to inbreeding followed by ear-to-row selection. The inbreeding was done at Hyderabad and Delhi. The productive ears with desirable traits were selected in each generation and after 7 generations of inbreeding, this line became uniform.

Different morphological traits studied in three seasons at Hyderabad and DMR, Delhi in kharif reveals that DMR 15 is late maturing and has short plant height (99cm). It yields 2.5 ton/ha in Kharif. It takes 60 days for flowering and 64 days to silk. It has sparse tassel branches. The grain row arrangement is irregular and has very attractive yellow flint grain colour.

55. DMR 16 (IC0584585; INGR10079), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity, Good Combining Ability, Long Cob, Attractive Grain Colour and Temperate Origin

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DMR 16 was derived from NC 390 (temperate material). Tropicalized plant from NC 262 material was subjected to inbreeding followed by ear-to-row selection. The inbreeding was done at Hyderabad and

53. DMR 7 (IC0584583; INGR10077), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity and Resistance to Pink Borer

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Pink borer tolerant population named WNZPBTL 2 was developed at Directorate of Maize Research to derive resistant inbred lines. This population was subjected to inbreeding followed by ear-to-row selection. Every generation was screened under artificial epiphytotic conditions against Pink borer. After 8 generations of continuous inbreeding, a uniform inbred line was developed which was named as DMR 7 and this inbed was resistant to pink borer.

The four year data with respect to Pink borer reaction revealed that the line has shown consistently very high level of resistance against the susceptible check CM300. The mean leaf injury for Pink borer in DMR 7 ranged from 2.5 to 3.3 against the check CM 300 (6.2-8.2). Thus can be utilized as a source of stable resistance against this insect for development of insect free hybrids as the source of resistance to this insect are rarely available.

The line was evaluated for various morphological traits for three seasons i.e. from 2007-2009 at Hyderabad and DMR, Delhi. Based on this data, it reveals that the line has late maturing height with medium sized cob length. It takes 56 days for anthesis and 59 days to silk during kharif season. It has sparse tassel branches. The grain row arrangement is straight and has very attractive yellow flint grain colour. Different quality parameters revealed that DMR 7 contains >12% protein and >70% starch.

54. DMR 15 (IC0584584; INGR10078), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity, Good Combining Ability, Attractive Grain Colour and Temperate Origin

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DMR 15 was derived from NC 262 (temperate material). Tropicalized plant from NC 262 material was subjected to inbreeding followed by ear-to-row selection. The inbreeding was done at Hyderabad and Delhi. The productive ears with desirable traits were selected in each generation and after 7 generations of inbreeding, this line became uniform.

Different morphological traits studied in three seasons at Hyderabad and DMR, Delhi in kharif reveals that DMR 15 is late maturing and has short plant height (99cm). It yields 2.5 ton/ha in Kharif. It takes 60 days for flowering and 64 days to silk. It has sparse tassel branches. The grain row arrangement is irregular and has very attractive yellow flint grain colour.

55. DMR 16 (IC0584585; INGR10079), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity, Good Combining Ability, Long Cob, Attractive Grain Colour and Temperate Origin

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DMR 16 was derived from NC 390 (temperate material). Tropicalized plant from NC 262 material was subjected to inbreeding followed by ear-to-row selection. The inbreeding was done at Hyderabad and

Delhi. The productive ears with desirable traits were selected in each generation and after 7 generations of inbreeding, this line became uniform.

Different morphological traits studied in three seasons at Hyderabad and DMR, Delhi reveals that DMR 16 is a late maturing line and takes 64 days for flowering and 68 days for silk emergence during kharif season. It has short plant height (85cm) with medium sized cob length. The line yields 2.3 ton/ha in Kharif. It has sparse tassel branches and the grain row arrangement is straight. It has very attractive yellow flint grain colour with cap.

56. DMR 17 (IC0584586; INGR10080), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity, Good Combining Ability, Attractive Grain Colour and Temperate Origin

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DMR 17 was derived from NC 418 (temperate material). Tropicalized plant from NC 418 material was subjected to inbreeding followed by ear-to-row selection. The inbreeding was done at Hyderabad and Delhi. The productive ears with desirable traits were selected in each generation and after 7 generations of inbreeding, this line became uniform.

Based on different morphological traits studied in three seasons at Hyderabad and DMR, Delhi, it shows that DMR 17 is a late maturing line. It has short plant height (85cm) and yields 2.1 ton/ha in Kharif. It takes 57 days to flower and 60 days for silk emergence. It has dense tassel branches and the grain row arrangement is straight. It has very attractive yellow flint grain colour.

57. HKI C-322 (IC0584587; INGR10081), Maize (*Zea mays* L.) Germplasm with Medium Duration White, Flint Grain, Productivity, Strong Plant and Dark Green Leaves

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HKI C-322 is medium maturing white maize inbred line derived from single cross hybrid HM 2. The hybrid was subjected to 7 generations of inbreeding followed by ear-to-row selection at at CCS HAU, Uchani, Karnal and a uniform inbred line was developed.

Different morphological traits studied in three seasons at winter nursery, Hyderabad and DMR, Delhi reveals that HKI C-322 has short plant height (106cm) with dark green leaves. It takes 58 days to flower and 63 days to silk during kharif. The grain yield is >2.5ton/ha. It has sparse tassel branches. The grain row arrangement is irregular and has white flint grain colour. Different quality parameters reveals that it contains >11% protein and >70% starch.

Delhi. The productive ears with desirable traits were selected in each generation and after 7 generations of inbreeding, this line became uniform.

Different morphological traits studied in three seasons at Hyderabad and DMR, Delhi reveals that DMR 16 is a late maturing line and takes 64 days for flowering and 68 days for silk emergence during kharif season. It has short plant height (85cm) with medium sized cob length. The line yields 2.3 ton/ha in Kharif. It has sparse tassel branches and the grain row arrangement is straight. It has very attractive yellow flint grain colour with cap.

56. DMR 17 (IC0584586; INGR10080), Maize (*Zea mays* L.) Germplasm with Flint Grain, Productivity, Good Combining Ability, Attractive Grain Colour and Temperate Origin

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DMR 17 was derived from NC 418 (temperate material). Tropicalized plant from NC 418 material was subjected to inbreeding followed by ear-to-row selection. The inbreeding was done at Hyderabad and Delhi. The productive ears with desirable traits were selected in each generation and after 7 generations of inbreeding, this line became uniform.

Based on different morphological traits studied in three seasons at Hyderabad and DMR, Delhi, it shows that DMR 17 is a late maturing line. It has short plant height (85cm) and yields 2.1 ton/ha in Kharif. It takes 57 days to flower and 60 days for silk emergence. It has dense tassel branches and the grain row arrangement is straight. It has very attractive yellow flint grain colour.

57. HKI C-322 (IC0584587; INGR10081), Maize (*Zea mays* L.) Germplasm with Medium Duration White, Flint Grain, Productivity, Strong Plant and Dark Green Leaves

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HKI C-322 is medium maturing white maize inbred line derived from single cross hybrid HM 2. The hybrid was subjected to 7 generations of inbreeding followed by ear-to-row selection at at CCS HAU, Uchani, Karnal and a uniform inbred line was developed.

Different morphological traits studied in three seasons at winter nursery, Hyderabad and DMR, Delhi reveals that HKI C-322 has short plant height (106cm) with dark green leaves. It takes 58 days to flower and 63 days to silk during kharif. The grain yield is >2.5ton/ha. It has sparse tassel branches. The grain row arrangement is irregular and has white flint grain colour. Different quality parameters reveals that it contains >11% protein and >70% starch.

58. HKI MBR-139-2 (IC0584588; INGR10082), Maize (*Zea mays* L.) Germplasm with Medium Duration, White Flint Grain, Good Combining Ability and Dark Green Leaves

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HKI MBR-139-2 is medium maturing white maize inbred line derived from HKI-139 (yellow maize). The line was subjected to of inbreeding followed by ear-to-row selection at CCS HAU, Uchani, Karnal. After 7 generations of continuous inbreeding, the line became uniform.

