Plant Germplasm Registration Notice*

The Plant Germplasm Registration Committee of ICAR in its XXIVth meeting held on November 29, 2011 at the National Bureau of Plant Genetic Resources, New Delhi, approved the registration of following 52 germplasm lines out of 104 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. WCF 12-7, WCF 12-61, WCF 12-19 and WCF 12-208 (IC0594376 - IC0594379; INGR11037-INGR11040), Wheat (*Triticum aestivum*) Germplasm with Drought Tolerance

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Morpho-physiological and agronomic characteristics of the RILS selected from the wheat cross WL711 X C306

The parent cultivars WL711 and C306 have several unique morphological and physiological differences in addition to yield and yield components such as: WL711 is a semi-dwarf, high yielding, drought susceptible, medium flowering variety with medium seedling vigour, erect growth habit and medium grains which are dull brown in colour while C306 is a tall, medium yielding, drought tolerant, late flowering variety with high seedling vigour, spreading growth habit and bold grains which are light amber in colour. Results presented here are based on the experiments conducted in the fields of Water Technology Centre, IARI, New Delhi during winter of 2007-08, 2008-09 and 2009-10. Water variable environments were created using differential irrigation.

1. WCF12-7

Morpho-agronomic Characteristics

a.) Tall (122 ± 5cm)

b.) Erect in habit, lodging

c.) Pubescent ears, ear tip fertile

d.) Medium flowering (86 ± 3 DAS)

e.) High yielding (grain yield=642 ± 35g/m^2)

f.) High grain weight (37.41 ± 0.62g 1000^{-1} grains), bold and amber coloured grains

g.) Medium total grain protein content (12.48 ± 0.36%)

h.) Medium gluten content (26.0 ± 0.3%). Grain quality parameters analyzed in grain quality lab, IARI, New Delhi-110 012

Associated Characters and Cultivated Practices

a.) Drought tolerance is based on drought susceptibility index (Fischer and Maurer, 1978). Drought tolerant under water variable environments (DSI=0.83 ± 0.14)

b.) High relative water content under water deficit stress (RWC=74.7 ± 4.0%; Barrs and Weatherly, 1962)

c.) High cellular tolerance under water deficit stress (%Injury=44.3 ± 0.78%; Blum and Ebercon, 1981)

2. WCF12-19

Morpho-agronomic Characteristics

a.) Tall (122 ± 2cm)

b.) Erect in habit, lodging

c.) Pubescent ears, ear tip sterile

d.) Medium flowering (91 ± 2 DAS)

e.) High yielding (grain yield=579 ± 36g/m^2)

f.) Medium grain weight (33.83 ± 1.52g 1000^{-1} grains), amber coloured grains

*Compiled and edited by: Anjali Kak and RK Tyagi, Division of Germplasm Conservation, National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi-110 012

g.) High total grain protein content on dry weight basis (14.75 ± 0.38%)

h.) High gluten content (35.30 ± 0.4%). Grain quality parameters analyzed in grain quality lab, IARI, New Delhi-110012

Associated Characters and Cultivated Practices

a.) Drought tolerance is based on drought susceptibility index (Fischer and Maurer, 1978). Drought tolerant under water variable environments (DSI=0.63 ± 0.08)

b.) High relative water content under water deficit stress (RWC=77.6 ± 4.2%; Barrs and Weatherly, 1962)

c.) High cellular tolerance under water deficit stress (% Injury=43.7 ± 0.61%; Blum and Ebercon, 1981)

3. WCF12-61

Morpho-agronomic Characteristics

a.) Semi-dwarf (103 ± 3cm)

b.) Erect in habit, non-lodging

c.) Glabrous ears, ear tip fertile

d.) Medium flowering (91 ± 3 DAS)

e.) High yielding (grain yield=615 ± 43g/m^2)

f.) Medium grain weight (33.55 ± 0.5g 1000^{-1} grains), brown coloured grains

g.) High total grain protein content on dry weight basis (14.10 ± 0.21%)

h.) High gluten content (31.90 ± 0.6%). Grain quality parameters analyzed in grain quality lab, IARI, New Delhi-110012

Associated Characters and Cultivated Practices

a.) Drought tolerance is based on drought susceptibility index (Fischer and Maurer, 1978). Drought tolerant under water variable environments (DSI=0.82 ± 0.04)

d.) High relative water content under water deficit stress (RWC=77.9 ± 2.7%; Barrs and Weatherly, 1962)

e.) High cellular tolerance under water deficit stress (%Injury=42.1 ± 0.78%; Blum and Ebercon, 1981)

4. WCF12-208

Morpho-agronomic Characteristics

a.) Tall (118 ± 1cm)

b.) Spreading in habit, lodging

c.) Glabrous ears, ear tip sterile

d.) Medium flowering (90 ± 2 DAS)

e.) High yielding (grain yield=618 ± 36g/m^2)

f.) High grain weight (36.12 ± 0.44g 1000^{-1} grains), bold and brown coloured grains

g.) High total grain protein content on dry weight basis (14.26 ± 0.53%)

h.) High gluten content (36.60 ± 0.5%). Grain quality parameters analyzed in grain quality lab, IARI, New Delhi-110012

Associated Characters and Cultivated Practices

a.) Drought tolerance is based on drought susceptibility index (Fischer and Maurer, 1978). Drought tolerant under water variable environments (DSI=0.67 ± 0.14)

b.) High relative water content under water deficit stress (RWC=76.9 ± 3.5%; Barrs and Weatherly, 1962)

c.) High cellular tolerance under water deficit stress (%Injury=31.1 ± 0.8%; Blum and Ebercon, 1981)

Morpho-physiological and agronomic characteristics of the parents of the selected RILs from the wheat cross WL711 x C306

Parent P1- WL711

Morpho-agronomic Characteristics

a.) Semi-dwarf (102 ± 2cm)

b.) Erect in habit, non- lodging

c.) Glabrous ears, ear tip fertile

d.) Medium flowering (88 ± 1 DAS)

e.) High yielding (grain yield=674 ± 57g/m^2)

f.) Medium grain weight (33.10 ± 0.62g 1000^{-1} grains), brown coloured grains

g.) Medium total grain protein content (11.10 ± 0.07%)

h.) Medium gluten content (25.40 ± 0.4%). Grain quality parameters analyzed in grain quality lab, IARI, New Delhi-110012

Associated Characters and Cultivated Practices

a.) Drought tolerance is based on drought susceptibility index (Fischer and Maurer, 1978). Drought susceptible under water variable environments (DSI=1.39 ± 0.15)

b.) Low relative water content under water deficit stress (RWC=66.2 ± 1.6%; Barrs and Weatherly, 1962)

c.) Low cellular tolerance under water deficit stress (%Injury=56.9 ± 0.98%; Blum and Ebercon, 1981)

Parent P2-C306

Morpho-agronomic Characteristics

a.) Tall (128 ± 1cm)

b.) Spreading in habit, lodging

c.) Pubescent ears, ear tip sterile

d.) Late flowering (96 ± 1 DAS)

e.) Medium yielding (grain yield=436± 23g/m^2)

f.) High grain weight (37.52 ± 0.31g 1000^{-1} grains), bold and amber coloured grains

g.) High total grain protein content (13.46 ± 0.19%)

d.) High gluten content (33.40 ± 0.2%). Grain quality parameters analyzed in grain quality lab, IARI, New Delhi-110012

Associated Characters and Cultivated Practices

a.) Drought tolerance is based on drought susceptibility index (Fischer and Maurer, 1978). Drought tolerant under water variable environments (DSI=0.71 ± 0.17)

b.) High relative water content under water deficit stress (RWC=76.1 ± 1.4%; Barrs and Weatherly, 1962)

c.) High cellular tolerance under water deficit stress (%Injury=45.2 ± 0.74%; Blum and Ebercon, 1981)

References

Fischer RA and R Maurer (1978) Drought tolerance in spring wheat cultivars. I. Grain yield responses. *Aus. J. Agri. Res*. **29:** 897-917.

Barrs HD and PE Weatherley (1962) A re-examination of the relatively turgidity technique for estimating water deficits in leaves. *Aus. J. Biol. Sci*. **24:** 519-570.

Blum A and A Ebecron (1981) Cell membrane stability as a measure of drought and heat tolerance in wheat. *Crop Sci*. **21:** 43-47.

2. DMR-PFSR-1 and DMR–PFSR–9 (IC0590094-IC0590095; INGR11041-INGR11042), a Maize (*Zea mays*) Germplasm, Resistant to Post Flowering Stalk Rots caused by *Macrophomina phaseolina* and *Fusarium moniliforme*, with Stiff, Strong and Stay Green Character of Stalk

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1. DMR - PFSR-1: (SW 93D-313-23-Pop-49-S4 (Z Path) -1-3-1-1-1-2-1-2-1-2-1) is an inbred line, source of resistance to post flowering stalk rots of maize caused by *Macrophomina phaseolina* and *Fusarium moniliforme* (Rakshit *et al,* 2011). The primary source of this material was received from CIMMYT. The inbred was developed at DMR, New Delhi, for desirable characters following pedigree breeding methodology. The germplasm /parental material was received from CIMMYT under collaborative programme of evaluation inbred lines against PFSR during 2001-2004. The multi-location evaluation of the genotype was done in hot spot locations at Hyderabad, Udaipur, Delhi and Ludhiana against PFSR from 2006 – 2010 under artificial epiphytotic condition. Maintenance and multiplication of inbred line was done at Directorate of Maize Research, New Delhi and winter nursery at Hyderabad.

Morpho-agronomic Characteristics

PFSR-R1 exhibited strong robust stiff and green stem with purple brace root, sparse spikelet. Plant length is short, conical ear with yellow, round, flint grain, desirable plant type and good agronomic traits like optimum ear placement, stiff stalk, good pollen shed and exhibited consistently resistant reaction against PFSR during four years evaluation. The disease reaction recorded from 1.0 to 4.2 on 1-9 rating scale (1 is highly resistant, 9 is highly susceptible) across the location.

b.) Low relative water content under water deficit stress (RWC=66.2 ± 1.6%; Barrs and Weatherly, 1962)

c.) Low cellular tolerance under water deficit stress (%Injury=56.9 ± 0.98%; Blum and Ebercon, 1981)

Parent P2-C306

Morpho-agronomic Characteristics

a.) Tall (128 ± 1cm)

b.) Spreading in habit, lodging

c.) Pubescent ears, ear tip sterile

d.) Late flowering (96 ± 1 DAS)

e.) Medium yielding (grain yield=436± 23g/m^2)

f.) High grain weight (37.52 ± 0.31g 1000^{-1} grains), bold and amber coloured grains

g.) High total grain protein content (13.46 ± 0.19%)

d.) High gluten content (33.40 ± 0.2%). Grain quality parameters analyzed in grain quality lab, IARI, New Delhi-110012

Associated Characters and Cultivated Practices

a.) Drought tolerance is based on drought susceptibility index (Fischer and Maurer, 1978). Drought tolerant under water variable environments (DSI=0.71 ± 0.17)

b.) High relative water content under water deficit stress (RWC=76.1 ± 1.4%; Barrs and Weatherly, 1962)

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Associated Characters and Cultivated Practices

Stem is green, stiff robust. Resistant against PFSR, is an economically important disease causes reduction of 18.7% in cob weight and 11.2% in 1000-grain weight in infected plants (Cook, 1978). The losses due to this disease in India have also been calculated to range from 10 to 42% (Payak and Sharma, 1978; Desai *et al*., 1991; Harlapur *et al*., 2002).

2. **DMR – PFSR – 9:** (JCY3-7-1-2-1(Z Path) -b-2-1-3-1) is inbred line, source of resistance to post flowering stalk rots of maize caused by *Macrophomina phaseolina* and *Fusarium moniliforme* (Rakshit *et al.,* 2011). The primary source of this material is JCY series from PAU, Ludhiana. The inbred was developed at DMR New Delhi, for desirable character following pedigree breeding methodology. The germplasm /parental material was received from PAU, Ludhiana under collaborative programme of evaluation inbred lines against PFSR during 2001-2004. The multi-location evaluation of the genotype was done in hot spot locations at Hyderabad, Udaipur, Delhi and Ludhiana against PFSR from 2006 – 2010 under artificial epiphytotic condition. Maintenance and multiplication of inbred line was done at Directorate of Maize Research, New Delhi and winter nursery at Hyderabad.

Morpho-agronomic Characteristics

Plant exhibited stay-green character, stiff, strong stem, purple brace root, with light purple silk, sparse spikelets, purple silk, plant length – long, ear conico- cylindrical; Grains are dent, yellow round in shape with desirable plant type and good agronomic traits like optimum ear placement, stiff stalk, good pollen shed. The inbred was consistently resistant against PFSR. The disease reaction recorded from 1.0 to 4.2 on 1-9 rating scale (1 is highly resistant, 9 is highly susceptible) across the location during 4 years of testing.