The line was evaluated for various morphological traits for three seasons i.e. from 2007-2009 at Hyderabad and DMR, Delhi. Based on this data, it reveals that the line has medium plant height (130cm) with medium sized cob length. It takes 69 days for flowering and 72 days for silk emergence in Kharif. It yields >2.0 ton/ha depending upon weather conditions. It has sparse tassel branches with medium dark green leaves. The grain row arrangement is straight and has white flint grain colour.

59. HKI 5072-2-BT (IC0584589; INGR10083), Maize (*Zea mays* L.) Germplasm with High Tryptophan, Medium Duration, Yellow, Flint, Attractive Grain Colour and Dark Green Leaves

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HKI 5072-2-BT is QPM line derived from DMRQPM-5072 (QPM line). The line was subjected toinbreeding followed by ear-to-row selection at CCS HAU, Uchani, Karnal. After 7 generations of continuous inbreeding, a medium maturing inbred line was developed.

Different morphological traits were studied in three seasons i.e. from 2007-2009 at winter nursery, Hyderabad and DMR, Delhi. Based on this data, it reveals that HKI 5072-2-BT has short plant height (95cm) with medium sized cob length. The leaves are dark green in colour. The line takes 58 days for flowering and 62 days for silk emergence during kharif. It has dense tassel branches. The grain row arrangement is straight and the Anthocyanin colour of glume is dark purple. It has yellow flint grain with cap. The line contains high levels of lysine and tryptophan.

60. DMRQ – 107 (IC0584590; INGR10084), a Maize (*Zea mays* L) Germplasm with High Tryptophan, Medium, Yellow, Flint, Good Combining Ability and Thin Cob

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DMRQ-107 is QPM line derived from CLQRCYQ-47-B (QPM line). The line was subjected to inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi. After 7 generations of continuous inbreeding, medium maturing inbred line was derived.

Different morphological traits were studied in three seasons i.e. from 2007-2009 at winter nursery,

58. HKI MBR-139-2 (IC0584588; INGR10082), Maize (*Zea mays* L.) Germplasm with Medium Duration, White Flint Grain, Good Combining Ability and Dark Green Leaves

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HKI MBR-139-2 is medium maturing white maize inbred line derived from HKI-139 (yellow maize). The line was subjected to of inbreeding followed by ear-to-row selection at CCS HAU, Uchani, Karnal. After 7 generations of continuous inbreeding, the line became uniform.

The line was evaluated for various morphological traits for three seasons i.e. from 2007-2009 at Hyderabad and DMR, Delhi. Based on this data, it reveals that the line has medium plant height (130cm) with medium sized cob length. It takes 69 days for flowering and 72 days for silk emergence in Kharif. It yields >2.0 ton/ha depending upon weather conditions. It has sparse tassel branches with medium dark green leaves. The grain row arrangement is straight and has white flint grain colour.

59. HKI 5072-2-BT (IC0584589; INGR10083), Maize (*Zea mays* L.) Germplasm with High Tryptophan, Medium Duration, Yellow, Flint, Attractive Grain Colour and Dark Green Leaves

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Different morphological traits were studied in three seasons i.e. from 2007-2009 at winter nursery, Hyderabad and DMR, Delhi. Based on this data, it reveals that HKI 5072-2-BT has short plant height (95cm) with medium sized cob length. The leaves are dark green in colour. The line takes 58 days for flowering and 62 days for silk emergence during kharif. It has dense tassel branches. The grain row arrangement is straight and the Anthocyanin colour of glume is dark purple. It has yellow flint grain with cap. The line contains high levels of lysine and tryptophan.

60. DMRQ – 107 (IC0584590; INGR10084), a Maize (*Zea mays* L) Germplasm with High Tryptophan, Medium, Yellow, Flint, Good Combining Ability and Thin Cob

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DMRQ-107 is QPM line derived from CLQRCYQ-47-B (QPM line). The line was subjected to inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi. After 7 generations of continuous inbreeding, medium maturing inbred line was derived.

Different morphological traits were studied in three seasons i.e. from 2007-2009 at winter nursery,

Hyderabad and DMR, Delhi. Based on this data, it reveals that DMRQ-107 has medium plant height ((146 cm) with medium sized cob length. The line flowers in 60 days during kharif. It has dense tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is spiral and has very attractive yellow dent grain with cap. The line contains high levels of protein (>11%) and tryptophan (>0.70%).

61. Win Sweet Corn (WSC 1) (IC0584591; INGR10085), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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WSC 1 is sweet corn line derived from Win Orange Sweet Corn (composite variety). The line was subjected to 7 generations of inbreeding followed by ear-to-row selection at Hyderabad and Directorate of Maize Research, Delhi. After 7 generations of continuous inbreeding, a uniform inbred line was developed which was early maturing in nature.

Different morphological traits studied in three seasons reveals that WSC 1 has short plant height (95.5 cm) with medium sized cob length. It takes 60 days for flowering and 62 days for silk emergence depending upon weather conditions. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is irregular and has very attractive yellow dent grain colour. WSC 1 contains high level of sugar and TSS (25.3%).

62. DMSC–1 (IC0584592; INGR10086), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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DMSC-1 is an early maturing, sweet corn line derived from MUS MADHU (sweet corn) after 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi.

Studies on different morphological traits reveal that DMSC-1 has short plant height (120 cm) with medium sized cob length. It takes 57 days for flowering and 61 days for silk emergence in kharif. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight and has very attractive yellow dent grain colour. The line contains high levels of sugar with TSS value of 16.2%.

Hyderabad and DMR, Delhi. Based on this data, it reveals that DMRQ-107 has medium plant height ((146 cm) with medium sized cob length. The line flowers in 60 days during kharif. It has dense tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is spiral and has very attractive yellow dent grain with cap. The line contains high levels of protein (>11%) and tryptophan (>0.70%).

61. Win Sweet Corn (WSC 1) (IC0584591; INGR10085), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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WSC 1 is sweet corn line derived from Win Orange Sweet Corn (composite variety). The line was subjected to 7 generations of inbreeding followed by ear-to-row selection at Hyderabad and Directorate of Maize Research, Delhi. After 7 generations of continuous inbreeding, a uniform inbred line was developed which was early maturing in nature.

Different morphological traits studied in three seasons reveals that WSC 1 has short plant height (95.5 cm) with medium sized cob length. It takes 60 days for flowering and 62 days for silk emergence depending upon weather conditions. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is irregular and has very attractive yellow dent grain colour. WSC 1 contains high level of sugar and TSS (25.3%).

62. DMSC–1 (IC0584592; INGR10086), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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DMSC-1 is an early maturing, sweet corn line derived from MUS MADHU (sweet corn) after 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi.

Studies on different morphological traits reveal that DMSC-1 has short plant height (120 cm) with medium sized cob length. It takes 57 days for flowering and 61 days for silk emergence in kharif. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight and has very attractive yellow dent grain colour. The line contains high levels of sugar with TSS value of 16.2%.

63. DMSC–6 (IC0584593; INGR10087), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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DMSC-6 is an early maturing, sweet corn line derived from MUS MADHU (sweet corn) after 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi.

Studies on different morphological traits reveal that DMSC-6 has medium plant height (100 cm) with medium sized cob length. It takes 58 days for flowering and 60 days for silk emergence during kharif. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is irregular and has very attractive yellow dent grain colour. The line contains high levels of sugar with TSS value of 15.6%.

64. DMS–201 (IC0584594; INGR10088), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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DMS-201 is sweet corn line derived from CP Golden Sweet 3. The line was subjected to 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi and a uniform line was derived which was early maturing.

Studies on different morphological traits reveal that DMS–201 has short stature plant height (104 cm) with medium sized cob length. The line takes 59 days for flowering and 61 days for silk emergence during kharif. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight and has very attractive yellow dent grain colour. The line contains high levels of sugar with TSS value of 18.2%.