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Rakshit S, HB Santosh, JC Sekhar, R Nath, M Shekhar, GK Chikkappa, RN Gadag and S Dass (2011) Analyses of genetic diversity among maize inbred lines differing for resistance to pink borer and post-flowering stalk rot *J. Plant Biochem. Biotech.* DOI: 10.1007/s13562-011-0043-8.

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Payak MM and RC Sharma. 1978. Research on disease of maize. *PL 480 project Final Technical Report (April 1969–March 1975). ICAR, New Delhi,* 228p.

3. IPM 205-7 (IC0589309-IC0589310; INGR11043-INGR11044), a Mung bean (*Vigna radiata* (L.) Wilczek) Germplasm with Super Early Maturity

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IPM 205-7: Mungbean [*Vigna radiata* (L.) Wilczek] is an important short duration grain legume having wider adaptability and low input requirements. It is widely grown in the sub-tropical countries of the South and Southeast Asia, Australia, West Indies, South and North America and Tropical and Subtropical Africa. India is the largest producer of mungbean and alone accounts for 65% of the world acreage and 54% of the world production. In India, it is grown in *kharif* (monsoon), *rabi* (winter) and spring/summer seasons in different agro-ecological regions. While comparatively longer duration genotypes (65-75 days maturity) are suitable for cultivation in the *kharif* season, short duration genotypes (<60 days maturity) are desirable for spring/summer seasons. Because of scarcity of irrigation water and intense heat wave during the months of April and May

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3. IPM 205-7 (IC0589309-IC0589310; INGR11043-INGR11044), a Mung bean (*Vigna radiata* (L.) Wilczek) Germplasm with Super Early Maturity

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coinciding with the reproductive phase of this crop in spring/summer sown crop, short duration genotypes are urgently required which can mature in about 50 days. Such genotypes when sown after the harvest of *rabi* crops can complete their life cycle well before the onset of intense heat wave escaping extreme temperatures during pod filling and maturity stage, giving good harvest. Such genotypes can also fit well in different crop rotations and cropping systems. Keeping this in view, an extra early maturing genotype, IPM 205-7 (IC0589309), was developed at Indian Institute of Pulses Research, Kanpur. This genotype has been derived from a cross 'IPM 02-1 x EC 398889' following pedigree method of breeding. It has short-statured and erect plants with green, ovate and entire leaves and a green stem with purple splashes. The flowers are of light yellow color while the pod habit is intermediate. Pods are short, straight and black on maturity while the seeds are green and shining. IPM 205-7 has synchronous maturity and it is resistant to Mungbean Yellow Mosaic Virus. This genotype matured 11-19 days earlier than the different check varieties when sown under Kanpur conditions (20º 27' N latitude, 80º 14' E longitude, and 152.4 meter above the mean sea level). While IPM 205-7 matured in 46-48 days, the check varieties matured in 55-67 days. This genotype can be used as a donor for transfer of earliness in agronomically superior backgrounds.

IPM 409-4: Mungbean [*Vigna radiata* (L.) Wilczek] is economically one of the most important pulse crops of the *Vigna* group and it is cultivated since prehistoric period in India. It is grown throughout Asia, Australia, West Indies, South and North America, Tropical and Subtropical Africa. In India, it is cultivated in different seasons including spring, summer, *rabi* and *kharif*. Development of early maturing genotypes is one of the prime breeding objectives in mungbean improvement programme because such genotypes can fit well in different crop rotations and multiple cropping systems. During spring/summer season, their cultivation after the harvest of wheat in North and Central India may save at least one to two irrigations and one pesticide spray leading to considerable savings. Besides this, it may also help the crop escape from terminal heat wave, which can otherwise lead to premature flower drop and significant yield loss due to lesser pod set. Keeping this in view, an extra early maturing genotype, IPM 409-4 (IC0589310), has been developed at Indian Institute of Pulses Research, Kanpur. This genotype derived from a cross 'PDM 288 x IPM 03-1', following pedigree method of breeding, has short-statured, erect and determinate plant type. The leaves are dark green, ovate and medium-sized with greenish purple veins while the flowers are light yellow in colour. The pods are present above the canopy and are short, black and curved while the seeds are green, shiny and oval in shape. When sown under Kanpur conditions (20º 27' N latitude, 80º 14' E longitude, and 152.4 meter above the mean sea level), this genotype matured 10-19 days earlier than the check varieties. While IPM 409-4 matured in 46-48 days, the check matured in 55-67 days. This genotype has synchronous maturity and is also resistant to Mungbean Yellow Mosaic Virus. Keeping in view its higher yield, resistance to MYMV and extra early maturity, it can be evaluated for possible release besides using it as donor in hybridization programme for development of early maturing and high yielding varieties of mungbean.

4. VBG-09-012 (INGR11045), an Urd Bean (*Vigna mungo*) Germplasm with Multi-Pod Formation at Base of Peduncle, Leaf Axils and Base of Clusters

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It is derived from *Vigna mungo* ADT3 x *V. mungo* var. *silvestris*. It is unique plant type with multipod formation at base of peduncle, leaf axils and base of clusters.

coinciding with the reproductive phase of this crop in spring/summer sown crop, short duration genotypes are urgently required which can mature in about 50 days. Such genotypes when sown after the harvest of *rabi* crops can complete their life cycle well before the onset of intense heat wave escaping extreme temperatures during pod filling and maturity stage, giving good harvest. Such genotypes can also fit well in different crop rotations and cropping systems. Keeping this in view, an extra early maturing genotype, IPM 205-7 (IC0589309), was developed at Indian Institute of Pulses Research, Kanpur. This genotype has been derived from a cross 'IPM 02-1 x EC 398889' following pedigree method of breeding. It has short-statured and erect plants with green, ovate and entire leaves and a green stem with purple splashes. The flowers are of light yellow color while the pod habit is intermediate. Pods are short, straight and black on maturity while the seeds are green and shining. IPM 205-7 has synchronous maturity and it is resistant to Mungbean Yellow Mosaic Virus. This genotype matured 11-19 days earlier than the different check varieties when sown under Kanpur conditions (20º 27' N latitude, 80º 14' E longitude, and 152.4 meter above the mean sea level). While IPM 205-7 matured in 46-48 days, the check varieties matured in 55-67 days. This genotype can be used as a donor for transfer of earliness in agronomically superior backgrounds.

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4. VBG-09-012 (INGR11045), an Urd Bean (*Vigna mungo*) Germplasm with Multi-Pod Formation at Base of Peduncle, Leaf Axils and Base of Clusters

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(E-Mail: mpandiyan8@yahoo.co.in)

It is derived from *Vigna mungo* ADT3 x *V. mungo* var. *silvestris*. It is unique plant type with multipod formation at base of peduncle, leaf axils and base of clusters.

5. VBG-04-014 (IC0589272; INGR11046), an Urd Bean (*Vigna mungo*) Germplasm with Unique Plant Type

M Pandiyan, S Geetha, D Packiaraj, K Thiyagarajan and N Senthil
National Pulses Research Centre, Vamban-622 303, Pudukkottai Dist., Tamil Nadu
(*E-Mail: mpandiyan8@yahoo.co.in*)

It is derived from *Vigna mungo* (VBN1) x *V. mungo* var. *silvestris1*. After flowering, pods comes above the plants.

6. Phule G96006 (IC0589349; INGR11047), a Chickpea (*Cicer arietinum*) Germplasm with Drought Tolerance

Balkrishna Mahadeo Jamadagni, Pandurang Nagoji Harer, Laxman Bapurao Mhase, Devidas Vishnu Deshmukh, Jagannath Vishnu Patil and Vivekanand Madhukar Kulkarni
Mahatma Phule Krishi Vidyapeeth, Rahuri-413 722, Ahmednagar Dist., Maharashtra
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Good yield performance (1,793 kg/ha) under rainfed conditions. Highest Proline content (2,160 mg/100 gm) which imparts high drought tolerance efficiency (DTE 71.36%). Stay green nature, the leaves remain green during grain filling stage even under moisture stress and good yield. Medium size grain with test weight of 18.6 g/100 seed. Resistant to *Fusarium wilt* (6.50%). Protein content (23.9%).

7. BPR-349-9 (IC0589778; INGR11048), an Indian Mustard (*Brassica juncea*) Germplasm with Thermo- Tolerance at Juvenile Stage

JS Chauhan, Maharaj Singh, KH Singh, VV Singh and ML Meena
Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321 303, Rajasthan
(E-mail: kharendrasingh@gmail.com)

The experiments were conducted at five locations (Hisar, Kanpur, Ludhiana, Bharatpur and SK Nagar) during 2009-10 and 2010-11 with 44 and 43 genotypes, respectively for screening against high temperature stress during juvenile stage by growing in plastic trays containing 5kg soil, which was thoroughly mixed with known volume of de-ionized water for germination. Sowing was in rows, with replication for genotype in a random order to avoid minor microclimatic variation inside the tray and the seed germinator. Seedlings were initially allowed to grow at 25±1ºC for days at 70-80% RH and then exposed to 45±1ºC at 30% RH for four hours daily with field capacity of 90-95%. The high temperature treatment was given up to three days. The tolerance was characterized on the basis of percent seedling mortality. Lower the mortality higher the tolerance. The proposed strain showed <20% seedling mortality at out of 10 locations during 2009-10 and 2010-11. It also showed lower seedling mortality then the registered check RH-8814 at 6 out of 10 locations during 2009-10 and 2010-11 (Table 1).

Table 1. Seedling mortality (%) under high temperature at juvenile stage in BPR-349-9 and checks

Centre	2009-10			2010-11	
	BPR-349-9	RH 8814 (Registered)	NRCDR-02	BPR-349-9	BPR-543-2 (Registered)
Hisar	20.0	18.5	18.2	4.9	-
Kanpur	15.8	33.9	26.0	28.4	21.8
Ludhiana	37.3	30.2	27.2	18.4	22.0
Bharatpur	17.6	32.4	17.5	10.5	17.0
SK Nagar	12.7	12.3	10.7	18.8	23.4
Mean	20.7	25.5	19.9	16.0	21.1

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8. MCA 1 (IC0589777 and IC0590093; INGR11049), a Karan rai (*Brassica carinata*) Germplasm with Cytoplasmic Male Sterility

KH Singh, JS Chauhan, Ritu Shakya, DK Chauhan and Karnal Singh
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Ethiopian mustard (*Brassica carinata* A. Braun) is among the oldest oil crops cultivated in Ethiopia. Owing to its drought and heat tolerance, the crop is now being considered as an alternative to *B. napus* and *B. juncea* in dryer areas of Canada and as a potential oil crop in India. Heterosis has been reported for seed yield as well as for early maturity in this crop. A cytoplasmic male sterility system called moricandia cytoplasmic male sterility (CMS) was developed in *B. juncea* through protoplast fusion of *Moricandia arvensis* and *B. juncea* (Prakash *et al.,* 1998). This CMS system has been used to develop the hybrids in Indian mustard (*B. juncea*) with the release of first public bred hybrid NRCHB 506. Looking the possibility of developing hybrid cultivars in Ethiopian mustard, efforts were initiated to transfer moricandia cytoplasm from a male sterile line of *B. juncea* into *B. carinata*.

The F_1 progeny of the cross MJA1 (CMS line of *B. juncea*) and KR9 (fertile line of *B. carinata*) showed an intermediate phenotype between *B. juncea* and *B. carinata*. The flowers were male sterile with well developed nectaries, style, stigma and gynoecium. Continuous backcrosses with *B. carinata* genotype (recurrent parent used as pollen parent) resulted in genome substitution from *B. juncea* to *B. carinata*. Visual observation on presence/absence of pollen grains revealed the absence of pollen grains in anthers of MCA 1 which was confirmed by the no seed set in selfed buds. On the other hand, pollen grains were present and found viable as depicted by stained pollens viewed under light microscope. Further the seed set under selfed buds confirmed the presence and viability of pollen grains of MCB 1. It confirmed the development of stable male sterile line of *Brassica carinata* after eight backcrosses. This line was named as MCA 1 having moricandia cytoplasm that possesses male sterility and its counterpart fertile line was named as MCB 1. t-statistics used for making comparison between developed cytoplasmic male sterile line MCA 1 and its maintainer line MCB 1, revealed that both A and B lines were statistically at par for days to flower initiation, days to maturity, number of primary branches, length of main raceme, siliquae on main raceme, siliqua length, plant height, petal length, petal width and style length (Table 1). Numerically longer main raceme and more number of siliquae are expected in male sterile line than that of maintainer line due to non production of pollen grains. The significant difference was observed for stamen length being low in male sterle line than its counterpart maintainer line. Underdeveloped stamens are the outcome of interaction between alien cytoplasm from *Moricandia arvensis* and nuclear genome of *B. carinata* resulting into male sterility. However, female fertility has not been affected as depicted by equal number of seeds per siliqua (which are through outcrossing in male sterile line) and siliqua length of MCA 1 and MCB 1. The developed CMS line MCA 1 will pave the way for hybrid development in *B. carinata*.