65. DMS–203 (IC0584595; INGR10089), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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DMS-203 is sweet corn line derived from Single cross hybrid [NSS 2W 9301A (sh2sh2) × Sweet corn]. The hybrid was subjected to 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi and a uniform line was derived

Studies on different morphological traits reveal that DMS-203 is an early maturing line. It has short plant height (116 cm) with medium sized cob. The line flowers in 55 days in kharif. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight and the Anthocyanin colour of glume is light purple. It has very attractive yellow dent grain colour. The line has high levels of sugar with TSS value of 26.1%.

66. DMS-206 (IC0584596; INGR10090), a Maize (*Zea mays* L) Germplasm with High Sugar and Yellow Shrunken Grain

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DMS-206 is sweet corn line derived from Single cross hybrid (WSC1 x MUS MADHU). The hybrid was subjected to 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi and a uniform early maturing inbred line was derived.

Studies on different morphological traits reveal that DMS–206 has short plant height (91 cm) with medium sized cob length. The line flowers in 57 days during kharif. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight and has very attractive yellow dent grain colour. The line contains high levels of sugar with TSS value of 21.3%.

67. DMS-207 (IC.No. 0584597; INGR No. 10091), a Maize (*Zea mays* L) Germplasm with High Sugar, Yellow Shrunken Grain and Thin Cob

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DMS-207 is sweet corn line derived from CUBA 378. The line was subjected to 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi and a uniform line was derived which was early maturing.

Studies on different morphological traits reveal that DMS-207 has short plant height (85 cm) with medium sized cob length. It takes 59 days for flowering and 63 days to silk during kharif. It has dense tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight and has very attractive light yellow dent grain colour. The line contains high levels of sugar with TSS value of 18.3%.

68. DMS-208 (IC0584598; INGR10092), a Maize (*Zea mays* L) Germplasm with High Sugar, Yellow Shrunken Grain and Long Cob

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DMS-208 is sweet corn line derived from CUBA 379. The line was subjected to 7 generations of inbreeding followed by ear-to-row selection at winter nursery, Hyderabad and DMR, Delhi and a uniform inbred line was derived which was early maturing in nature.

Different morphological traits were studied in three seasons *i.e.* from 2007-2009 at winter nursery, Hyderabad and DMR, Delhi. Based on this data, it reveals that DMS-208 has short plant height (98 cm) with medium sized cob length during *kharif*. The line takes 65 days to flower and 69 days to silk. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight and has very attractive light yellow dent grain colour. The line contains high levels of sugar with TSS value of 25.8%.

69. HKI PC-4B (IC0584599; INGR10093), a Maize (*Zea mays* L) Germplasm with High Popping, Medium Duration and Good Pollinator

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HKI PC-4B popcorn inbred line was derived from LMC 4 collected from local market of Karnal (Haryana). LMC 4 was subjected to 7 generations of inbreeding followed by ear-to-row selection at CCS HAU, Uchani, Karnal and a uniform line was derived.

Different morphological traits studied in three seasons at Hyderabad and DMR, Delhi reveals that HKI PC-4B is medium maturing and has short plant height (108 cm) with medium sized cob length. The line takes 50 days to flower and 53 days to silk during kharif. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is straight. It has very attractive yellow flint grain colour. The line has 100% popping trait.

70. HKI PCBT-3(IC0584600; INGR10094), a maize (*Zea mays* L) Germplasm with High Popping, Early and Good Pollinator

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HKI PCBT-3 is popcorn line, derived from LMC 3 collected from local market of Karnal (Haryana). LMC 3 was subjected to 7 generations of inbreeding followed by ear-to-row selection at CCS HAU, Uchani, Karnal and a uniform line was derived which was early maturing in nature.

Different morphological traits studied in three seasons at Hyderabad and DMR, Delhi reveals that HKI PCBT-3 is a hard endosperm, short grain, high popping trait line. It has short plant height with medium sized cob length. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is irregular and has very attractive yellow flint grain colour. The line has 100% popping trait.

71. HKI -6 (IC0584601; INGR10095), a Maize (*Zea mays* L) Germplasm with High Oil Content and Yellow Flint Grain

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HKI-6 is high oil line derived from high oil Shahad population (SHD-1ER6). The population was subjected to inbreeding followed by ear-to-row selection at CCS HAU, Uchani, Karnal. After 7 generations of continuous inbreeding, a uniform line was derived which was early maturing in nature.

The line was evaluated for various morphological traits for three season i.e. from 2007-2009 at Hyderabad and DMR, Delhi. Based on this data, HKI–6 has short plant height with medium sized cob length. It takes 58days for anthesis and 64days for silk emergence depending on different weather conditions. It has sparse tassel branches and a good pollen shedder, which is a merit of good pollen parent. The grain row arrangement is irregular. It has very attractive yellow flint grain colour. The line contains high levels of protein and oil.

72. HKI–1 (T) (IC0584602; INGR10096), a Maize (*Zea mays* L) Germplasm with High Oil Content and Yellow Flint Grain

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HKI-1(T) is high oil line derived from from Talar (high oil). The line was subjected to 7 generations of inbreeding followed by ear-to-row selection at CCS HAU, Uchani, Karnal and a uniform late maturing line was derived named as HKI-1(T).

Different morphological traits studied in three seasons at winter nursery, Hyderabad and DMR, Delhi reveals that HKI 1-(T) has short plant height (100cm). It takes 53 days for flowering and 56 days for silk emergence in kharif. It has sparse tassel branches. The grain row arrangement is straight. It has very attractive yellow flint grain colour. Different quality parameters revealed that it contains high levels of protein (13.12%) and oil (6.31%).

73. HS-491 (IC0566222; INGR10097), a Wheat (*Triticum aestivum*) Germplasm with Good Biscuit Quality

Sanjay Kumar, Dharam Pal, DK Bhatnagar, Rashmi Bhatnagar, RK Gupta, D Mohan and Sewa Ram
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74. UP 2698 (IC0573852; INGR10098), a Wheat (*Triticum aestivum*) Germplasm with High Protein (12.8%)

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UP 2689, an elite wheat genetic stock, which was tested in the name of UP 2689, has been registered as an unique germplasm vide registration number INGR: 09122 (IC 0573852), which has given an average protein content of 13 per cent in North Eastern Plains Zone (NEPZ) where in general low protein content is reported in the wheat varieties. Hence this genetic stock will be useful as a donor for developing the wheat varieties with high protein content. High protein content is one of the most important quality parameters which is required not only for mitigating the malnutrition but also for the production of better quality bread and other value added products. Wheat is staple crop of India and development of variety with high protein is essentially required.

UP 2689, a spring wheat (*Triticum aestivum* L.) is derived from the cross UP 2382/DLRSN-5 and developed through pedigree breeding method. It was evaluated in All India Coordinated Wheat & Barley Improvement Project (ICAR) in the year 2005-06 in NIVT-3 and in 2006-07 in AVT-IR-LS-TAS in North Eastern Plains Zone (NEPZ). In late sown conditions, it has given an average yield of 39.2 q/ha in NIVT-3 and 28.5 q/ha in AVT on NEPZ.

In addition to high protein content its thousand grain weight 39 g is also acceptable. It has shown high resistance to brown rust and also possesses Sr2 complex. Its ear size is large with dense spikelets, ears are in club shaped with white colour, outer glumes are glabrous. Anthocyanin pigmentation is

72. HKI–1 (T) (IC0584602; INGR10096), a Maize (*Zea mays* L) Germplasm with High Oil Content and Yellow Flint Grain

S Dass, Dharam Pal, JC Mehla and KS Dhanju
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Different morphological traits studied in three seasons at winter nursery, Hyderabad and DMR, Delhi reveals that HKI 1-(T) has short plant height (100cm). It takes 53 days for flowering and 56 days for silk emergence in kharif. It has sparse tassel branches. The grain row arrangement is straight. It has very attractive yellow flint grain colour. Different quality parameters revealed that it contains high levels of protein (13.12%) and oil (6.31%).