Table 1. Characterization of MCA 1 (CMS line) and its maintainer (B) line for agronomic and floral traits

Trait	MCA 1	MCB 1	t value	p value
Days to flower initiation	57	58		
Days to maturity	138	140		
Primary branch	10.2	9.6	0.34	0.37
Plant height (cm)	195	193	-0.53	0.31
Length of main raceme (cm)	90	78	1.67	0.06
Siliquae on main raceme	54.8	45.2	1.75	0.06
Siliqua length (cm)	4.9	5.1	-0.71	0.25
Seeds per siliqua	14.2	14.0	0.34	0.37
Petal length	1.42	1.38	1.63	0.08
Petal width	0.62	0.64	-1	0.18
Stamen length	0.64*	0.76	-6	0.001
Style length	0.76	0.72	1	0.18

* Significantly different from respective maintainer line at p= 0.05

Reference

Prakash S, PB Kirti, SR Bhat, K Gaikwad, VD Kumar and VL Chopra (1998) A *Moricandia arvensis*-based cytoplasmic male sterility and fertility restoration system in *Brassica juncea*. *Theo. Appl. Genet.* **7:** 488-492.

9. E 1-3 (IC0590089; INGR11050), a Potato (*Solanum tuberosum* (+) *S. etubersoum*) Tetraploid Somatic Male Fertile Hybrid Carrying Resistance to Potato Virus Introgressed from *S. etuberosum*

Jagesh K Tiwari[1], Poonam[1], D Sarkar[1], SK Pandey[1], Jai Gopal[1] and S Raj Kumar[2]
[1]*Central Potato Research Institute, Shimla-171 001, Himachal Pradesh*
[2]*Institute of Himalayan Bioresource and Technology, Palampur-176 061, Himachal Pradesh*
(E-mail: jageshtiwari@gmail.com)

Interspecific potato somatic hybrids between the cultivated potato *Solanum tuberosum* L., dihaploid C-13 and wild species *S. etuberosum* Lindl. were produced by protoplasts electro-fusion. Since, the wild species is not crossable with cultivated potato therefore somatic fusion was attempted to transfer Potato virus Y (PVY) resistance from the wild species into the cultivated potato as previously investigated by Thieme *et al*. (2004). Post-fusion products were cultured in VKM medium followed by regeneration of calli in MS_{13} K medium at 20ºC under a 16-h photoperiod, and regenerants were multiplied on MS medium. Twenty-one somatic hybrids were confirmed by RAPD, SSR and cytoplasm (chloroplast/mitochondria) type analysis possessing species-specific diagnostic bands of corresponding parents. Tetraploid nature of the somatic hybrid was determined through flow cytometry analysis as described by Arumuganathan and Earle (1991). Somatic hybrid showed intermediate phenotypes (plant, leaves and floral morphology) to their parents in glasshouse grown plants and male fertile following DUS descriptors by Gopal *et al.* (2008). ELISA assay of somatic hybrid E 1-3 after artificial inoculation of PVY infection reveals high resistance (Anonymous 2007). The tetraploid somatic hybrid E 1-3 can be exploited in the future potato breeding programmes.

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Thieme R, U Darsow, Tican L Rakosy, Z Kang, T Gavrilenko, O Antonova, U Heimbach and T Thieme (2004) Use of somatic hybridization to transfer resistance to late blight and potato virus Y (PVY) into cultivated potato. *Plant Breed. Seed. Sci.* **50:** 113-118.

10. P-7 (IC0590090; INGR11051), a Potato (*Solanum tuberosum* (+) *S. pinnatisectum* Tetraploid, Somatic Male Fertile Hybrid Carrying Resistance to Potato Late Blight Introgressed from *S. pinnatisectum*

D Sarkar[1], Jagesh K Tiwari[1], Sushruti Sharma[1], Poonam[1], Sanjeev Sharma[1], J Gopal[1], BP Singh[1], SK Luthra[1], SK Pandey[1] and D Pattanayak[1]
[1]*Central Potato Research Institute, Shimla-171 001, Himachal Pradesh*
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Interspecific somatic hybrids between the dihaploid of cultivated potato (*Solanum tuberosum*) and the diploid wild species *S. pinnatisectum* Dun. were produced via protoplast fusion. Since, the wild species is not crossable with cultivated potato because of genetic barriers therefore somatic hybridization was attempted to transfer late blight resistance from wild species into cultivated (Thieme *et al*. 2010; Polzerová *et al.* 2011). Protoplast isolation, electrofusion, culture of post-fusion products and regeneration of calli/shoots were undertaken following optimized protocols. Regenerants were characterized for hybridity, ploidy and resistance to *Phytophthora infestans* (Mont.) de Bery, causal fungal pathogen of late blight disease. From a total of 126 regenerated macrocalli, 12 somatic hybrids were confirmed by possessing species specific diagnostic bands of their corresponding parents as revealed by RAPD, SSRs and cytoplasmic-DNA analyses. Tetraploid status of the somatic hybrid was determined using flow cytometry analysis as described by Arumuganathan and Earle (1991). Intermediate

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phenotypes for leaf, flower, and tuber characteristics and high male fertility were observed in field-grown hybrid plants following DUS descriptors discussed by Gopal *et al.* (2008). Hybrids were highly resistant to foliage late blight based on field assessment for two seasons using methods of Kaushik *et al.* (2007). In contrast, moderate level of resistance to foliage blight of the somatic hybrid P-7 was observed in hybrids based on the detached leaf assay under laboratory conditions. Overall, somatic hybrid P-7 with moderate levels of resistance to foliage blight was identified, and these will be useful for in situ hybridization in potato breeding efforts.

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11. PS-52 (IC0590839; INGR11052), a Shisham (*Dalbergia sissoo* Roxb.) Germplasm with Straight Bole and High Height and Diameter

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Shisham (*Dalbergia sissoo* Roxb.) is one of the most important multipurpose plantation tree of northern India. It grows naturally and it is also planted on alluvial soils. It is cultivated more extensively than any other species except teak. In its natural habitat the tree grows rigorously in the new alluviums formed deposits of sand, boulders and gravels in the sub-Himalayan river beds and river banks. It prefers well drained sandy loam soils with adequate moisture supply. Shisham is a deciduous tree and coppices vigorously and produces profuse root suckers. The roots including taproots and lateral roots are covered with nitrogen fixing bacteria *Rhizobium*.

PS-52 has been selected as plus tree from natural population from Gonda district of Uttar Pradesh. It has shown superiority for straight bole and high height (13.70 m) and diameter (15.40 cm) growth at the age of 10 years and registered for these parameters, besides shown resistance to mortality (Tewari and Kaushal, 2006). PS-52 plants may be propagated through clonal propagation (sprout cuttings and root suckers). Nicked root plants may be planted in January - February while poly-packed plants may be planted in July – August. Germplasm PS-52 has been evaluated in agroforestry coordinated trials for over ten years and found consistent for its traits expression (AICRP on Agroforestry, 2011).

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Shisham (*Dalbergia sissoo* Roxb.) is one of the most important multipurpose plantation tree of northern India. It grows naturally and it is also planted on alluvial soils. It is cultivated more extensively than any other species except teak. In its natural habitat the tree grows rigorously in the new alluviums formed deposits of sand, boulders and gravels in the sub-Himalayan river beds and river banks. It prefers well drained sandy loam soils with adequate moisture supply. Shisham is a deciduous tree and coppices vigorously and produces profuse root suckers. The roots including taproots and lateral roots are covered with nitrogen fixing bacteria *Rhizobium*.

PS-52 has been selected as plus tree from natural population from Gonda district of Uttar Pradesh. It has shown superiority for straight bole and high height (13.70 m) and diameter (15.40 cm) growth at the age of 10 years and registered for these parameters, besides shown resistance to mortality (Tewari and Kaushal, 2006). PS-52 plants may be propagated through clonal propagation (sprout cuttings and root suckers). Nicked root plants may be planted in January - February while poly-packed plants may be planted in July – August. Germplasm PS-52 has been evaluated in agroforestry coordinated trials for over ten years and found consistent for its traits expression (AICRP on Agroforestry, 2011).

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12. PP-5 (IC0590840; INGR11053), a Poplar (*Populus deltoids* Bartr.) Germplasm with High Height and Diameter

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Poplar (*Populus deltoids* Bartr.) is one of the most important agroforestry tree species in the states of northern India. Owing to fast growth rate and ability to grow well over large areas in the alluvial plains, poplar contributes greatly towards production of wood for industrialization and other commercial purposes, besides maintaining ecological balance and also as an excellent source of income to the farmers. It has assumed the status of being commercially most useful tree species of the genus *Populus* in India. The genus *Populus* belongs to family Salicaceae and its wood is used in manufacture of packing cases, hardboard, veneers, sport goods, pulpwood and poles. Besides this, poplar wood is also used in matchbox industry for manufacturing match splints and boxes.

PP-5, a mutant has been developed through mutation breeding using parental line L-89-4. Germplasm PP-5 has shown its superiority and registered for higher height growth (22.3%) and diameter growth (24.27%) than the check G 48. It has also shown resistance to stem borer, clear bole length and winter bud shape and colour in comparison to check (Chaudhary and Tewari, 2006). Large number of uniform plants can be produced through clonal propagation (stem cuttings). Germplasm PP-5 has been evaluated in agroforestry coordinated trials for about ten years and found consistent for its traits expression and shown its stability (AICRP on Agroforestry, 2006). PP-5 has high commercial value and may be planted under agroforestry system (as inter-crop and on field boundary) in whole of northern states *viz.* Punjab, Haryana, western Uttar Pradesh and Uttrakhand between January 15 to February 15.

References

AICRP (Agroforestry) 2006. *Annual Progress Report* of G.B.Pant University of Agriculture & Technology, Pantnagar-263 145, Uttrakhand.

Chaudhary L and Salil K Tewari (2006) Identification of Poplar clones through Morphological Markers of winter buds. *Indian J. Forestry*. **29:** 135-138.

13. NRCGCS-15 (IC0589174; INGR11054) Multiple Disease Resistant Spanish Bunch Groundnut Genotype

SK Bera[1], Gururaj Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1], T Radhakrsihnan[1]
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(E-mail: rathnakumar@nrcg.res.in)

NRCGCS-15 (IC0589174; INGR11054) was selected from advanced generation of cross (CT7-1 x SBXI) x *A. pusilla.* 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 37 days after sowing (DAS) and matures in 118 DAS during rainy season. The genotype produces an average pod yield of 97.66 g per square metre with 67% shelling out turn. Pods are slightly constricted with prominent beak and deep reticulation; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 44.6 g and contain 51.5% oil. The severity of foliar diseases in the genotype under field conditions are 2.8 for rust, 5.0 for early leaf spot and 5.0 for late leaf spot on a modified 9-point scale, and an incidence of 6.9% for peanut bud necrosis disease (PBND) and 5.2% 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.

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14. NRCGCS-74 (INGR11055) a Multiple Disease Resistant Spanish Bunch Groundnut Genotype

SK Bera[1], Gururaj 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 Sciences, Raichur-584 102, Karnataka*
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15. NRCGCS-186 (INGR11056) a Multiple Disease Resistant Virginia Runner Groundnut Genotype

SK Bera[1], Gururaj Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS-186 was selected from advanced generation of cross (C-364 x PBDR 25) x *A. oteroi.* The genotype was developed by pedigree selection from inter-specific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has Virginia runner growth habit, produces 50% flowering in 32 days after sowing (DAS) and matures in 123 DAS during rainy season. The genotype produces an average pod yield of 46.83 g per square metre with 65% shelling out turn. Pods are slightly constricted with moderate beak and reticulation; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 32.5 g and contain 50% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 4.0 for early leaf spot and 4.0 for late leaf spot on a modified 9-point scale, and an incidence of 21.1% for peanut bud necrosis disease (PBND) and 12.8% 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.