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In addition to high protein content its thousand grain weight 39 g is also acceptable. It has shown high resistance to brown rust and also possesses Sr2 complex. Its ear size is large with dense spikelets, ears are in club shaped with white colour, outer glumes are glabrous. Anthocyanin pigmentation is

absent in the coleoptiles while it is medium on leaf sheath auricle at flag leaf stage. The average plan height is 83 cm having thick culm and dark green leaves. This genetic stock flowers in 74 days, matures in about 108 days, produces amber and hard grains. The thousand grain weight of UP 2689 is 39 gm.

75. PU 06-14 (IC0570262; INGR 10099), PU 06-23 (IC0570264; INGR 10100), PU 06-24 (IC0570265; INGR 10101), PU 06-19 (IC0570267; INGR 10102), PU 06-20 (IC0570268; INGR 10103), PU 06-21 (IC0570269; INGR 10104), Blackgram (*Vigna mungo*) Germplasm, with High Iron, Zinc, Protein Content, High Resistance to MYMV (Mung Bean Yellow Mosaic Virus)

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Germplam lines PU 06-14 (INGR 10099), PU 06-23 (INGR 10100), PU 06-24 (INGR 10101), PU 06-19 (INGR 10102), PU 06-20 (INGR 10103), PU 06-21 (INGR 10104), are high in iron and/or zinc and/or protein and resistant to MYMV (Table 1), have been derived from a wide cross between mungbean cv. BDYR-1 and blackgram cv. DPU 88-31 (Kumar, 2008). BDYR-1 is a popular mungbean cultivar susceptible to MYMV, while DPU 88-31 is a MYMV resistant blackgram line. Mungbean x Blackgram hybridization has emerged as an important breeding strategy for simultaneously improvement of the two crops and has resulted in development of four varieties of mungbean. The development of blackgram lines from mungbean x blackgram wide cross has eluded the breeders in the past owing to the failure of blackgram type progenies to survive as a result of abnormalities arising from chromosomal imbalances (Singh *et al*., 2009). The wide cross, BDYR-1 x DPU 88-31, was made in Kharif 2001. In the F_1, which was raised in 2002, only two plants survived and produced seeds. In the F_2, 26 plants were obtained and seed from each individual was harvested separately. In 2004, 103 plants across the 26 F_3 families were selected and seed harvested separately. Of the 103 F_4 families, 34 were uniform, while 69 showed segregation. In 2006, a station trials comprising of the 34 bulks and four checks was conducted (Sharma and Singh, 2007). The bulks were retested again in a station trial in 2007 (Kumar *et al*., 2008). Some of the blackgram type of derivatives/progenies were superior to the checks for iron and/or iron and protein. These progenies also exhibited transgressive segregation for one or more quality traits. The details are given in Table 1. The lines were developed under AICRP on MULLaRP at G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India.

Mungbean Yellow Mosaic Virus (MYMV) is economically the most important disease of blackgram and resistance to MYMV is essentially required in the cultivars to sustain their high yield potential over long period of time. Enhancement of protein content in the cultivars is important to combat the growing malnutrition problems, particularly in the Indian subcontinent where grain legumes constitute chief source of dietary protein in the predominantly vegetarian diets of people. The germplasm lines INGR 10099 to 10104 derived from mungbean x blackgram wide cross will be useful to breeders for developing biofortified, disease resistant and high yielding cultivars of blackgram (Singh and Khulbe, 2009).

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Different morphological traits studied in three seasons at winter nursery, Hyderabad and DMR, Delhi reveals that HKI 1-(T) has short plant height (100cm). It takes 53 days for flowering and 56 days for silk emergence in kharif. It has sparse tassel branches. The grain row arrangement is straight. It has very attractive yellow flint grain colour. Different quality parameters revealed that it contains high levels of protein (13.12%) and oil (6.31%).

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Germplam lines PU 06-14 (INGR 10099), PU 06-23 (INGR 10100), PU 06-24 (INGR 10101), PU 06-19 (INGR 10102), PU 06-20 (INGR 10103), PU 06-21 (INGR 10104), are high in iron and/or zinc and/or protein and resistant to MYMV (Table 1), have been derived from a wide cross between mungbean cv. BDYR-1 and blackgram cv. DPU 88-31 (Kumar, 2008). BDYR-1 is a popular mungbean cultivar susceptible to MYMV, while DPU 88-31 is a MYMV resistant blackgram line. Mungbean x Blackgram hybridization has emerged as an important breeding strategy for simultaneously improvement of the two crops and has resulted in development of four varieties of mungbean. The development of blackgram lines from mungbean x blackgram wide cross has eluded the breeders in the past owing to the failure of blackgram type progenies to survive as a result of abnormalities arising from chromosomal imbalances (Singh *et al*., 2009). The wide cross, BDYR-1 x DPU 88-31, was made in Kharif 2001. In the F_1, which was raised in 2002, only two plants survived and produced seeds. In the F_2, 26 plants were obtained and seed from each individual was harvested separately. In 2004, 103 plants across the 26 F_3 families were selected and seed harvested separately. Of the 103 F_4 families, 34 were uniform, while 69 showed segregation. In 2006, a station trials comprising of the 34 bulks and four checks was conducted (Sharma and Singh, 2007). The bulks were retested again in a station trial in 2007 (Kumar *et al*., 2008). Some of the blackgram type of derivatives/progenies were superior to the checks for iron and/or iron and protein. These progenies also exhibited transgressive segregation for one or more quality traits. The details are given in Table 1. The lines were developed under AICRP on MULLaRP at G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India.

Mungbean Yellow Mosaic Virus (MYMV) is economically the most important disease of blackgram and resistance to MYMV is essentially required in the cultivars to sustain their high yield potential over long period of time. Enhancement of protein content in the cultivars is important to combat the growing malnutrition problems, particularly in the Indian subcontinent where grain legumes constitute chief source of dietary protein in the predominantly vegetarian diets of people. The germplasm lines INGR 10099 to 10104 derived from mungbean x blackgram wide cross will be useful to breeders for developing biofortified, disease resistant and high yielding cultivars of blackgram (Singh and Khulbe, 2009).

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Table 1. Salient agro–morphological characteristics of mungbean lines derived from BDYR–1 x DPU 88–31 wide cross

Character	PU 06–14 (INGR 10099)	PU 06–23 (INGR 10100)	PU 06–24 (INGR 10101)	PU 06–19 (INGR 10102)	PU 06–20 (INGR 10103)	PU 06–21 (INGR 10104)	Pant U–35	BDYR–1	DPU 88–31
Days to first flowering	43.7	42.7	41.0	43.7	40.7	44.3	37.3	33.0	44.0
Days to 50% flowering	46.7	46.0	46.7	46.7	44.7	47.7	42.3	37.0	48.0
Days to first pod maturity	62.7	62.0	63.7	63.0	63.0	63.0	62.7	56.3	63.0
Plant height (cm)	73.0	64.0	68.7	70.0	62.0	67.7	83.0	64.0	74.0
Clusters/plant.)	20.0	20.7	10.7	16.3	11.7	21.3	15.3	8.7	14.0
Pods/cluster	2.0	2.7	3.3	3.7	3.0	2.7	3.7	3.3	2.7
Pods per plant	49.0	52.0	28.7	38.7	36.3	57.7	53.3	27.0	45.3
Seeds/pod	6.0	5.0	4.3	5.0	6.7	6.3	6.7	10.0	6.7
100–seed weight (g)	3.9	4.1	4.2	4.1	4.1	4.0	4.4	4.06	4.37
Yield/plant (g)	34.1	37.6	20.3	23.4	26.2	44.9	47.5	34.3	46.4
Seed colour	Black	Black	Black	Black	Black	Black	Black	Shining green	Black
MYMV incidence (1–9)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.0	1.0
Protein content (%)	23.10	23.10	24.56	26.50	26.25	26.70	24.50	22.10	22.30
Iron (mg/100 g sample)	11.53	11.29	12.05	6.85	7.59	7.70	8.80	7.15	7.92
Zinc (mg/100 g sample)	2.62	3.11	4.11	2.78	3.11	2.82	3.45	3.19	2.98

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76. BDN 2004-4 (IC0573418; INGR10105), a Pigeonpea (*Cajanus cajan* L. Millsp.) Germplasm with Open Flower and Obcordate Leaf

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Pigeonpea (*Cajanus cajan* L. Millsp.) has a typical papilionaceous flower ensuring self pollination, a certain amount of entomophillus cross pollination does occur (Saxena *et al.*, 1990) . Basically the self-pollination occurs in the bud before the petal opens, when the petals are open insect pollination may take place (Van der Maesen, 1986) Natural out crossing has a potential role in hybrid Pigeonpea research. Thus an open flower mutant can be effectively utilized for the development of exclusively cross pollinating Pigeonpea. This desirable trait can be effectively transferred in CMS line and agronomical suitable genotype can be developed after inheritance study.

During *kharif* 2004-05, a kind of mutant action is found to have in the population of cultivated species of *Cajanus cajan* in the genotype BDN-2003-2 at Agril. Research Station, Badnapur, MS (Marathwada Agricultural University, Parbhani) i. e. BDN 2004-4.

Morpho-agronomic Characteristics

The pigeonpea flower is irregular (zygomorphic) consisting of five petals, a standard, two wings and two petals fused together to form a keel which encloses anthers and stigma. The genotype BDN 2004-4 is a natural mutant possessing characteristic flower having free keel petals, symmetrical wings and normal standard petal having yellow colour. The boat-shaped keels were split dorsally exposing the reproductive parts to the environment. Such open flowers encourage cross pollination as the pollinating agents such as honey bees have free access to pollen grains liberated after bursting of anthers and the stigma. Another feature

Table 1. Salient agro–morphological characteristics of mungbean lines derived from BDYR–1 x DPU 88–31 wide cross

Character	PU 06–14 (INGR 10099)	PU 06–23 (INGR 10100)	PU 06–24 (INGR 10101)	PU 06–19 (INGR 10102)	PU 06–20 (INGR 10103)	PU 06–21 (INGR 10104)	Pant U–35	BDYR–1	DPU 88–31
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Days to 50% flowering	46.7	46.0	46.7	46.7	44.7	47.7	42.3	37.0	48.0
Days to first pod maturity	62.7	62.0	63.7	63.0	63.0	63.0	62.7	56.3	63.0
Plant height (cm)	73.0	64.0	68.7	70.0	62.0	67.7	83.0	64.0	74.0
Clusters/plant.)	20.0	20.7	10.7	16.3	11.7	21.3	15.3	8.7	14.0
Pods/cluster	2.0	2.7	3.3	3.7	3.0	2.7	3.7	3.3	2.7
Pods per plant	49.0	52.0	28.7	38.7	36.3	57.7	53.3	27.0	45.3
Seeds/pod	6.0	5.0	4.3	5.0	6.7	6.3	6.7	10.0	6.7
100–seed weight (g)	3.9	4.1	4.2	4.1	4.1	4.0	4.4	4.06	4.37
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76. BDN 2004-4 (IC0573418; INGR10105), a Pigeonpea (*Cajanus cajan* L. Millsp.) Germplasm with Open Flower and Obcordate Leaf

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Morpho-agronomic Characteristics

The pigeonpea flower is irregular (zygomorphic) consisting of five petals, a standard, two wings and two petals fused together to form a keel which encloses anthers and stigma. The genotype BDN 2004-4 is a natural mutant possessing characteristic flower having free keel petals, symmetrical wings and normal standard petal having yellow colour. The boat-shaped keels were split dorsally exposing the reproductive parts to the environment. Such open flowers encourage cross pollination as the pollinating agents such as honey bees have free access to pollen grains liberated after bursting of anthers and the stigma. Another feature

in this variant was the obcordate leaf structure. The plant had trifoliate leaf reduced in shape with short petiole as compared to the normal pigeonpea plant. The leaflet apices were protruded inwards to the mid rib. However, the veination was prominent and normal. The plant had short stature as compared to the normal plant of the genotype.

This mutant was stabilized and crossed with normal plant to study the inheritance of open flower and leaf structure during *Kharif* 2005-06. Such types of cases were reported by Singh *et al.* (1942), Kajjari (1956) and Patil (1959).

For inheritance study, the crosses were made between an open flower mutant having obcordate leaf type and normal plant. All F_1s had normal flower and normal leaf. However in F_2 segregation from these cross showed the ratio of 3:1 i.e. Normal flower: Open flower. Similarly for leaf structure, obcordate leaf structure the ratio is 3:1 i.e. Normal leaf: obcordate leaf, which indicates the simple monogenic inheritance with the recessive gene which govern the character of open flower and obcordate leaf.

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77. BDN 2004-4A & B (IC0573419; IC0573420; INGR10106), a Pigeonpea (*Cajanus cajan* L. Millsp.) Germplasm, CMS based BDN 2004A and B Male Sterile Open Flower Mutant

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During *kharif* 2004-05, a kind of mutant action is found to have in the population of cultivated species of *Cajanus cajan* in the genotype BDN-2003-2 at Agril. Research Station, Badnapur, M.S. (Marathwada Agricultural University, Parbhani). This mutant is successfully converted into male sterile background with the cytoplasm of *C. scarabaeoides*. (BDN 2004A & B).

Morpho-agronomic Characteristics

The pigeonpea flower is irregular (zygomorphic) consisting of five petals, a standard, two wing petals and two petals fused together to form a keel which encloses anthers and stigma. This natural mutant had characteristic flower having free keel petals, symmetrical wings and normal standard petal possessing yellow colour. The boat-shaped keels were split dorsally exposing the reproductive parts to the environment. Such open flowers encourage cross pollination as the pollinating agents such as honey bees, have free access to pollen grains liberated after bursting of anthers and the stigma. Another feature in this variant was the obcordate leaf structure. The plant had trifoliate leaf reduced in shape with short petiole as compared

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The plant is successfully converted into sterile cytoplasm (CMS base male sterility) to take the advantage of open flower for easy pollination and to facilitate easy seed production to minimise the cost.

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78. MTS-37 (IC 0418452; INGR 10107), a Mungbean (*Vigna radiata*) Germplasm, with Highest Seed Weight (9.43 g/100seed)

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A wide range of variability has been reported for several morphological characters in mungbean germplasm. The range of variability for 100-seed weight in Indian mungbean germplasm varies from 0.8 g to 6.8 g (Bisht *et al.*1998). The variability for seed weight in the world mungbean collection at AVRDC, Taiwan ranges from 2.65 g to 7.75 g per 100 seeds (Andreas W. Ebert, AVRDC, Personal communication). Among the 73 mungbean varieties released in India since 1936, only two cultivars namely Pusa Vishal and SMBL 668 have been found to posses large seeds (>5 g) (Katiyar *et al.* 2008). IC 418452 is an unique extra bold seeded germplasm with highest 100-seed weight (>9.0 g) recorded till date among all the mungbeaqn germplasm accessions collected and characterized in India.

A mungbean accession IC418452 (Collector No. MTS-37) collected from North Andaman (Andaman and Nicobar Islands) was characterized during *kharif* 2004 at NBPGR Regional Station, Jodhpur in an Augmented Block Design. It was observed to posses unusually extra bold seeds with 100 seed weight of more than 9.0g (Dwivedi and Gopala Krishnan, 2009). This germplasm accession was further evaluated during *kharif* 2005 for validation of the trait. During *kharif* 2008, an experiment was conducted in Randomized Block Design with twenty three accessions of bold seeded mungbean germplasm accessions possessing 100-seed weight of more than 6.0 g along with M1319B, Pusa Vishal and Pusa 105 as checks. Among all twenty three accessions of mungbean evaluated, IC418452 recorded the highest 100-seed weight of 9.43 g compared to that of the three checks which had 100-seed weight less than 6.00 g.