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16. NRCGCS-196 (IC0589180; INGR11057) a Multiple Disease Resistant Virginia Bunch Groundnut Genotype

SK Bera[1], Gururaj Sunkad[2], Vinod Kumar[3], AL Rathnakumar[1] and T Radhakrishnan[1]
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NRCGCS-196 was selected from advanced generation of cross (GAUG-10 X CGC-4018) *A. correntina.* The genotype was developed by pedigree selection from inter-specific progenies developed at the Cytogenetics Section, Directorate of Groundnut Research, Junagadh, Gujarat. The plant has Virginia bunch growth habit, produces 50% flowering in 40 days after sowing (DAS) and matures in 120 DAS during rainy season. The genotype produces an average pod yield of 160.9 g per square metre with 74% shelling out turn. Pods are prominently constricted with prominent beak and deep reticulation; mostly two seeded with rose colour kernels. Kernels are medium in size with hundred kernel mass of 32.5 g and contain 50.7% oil. The severity of foliar diseases in the genotype under field conditions are 3.0 for rust, 3.0 for early leaf spot and 3.0 for late leaf spot on a modified 9-point scale, and an incidence of 9.6% for peanut bud necrosis disease (PBND) and 8.6% 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. TGM-112 (IC0585932 INGR11058), a Groundnut (*Arachis hypogaea*) Germplasm with White to Light Orange Flower Colour Mutation

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Groundnut has been treated extensively to different mutagens for induction of genetic variability. Several studies showed number of mutations affecting leaf size, shape and colour, plant height, plant habit, flower colour, pod and seed traits. Groundnut has five distinct flower colours (white, yellow, orange, burnt orange and amber). Of these, yellow and orange flowers are most common. Seeds of groundnut cultivar tag 24 (Patil *et al.,* 1995) were treated with 150, 250 and 350 gy gamma rays during rainy season 2000 and the M_2 plants were grown at the Bhabha Atomic Research Centre, Mumbai. Groundnut mutant, TGM 112, was isolated with white to light orange flower from the 250 gy treatment with a frequency of 0.02% based on M_2 plant population (Badigannavar, 2007).

In the induced groundnut mutant TGM 112, the colour of petals, namely, standard, wing and keel ranged from different grades of white to light-orange (hence it was referred as light-orange) as compared to orange petals found in the parent variety, TAG 24. Further, the central crescent area of the standard was also light-orange in mutant, while it was orange in the parent. At any given time, the mutant had either all the flowers in white colour or a combination of white and light-orange flowers. The mutant was bred true in the M_3 and its true breeding behaviour was confirmed up to the M_8 generation.

Associated Characters and Cultivated Practices:

In the crosses between the parent variety and mutant, all the F_1 plants had orange flowers indicating dominance of orange flower over light-orange. The F_2 plant population segregated to the 3:1 ratio for orange: light-orange flowered plants. Reciprocal crosses also did not differ from the expected 3:1 ratio, indicating absence of maternal effect for this trait. The F_3 progenies were classified on the basis of plants with orange and light-orange flowers with a good fit to the ratio of 1 (all plants with orange flowers) : 2 (3 orange: 1 light-orange) : 1 (all plants

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17. TGM-112 (IC0585932 INGR11058), a Groundnut (*Arachis hypogaea*) Germplasm with White to Light Orange Flower Colour Mutation

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with light-orange flowers). Thus, both phenotypic and genotypic segregation in F_2 and F_3 generations confirmed that the light-orange flower colour was due to a single recessive gene. Mutant had Spanish bunch growth and branching habit with sequential flower pattern. It matured in 100 days like its parent. The mutant trait is a very good genetic marker for an easy identification.

References

Badigannavar AM (2007) Inheritance of flower colour mutant in groundnut. *Ind. J. Genet*. **67:** 266-267.

Patil SH, DM Kale, SN Deshmukh, GR Fulzele and BG Weginwar (1995) Semi-dwarf, early maturing and high yielding new groundnut variety, TAG-24. *J. Oilseed Res.* **12:** 254- 257.

18. Yellow Stem Mutant Castor (IC0587750; INGR11059), a Castor (*Ricinus communis* L.) Germplasm with Unique Colour and Single Bloom. Facilitating Development of Short Duration Varieties with Synchronous Maturity of Single Harvest

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The castor mutant is characterized by the yellow stem colour with single bloom. While the young seedlings have expressed very light green stem colour which later changing to yellow, it was observed that all other parts of the plants viz., leaves, petiole, inflorescence, peduncle and capsules also gradually turning from light green to yellow. This yellow stem colour mutant of castor is a spontaneously occurred mutant isolated from the breeding line DCS 99 during *kharif* 2009 at the Narkhuda farm of the Directorate of Oilseeds Research (DOR), Hyderabad.

The selfed progenies of the yellow stem mutant plant have been raised during *rabi* 2009-10 and found to be true breeding. Similarly, the selfed progenies of the progeny plants of 2009-10 have been evaluated during immediate *kharif 2010* and subsequently in advanced generation during *rabi* 2010-11, *kharif* 2011 and *rabi* 2011-12 through selfing. The progenies have not shown any deviation in all morphological traits including the yellow stem colour, in five successive generations and hence the mutant is stable in expressing the trait of interest *i.e.,* yellow stem colour. This unique mutant has not been discovered or reported earlier in castor. This mutant will be of immense use not only in understanding several biochemical and physiological mechanisms related to growth and development of castor plant but also in unraveling the evolutionary aspects of different coloured capsule variants in castor. Further, the yellow stem mutant castor can be used as a garden plant with high ornamental value.

19. 96-508-2-90 (IC0588696; INGR11060), a Safflower (*Carthamus tinctorius* L.) Germplasm with Drought Tolerance and Resistance to *Fusarium* wilt

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The safflower breeding line 96-508-2-90 is developed through multiple crosses at the Directorate of Oilseeds Research, Hyderabad. It is a drought and Fusarium wilt resistant high yielding breeding line. It was found to be immune to all Fusarium isolates collected across the safflower growing areas in the country when tested in wilt sick pots and plot. It could yield higher than the highest yielding national check variety A1 over years.

with light-orange flowers). Thus, both phenotypic and genotypic segregation in F_2 and F_3 generations confirmed that the light-orange flower colour was due to a single recessive gene. Mutant had Spanish bunch growth and branching habit with sequential flower pattern. It matured in 100 days like its parent. The mutant trait is a very good genetic marker for an easy identification.

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with light-orange flowers). Thus, both phenotypic and genotypic segregation in F_2 and F_3 generations confirmed that the light-orange flower colour was due to a single recessive gene. Mutant had Spanish bunch growth and branching habit with sequential flower pattern. It matured in 100 days like its parent. The mutant trait is a very good genetic marker for an easy identification.