IC418452 has semi-erect growth habit and attains a height of 40–60 cm. Flowering is synchronous and it flowers in 43–45 days. The hypocotyls colour is purple. Leaves are trifoliate, alternate and intermediate green in colour. The terminal leaf is large and the leaflets are entire. The plant is pubescent with central branching pattern. The flower colour is greenish yellow. The raceme position is indeterminate. Mature pods are brownish black, densely pubescent and possess 11–13 seeds/pod. Seeds are drum shaped and dull green in colour. It has an average 100-seed weight of 9.43 g. It has 2–3 primary branches with 9–10 clusters per plant. IC415482 produces an average seed yield of 16.52g per plant compared to the 16.94 g in Pusa Vishal. A photograph comparing the seeds of extra bold seeded germplasm accession IC418452 with that of cultivars namely M1319B, Pusa Vishal and Pusa 105 is given below:

Seed size is an important character in mungbean since large seed has an advantage of having higher stored energy supply and also has good consumer preference. The extra bold seeded mungbean genotype IC418452 can be utilized in developing improved mungbean cultivars with bold seeds and higher yield.

to the normal pigeonpea plant. The leaflet apices were protruded inwards to the mid rib. However, the veination was prominent and normal. The plant had short stature as compared to the normal plant of the genotype.

The plant is successfully converted into sterile cytoplasm (CMS base male sterility) to take the advantage of open flower for easy pollination and to facilitate easy seed production to minimise the cost.

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78. MTS-37 (IC 0418452; INGR 10107), a Mungbean (*Vigna radiata*) Germplasm, with Highest Seed Weight (9.43 g/100seed)

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Seed size is an important character in mungbean since large seed has an advantage of having higher stored energy supply and also has good consumer preference. The extra bold seeded mungbean genotype IC418452 can be utilized in developing improved mungbean cultivars with bold seeds and higher yield.

In addition, it can be utilized in mapping QTLs (genes) for seed weight in mungbean.

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79. PRB-2006-5 (IC573439; INGR10108), a Mustard (*Brassica juncea*) Germplasm, with Bold Seed

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PRB-2006-5 is an Indian-mustard (*Brassica juncea* L. Czern. & Coss.) strain registered for seed boldness with national identity, IC0573439 and registration number INGR10108. It was developed from a three-way cross "(Kranti×LPIPS-2)×BSIPS-11" by pedigree selection. Among its parents Kranti is a high yielding widely adapted variety but its small seeds have generally been a deterrent for its wide acceptance by its growers. LPIPS-2 is a long siliquae (>4 cm) and BSIPS-11 is a bold seeded selection developed through pedigree selection following hybridization between medium bold × bold seeded strains.

It was tested in the coordinated Initial Varietal Trial-Mustard (Timely sown) under AICRP on Rapeseed-Mustard at 16 locations across zones during Rabi 2007-08 (AICRP on Rapeseed-Mustard, 2008). On the basis of average over locations in IVT-Mustard, PRB-2006-5 registered the boldest seeds averaging 6.10 g/1000-seeds which were 16.86 and 37.70% higher than national checks Varuna and Kranti respectively. Its boldest seed were produced at Morena location in zone-III (7.90 g/1000 seeds). The seeds of PRB-2006-5 are brown with 39.52% oil and 20.89% protein. Being an improved genetic stock it is high yielding (1949 kg/ha) and at par with varieties Varuna (1838 kg/ha) and Kranti (2014 kg/ha) besides having extra bold seeds.

It is medium maturing genotype (135 days) being numerically at par with that of Varuna (134 days) and Kranti (133 days). PRB-2006-5 is being used as potential genetic donor in mustard breeding programme for improving the seed size-an important seed yield component in mustard besides other traits.

References

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80. PCL8 (IC0563952; INGR10109), a Linseed (*Linum usitatissimum*) Germplasm, with High Yield Coupled with Resistance against Major Diseases

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Development of high yielding multiple diseases resistant varieties has been thrust areas of linseed breeding. PCL 8 – a derivative of cross (RL 993 × Ayogi) × Ayogi was handled through pedigree method of breeding at Project Coordinating Unit (Linseed), CSA University of Agriculture and Technology, Campus, Kanpur.

In addition, it can be utilized in mapping QTLs (genes) for seed weight in mungbean.

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Dwivedi, NK and S Gopala Krishnan (2009) IC418452 – A unique extra bold seeded germplasm accession of mungbean [*Vigna radiata* (L.) Wilczek] *J. Arid Legumes* **6 (2):** 77-79.

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79. PRB-2006-5 (IC573439; INGR10108), a Mustard (*Brassica juncea*) Germplasm, with Bold Seed

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Table1. Disease Reactions of linseed genotype PCL 8 in Uniform disease nursery trial (UDN Natural)

Entry	Alternaria blight (0–5 Scale*)													
	Berhampore		Faizabad		Jashipur	Kangra	Kanke	Kaul	Kota	Ludhiana	P.C.Unit	Raipur		Overall rating
	L	B	L	B								L	B	
PCL 8	1	29.8	1	10.0	0	23.3	2	0	4	27.5	2	1	12.41	MR
Sheela (RC)	3	26.1	2	15.0	1	23.6	1	0	–	20.7	2	1	20.22	MR
Chambal (SC)	3	12.5	3	20.5	4	—	2	0	–	22.5	3	–	13.24	MS

Entry	Powdery mildew (0–5 Scale*)						
	Kota	Mauranipur	Nagpur	Jashipur	Raichur	Raipur	Overall rating
PCL 8	3	1	0	0	2	0	R
Kiran (RC)	–	1	1	0	2	1	R
Chambal (SC)	–	4	5	0	5	5	HS

Entry	Rust (0–5 Scale*)			
	Kangra	Kanke	Berhampore	Overall rating
PCL 8	1	1	1	R
Surabhi (RC)	0	1	1	R
Chambal (SC)	5	2	1	HS

L = Leaf; B= Bud; RC = Resistant Check; SC= Susceptible check

1 = 0 to 10% area of leaves/plant infection (R),
2 = 10.1 to 25% area of leaves/plant infection (MR),
3 = 25.1 to 50% area of leaves/plant infection (MS),
4 = 50.1 to 75% area of leaves/plant infection (S),
5 = Above 75% area of leaves/plant infection (MS)

Source: Annual Report (Linseed), 2006 –07, pp: 162–163.
(0–5 Scale*)
0 = No disease or free,

PCL 8 was screened under natural condition of uniform disease nursery trial during *rabi* 2006-07 and found to be resistant to rust, powdery mildew and moderately resistant *Alternaria* blight which are the major diseases of economic importance (Table 1).

It is a blue flowered variety with disc shape flower and semi-twisted aestivation. PCL 8 belongs to medium maturity group (139 days) and can gain a height up to 70cm. Its seed colour is light brown and medium sized seed contains 38.93 per cent oil.

PCL 8 recorded mean seed yield of 1359 kg/ha in initial varietals trial conducted under irrigated condition at 20 locations during *rabi* 2006-07.

81. CMSA-line & B-line (IC0570071 & IC0570261; INGR10110), a Carrot (*Dacus carrota* L.) Germplasm, Petaloid Type Stable Male Sterile Line of Asiatic Carrot

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Male sterility is a noble tool in the hands of plant breeders for their usefulness in hybrid seed production of crop plants. The male sterility in temperate type carrot has been available since long (Thompson, 1962 and Morelock, 1974). There are two main sources of cms identified in carrots: I) Petaloid and carpeloid CMS system which was found in wild stocks of carrot where, stamens get modified to petals (Munger, 1953) or to carpels (Linke *et al*., 2003). II) Brown anther type CMS, where, anthers get dried and deformed due to degeneration found by Welch and Grimball, 1947 in cv. Tendersweet. Newer sources for both types of CMS have been found in the recent years. However, there are no reports of male sterile lines in Asiatic carrot.

Studies were conducted at Plant Biotechnology Center, Rajasthan Agricultural University, Bikaner to isolate male sterile line (s) from the local carrot

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Entry	Powdery mildew (0–5 Scale*)						
	Kota	Mauranipur	Nagpur	Jashipur	Raichur	Raipur	Overall rating
PCL 8	3	1	0	0	2	0	R
Kiran (RC)	–	1	1	0	2	1	R
Chambal (SC)	–	4	5	0	5	5	HS

Entry	Rust (0–5 Scale*)			
	Kangra	Kanke	Berhampore	Overall rating
PCL 8	1	1	1	R
Surabhi (RC)	0	1	1	R
Chambal (SC)	5	2	1	HS

L = Leaf; B= Bud; RC = Resistant Check; SC= Susceptible check

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Studies were conducted at Plant Biotechnology Center, Rajasthan Agricultural University, Bikaner to isolate male sterile line (s) from the local carrot

material collected from the local markets. Some male sterile plants were identified in a seed lot of 'ameri red' cultivar, a local cultivar from Amer region, Jaipur, Rajasthan, India. Sterile plants were noticed for their grossly different umbel morphology. The umbels were devoid of petals and looked sepaloid. The close microscopic examination revealed absence of anthers. In order to recover seeds and establish nature of sterility, different pollination methods (selfing, hand pollination and open pollination) were applied. The plants raised from crossed seed showed complete sterility in next generation.

All of the plants (about 100 from each type of cross) raised from these crosses showed complete sterility over three generations in crosses with different populations while seed set completely failed on selfing. No segregation on crossing with various populations suggests cytoplasmic nature of the male sterility under study. Moreover, the recovery of sterile plants from crosses with various populations involving more than 5 plants each in addition to from open pollination suggests non-availability of restorers for it. However, being a root crop this type of male sterility may efficiently be used for commercial hybrid production in carrot.

Plants of CMS lines obtained in different backgrounds and in its original genotype were otherwise normal growing. However, cross with var. super red (CR 27) produced genotypes with most desirable type root characters resembling to its recurrent parent and was further evaluated and maintained in abundance. The CMS line developed in the back ground of CR 27 was named as PK/RA CR-27S against the male fertile line CR27F**.** The sterile cytoplasm PK/RA CR-27S and its male counter part CR27F has been provided with national identity, IC-570071and IC 0570261 respectively by NBPGR, New Delhi.

The major morphological characters of PK/RA CR-27S (Sterile cytoplasm) are as follows: Root Length:20±2.6 cm., Root girth:11.6±1.79, Days to maturity:100±7.3, Medium self core, Juicy and sweet, Smooth, Cylindrical tapering, Dark red colored roots, Plant height (cm):58.6±6.4, No. of primary branches:6.3±0.55, No. of secondary branches:10.3±1.13, No. of umbel/plant:15±1.4, Umbel size (L×W) cm^2: 41.6±2.6 etc. The cultivation practice is similar like ordinary Asiatic carrots.

In the present CMS system whole umbel look green. This could be a newer class of male sterility. The CMS system reported could be of great importance to resolve genetic and molecular mechanism differentiating carpeloid/sepaloid and brown anther type CMS systems of carrot in addition to their use in hybrid seed production. This is critical as the inheritance of cms has not been considered simple and has not been completely resolved. Both types of cms are dominant and may be determined by triplicated nuclear genes, one dominant (M), the two recessive (t and l), which interact with sterile cytoplasm (Morelock, *et al*.,1996). Maternally inherited defects in the formation of male flower organs leading to cytoplasmic male sterility (CMS) indicate an involvement of mitochondrial genes in the control of flower formation.

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82. Coll. No. 002/FI No. 002 or Gauri-UBKVM-1 (IC0569192; INGR10111), a Nepalease Kutki (*Picrorhiza scrophulariiflora*) Germplasm with High Picroside Content

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The Nepalease Kutki **(***Picrorhiza scrophulariiflora* (Pennell), *Scrophulariacea*, is an endangered small herbaceous plant found in the sub-alpine as well as alpine zone of the eastern Himalayas comprising Sikkim, Nepal and China (Bantawa *et al*., 2009a). The rhizomes are used in Tibetan and Chinese traditional medicines to treat various ailments such as liver disorders, fever, asthma, jaundice and have pharmaceutical value for hepatoprotective, immunomodulator and antiasthamatic activities. Rhizomes of mature plants collected from various locations of the eastern Himalayan region of Indo-China border were characterized morphologically and analyzed chemically by TLC, HPLC to determine the content of marker compounds, namely picroside I and II. Amidst the genotypes, one genotype Gauri-UBKVM-1 was found to contain highest amount of total picroside (7.33% dw) (Table 1). The same genotype was multiplied by micropropagation and distributed to the tribal of Sikkim for sustainable conservation (Bantawa *et al.*, 2009b, Bantawa et al., 2010a, Bantawa et al., 2010b).

Characteristics: Long, thick rhizome,Irhizome with higher dry weight, the picroside content is highest and it is easy to propagate.

Table1. Morphological descriptions and Picroside I and II contents in rhizomes

Name of the gerplasm	Rhizome			Picroside I (%)	Picroside II (%)	Total (%)
	Diameter(cm)	Length (cm)	Dry weight (g/rhizomes)			
Gauri–UBKVM–1	0.7 ± 0.12	11.89 ± 0.4	2.12 ± 0.31	2.21 ± 0.56	5.12 ±0.12	7.33 ±0.68

Data (mean ± SE) pooled from three independent experiments

83. Coll. No. SL No. 005/FL No. 008 or Shankar-UBKVM-2 (IC0569193; INGR10112), an Indian Winter Green (*Gaultheria fragrantissima)* Germplasm with High Essential Oil Content

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Indian Wintergreen (*Gaultheria fragrantissima* Wall. (Ericaceae) is a small woody evergreen perennial plant, found in hilly terrain of north-eastern India including Indo-Nepal as well as Indo-Bhutan territories at an altitude between 1,800 to 2,500 m and also in Nilgiri, Palani hills of Travancore at an altitude above 1,500m in Western Ghats of India (Bantawa and Mondal , 2008). The genus *Gaultheria* comprises about 200 species which are native to a wide geographical areas ranging from Andes, North America, Australia and nearby islands to eastern Asia and Himalayas. Out of the 12 species found in India, two belong to north-eastern India and seven species are found in Darjeeling-Sikkim Himalayas and rest three is available in Western Ghats of South India. This oil is popular as anti-inflammatory, antiseptic and soothing to the digestive system. The oil of wintergreen is an effective remedy for rheumatic, cellulites treatment and arthritic problems and it relieves flatulence and colic. The oil is also used as a flavouring agent (confectionaries,

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herbal tea, tooth paste, etc.) in perfuming industries and as condiments. Traditionally the leaves are used to treat headaches, aching muscles and sore throat. The oil of wintergreen is well document to have fungicidal properties. Leaves of mature plants collected from various locations of the eastern Himalayan region of Indo-China border were analyzed by steam distillation which resulted to identify an elite line (Shankar-UBKVM-2) containing 1.79% essential oil, of which 98% was methyl salicylate as determined by gas chromatography.

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84. NRCO-Coll-77 (IC0566525; INGR10113), a Red Vanda (*Renanthera imschootiana*) Germplasm, with Red Colour Flower, Open Broad Sepals. Endemic to North-East

R Devadas[1], RC Upadhyaya[1], SV Ngachan[3], P Khatiwara[1], K Lachungpa[2], P Subba[2] and D Barman[1]

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Attractiveness, exotic nature, and shelf life of flowers play a major role in ornamental floriculture. Sometimes, rarity of these species also makes them almost novel, but popularity in disguise makes them more vulnerable due to over exploitation and leading even extinction in its own natural habitat. It is the common phenomenon currently occurring to Orchids, especially those listed under threatened and endangered category. *Renanthera imschootiana* Rolfe., known as 'red vanda' classified as an ally to Vanda group (Rao, 1997), comes under such category from north-east India. It is the only one species belonging to the genus Renanthera, found endemic to Manipur, Mizoram and Nagaland that are the part of the Indo-Burma mega bio-diversity hot spot. Enlistment of this species in Appendix-I, CITES (Convention on International Trade in related Endangered Species of Wild Fuana and Flora) during 1975 and prohibition of all species of orchids from exports as per 'Foreign Trade Development and Regulation Act, 1992' in India had much relevance for strengthened protective measures for conserving our rich orchid diversity. This species collected during 1998-99 at Imphal, Manipur with help rendered from ICAR RC NEHR, Manipur Centre was currently conserved at NRC for Orchids, Pakyong, Sikkim (Altitude 1,300 MSL) under the capacity as NAGS (National Active Germplasm Site) for Orchids. Apart from morphological characterization, its true breeding value of the accession was also assessed for effective utilization in genetic enhancement programmes. The accession, being monopodial epiphyte, the growth in terms of height was recorded from 35 cm to > 58 cm in a span of eight years (1999-2007). Stem is stout with leaves linear in shape measuring 7.8 cm x 1.6 cm with approx 14 numbers (per se). Generally the inflorescence is un-branched raceme, but in the year 2007-08 the branching of raceme was also noticed, with a recorded length of 38.2 cm. The flower size measures 4.7 cm x 2.9 cm. The species is peculiarly characterized with short (1.7 cm) and lanceolate shaped dorsal sepal and broader and free lateral sepals with a length of 2.8 cm. The red-purple (RHS-60A), the dominant color of the flower (lateral sepal & lip) and petals were colored grayed orange (RHS-164C)

herbal tea, tooth paste, etc.) in perfuming industries and as condiments. Traditionally the leaves are used to treat headaches, aching muscles and sore throat. The oil of wintergreen is well document to have fungicidal properties. Leaves of mature plants collected from various locations of the eastern Himalayan region of Indo-China border were analyzed by steam distillation which resulted to identify an elite line (Shankar-UBKVM-2) containing 1.79% essential oil, of which 98% was methyl salicylate as determined by gas chromatography.

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with shade. The petals were observed smaller with a length of 1.3 cm and spotted. The lip size recorded 0.6 cm x 0.2 cm having presence of callus. The throat and column are in yellow color (RHS-8A). The flowering traits like spike initiation, flower bud initiation, days to 1st flower opening and days to 1st flower withering showed consistency, except number of raceme branches and number of flowers. Broader lateral sepals with attractive dominant red-purple/ crimson colour and grayed orange with reddish spots of petals in center of flower, having medium range vase life of 23.7 days have high breeding value of this accession for developing new hybrid derivatives at both national and international level.

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85. Selection IIHR-1 (IC0568708; INGR10114), Selection IIHR-2 (IC0568709; INGR10115), Chrysanthemum (*Dendranthema grandiflora*) Germplasm, with Early and Off Season Flowering, Suitable for Pot and Garden Use; Early and Off Season Flowering, Suitable for Pot and Garden Use

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Chrysanthemum is the second largest cut flower grown all over the globe. It is one of the most popular and commercial flower crops grown in India. In India large flowered varieties are grown as cut flower and used for interior decoration and for exhibition purposes. While small flowered varieties are also grown as flower and used for making garland, wreaths, 'veni', religious offerings and for bedding and potting purposes. Small flowered varieties are commercially grown in Tamil Nadu, Karnataka and Maharashtra (Poonam and Ashokkumar, 2007).

Fifteen chrysanthemum varieties have been developed at Indian Institute of Horticultural Research, Bangalore. Recently, efforts have been made to breed early and off-season varieties suitable for Bangalore conditions. Varieties for earliness in germplasm collection were strengthened from different sources. Two open pollinated seedlings, IIHR-1 (Pink Seedling) IIHR-2 (Brown seedling) from early flowering Punjab Gold (PAU, Ludhiana) were found to be promising. These were multiplied by vegetative propagation through rooted cuttings.

Characteristic Features of New Selections

IIHR-1 (Pink Seedling): This early flowering selection produces flowers in about 62.92 days in July-Sept. Plants are dwarf (about 24.14 cm) with yellow green and medium leaves. Flowers are semi double with attractive pink (Purple 75 B) colour and are small-sized (about 3 cm in diameter). Average number of flowers per plant is 318.54 (Table 1)

IHR-2 (Brown Seedling): This early flowering selection produces flowers in about 68.02 days in July-Sept. Plants are dwarf (about 32.43 cm) with yellow green and medium leaves. Flowers are semi double with attractive brown (Grayed Orange 172 A) colour and are small-sized (about 4.84 cm in diameter).Average number of flowers per plant is135.26 (Table 1)

Cultivation

It is multiplied by suckers and cuttings. After flowering, stems are cut back jest above the ground. This induces formation of side suckers that are separated from mother plants and planted in the sand bed. Well-rooted suckers are directly transplanted to well drained red soil. Chrysanthemum is sensitive to waterlogging. Its transplanting is done during March-April under Bangalore like conditions.

Add 20-25 tonnes of well rotten farmyard mannure, 125 kg N, 400 kg P_2O_5 and 200 kg K_2O in a hectare. Well-rooted suckers/cuttings are planted in beds following a spacing of 30 cm × 30 cm.

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IHR-2 (Brown Seedling): This early flowering selection produces flowers in about 68.02 days in July-Sept. Plants are dwarf (about 32.43 cm) with yellow green and medium leaves. Flowers are semi double with attractive brown (Grayed Orange 172 A) colour and are small-sized (about 4.84 cm in diameter).Average number of flowers per plant is135.26 (Table 1)

Cultivation

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Table1. Quantitative and qualitative characters of IIHR–1 and IIHR–2

Variety	IIHR–1 (Pink Seedling)	IIHR–2 (Brown seedling)	Punjab Gold	SEm±	CD @ 5%
Plant height (cm)	24.14	32.43	35.51	0.31	1.22
Plant Spread (cm)	32.97	37.7	33.62	0.3	1.18
No. of Lateral branches	18.80	22.01	18.01	0.09	0.39
Days taken to flowering	62.92	68.02	74.49	0.24	0.95
No. of flowers/plant	318.54	135.26	132.99	0.56	2.21
Size of flowers (cm)	2.95	4.84	6.75	0.05	0.21
Average weight of flowers (g)	0.53	1.51	2.49	0.03	0.12
Yield (gms/plant)	156.62	191.48	325.75	0.69	2.71

Table2. Qualitative characters of IIHR–1 and IIHR–2

Variety	IIHR–1 (Pink Seedling)	IIHR–2 (Brown seedling)	Punjab Gold
Flower colour	Purple 75 B*	Grayed Orange 172 A*	Yellow 12 A*
Disc presence	Prominent	Prominent	Not prominent
Flower type	Semidouble	Semidouble	Double
Economic use	Pot & garden use	Pot & garden use	Pot & garden use

*As per RHS Colour Chart

Another dose of 125 kg N/ha is given at the time of first pinching and 125 kg N/ha is given at the time of first pinching and 125 kg N one month after pinching. Irrigate once or twice in a week depending upon soil and weather conditions.

If foliage first turns yellow and dark brown with blackened margins, spray with Dithane M-45 or Kavach at 0.2%. Powdery mildew disease can be easily identified by powdery growth on leaves. Spraying of wettable sulphur 3 g/litre or Bavistin 2 g/litre helps control it. Aphids sucking the sap on leaves and causing discoloration of petals can be controlled by spraying of Demeton S-Methyl 0.05% (Metasystox 2 ml/litre). Caterpillars feeding on leaves and flowers are checked by spraying of neem oil 4 ml/litre.

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