References

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18. Yellow Stem Mutant Castor (IC0587750; INGR11059), a Castor (*Ricinus communis* L.) Germplasm with Unique Colour and Single Bloom. Facilitating Development of Short Duration Varieties with Synchronous Maturity of Single Harvest

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The castor mutant is characterized by the yellow stem colour with single bloom. While the young seedlings have expressed very light green stem colour which later changing to yellow, it was observed that all other parts of the plants viz., leaves, petiole, inflorescence, peduncle and capsules also gradually turning from light green to yellow. This yellow stem colour mutant of castor is a spontaneously occurred mutant isolated from the breeding line DCS 99 during *kharif* 2009 at the Narkhuda farm of the Directorate of Oilseeds Research (DOR), Hyderabad.

The selfed progenies of the yellow stem mutant plant have been raised during *rabi* 2009-10 and found to be true breeding. Similarly, the selfed progenies of the progeny plants of 2009-10 have been evaluated during immediate *kharif 2010* and subsequently in advanced generation during *rabi* 2010-11, *kharif* 2011 and *rabi* 2011-12 through selfing. The progenies have not shown any deviation in all morphological traits including the yellow stem colour, in five successive generations and hence the mutant is stable in expressing the trait of interest *i.e.,* yellow stem colour. This unique mutant has not been discovered or reported earlier in castor. This mutant will be of immense use not only in understanding several biochemical and physiological mechanisms related to growth and development of castor plant but also in unraveling the evolutionary aspects of different coloured capsule variants in castor. Further, the yellow stem mutant castor can be used as a garden plant with high ornamental value.

19. 96-508-2-90 (IC0588696; INGR11060), a Safflower (*Carthamus tinctorius* L.) Germplasm with Drought Tolerance and Resistance to *Fusarium* wilt

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The safflower breeding line 96-508-2-90 is developed through multiple crosses at the Directorate of Oilseeds Research, Hyderabad. It is a drought and Fusarium wilt resistant high yielding breeding line. It was found to be immune to all Fusarium isolates collected across the safflower growing areas in the country when tested in wilt sick pots and plot. It could yield higher than the highest yielding national check variety A1 over years.

20. CNH 301 (IC0587405; INGR11061), a Cotton (*Gossypium hirsutum*) Germplasm with Drought Tolerant Nature and Yield Stability

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(E-mail: sumanbalasingh2005@yahoo.com)

The advance culture was developed through pedigree breeding from a single cross between SRT 1 x 1301 DD. F1 and F2's were evaluated under both rainfed and irrigated condition followed by selection under rainfed condition. The single plant selections were further tested under both the conditions and under simulated drought in pots. Drought susceptibility index was estimated and progenies were selected with low susceptibility index.

CNH 301 is one of the progeny which recorded high seed cotton yield and maintained high leaf water potential through higher stomatal resistance and lower rate of transcription, high chlorophyll stability and low % fall in pH. It possesses small thick leaves, compact plant body with yellow flowers. All these character are associated with drought tolerance.

21. IGFRI-CcSx -08/1 (IC0590889; INGR11062), an Anjan grass (*Cenchrus ciliaris* L.) Germplasm with a Rare Obligate Sexual Plant

Suresh Kumar, Amaresh Chandra, MG Gupta and GP Shukla
Indian Grassland and Fodder Research Institute, Jhansi-284 003, Uttar Pradesh
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Buffel grass (*Cenchrus ciliaris* L.), also known as Anjan grass, is an important forage grass grown throughout the semi-arid tropics. It reproduces predominantly by aposporous apomixis (Yadav *et al*., 2011). Apomixis provides a means of clonal propagation through seeds by producing progenies which are genetically identical to the mother plant. Absence of sexual reproduction in *C. ciliaris* has severely limited the possibilities of genetic improvement of this species. Clonal mode of reproduction further complicates molecular studies for apomixis. Generally, apomixis is dominant over sexuality due to which occurrence of obligate sexual plants in natural population becomes rare, and over a period of time apomictic individuals outnumber sexual ones. Since *C. ciliaris* is protogynous, open pollination leads to fertilization by neighbouring apomictic plants that gives rise to either facultative or obligate apomictic types. On screening the germplasm collection of *C. ciliaris* at IGFRI, a natural variant of Indian accession was identified to be exclusively sexually reproducing as examined by pistil-clearing technique and embryo sac analysis (Young *et al*., 1979). In contrast to the source plant being an apomict, the variant was found to be obligate sexual and self-incompatible.

Embryo sac analysis in two constitutive years confirmed that the plant bears eight-nucleated sexual embryo sacs. The sexual plant was observed to be very short in stature with distinct morphology. The plant bears awnless panicles of smaller size with a fewer florets. Leaves are comparatively thick, smaller in size and placed at shorter internodes. The plant was characterized as protogynous, self-incompatible with poor seed setting on open pollination (Kumar *et al.,* 2010).

Flow cytometric analysis confirmed it to be a tetraploid (2n=4x=36). Being perennial in nature, it is maintained by vegetative propagation using root-slips. Under natural conditions the plant shows very poor growth and survival. In pots with intensive care the plant grows well and flowers 3-4 times in a year. Due to self-incompatibility the plant does not produce seeds in isolation or on selfing, however seeds were obtained on open pollination. As per our knowledge, this is the only obligate sexual *Cenchrus ciliaris* plant available in the country. The plant is very useful for genetic improvement/studies of this species by hybridization, studying phylogenetic relationship, genome mapping and identification of gene(s) for apomixis.

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23. TV-3, TV-4, TV-5, TV-6, TV-7, TV-8, TV-9, TV-10, TV-11, TV-12, TV-13, TV-14, TV-15, TV-16, TV-18, TV-21, TV-22, TV-23, TV-24, TV-25, TV-26, TV-27, TV-28, TV-29, TV-30 and TV-31 (IC0587385-IC0587404 and IC0587772-IC0587777; INGR11063-INGR11088), Tea (*Camellia sinensis*) Germplasm

Tarun Sen Burman

Tocklai Experimental Station, Tea Research Association, Jorhat-785 008, Assam
(E-mail: tra.tocklai@tocklai.net)

TV-3: High Assam flavour tea. Leaf base round, leaf apex acute, small leaves.

TV-4: Temperature tolerant and resistance to tea thrips. Leaf base highly acute, venation not prominent, large leaves.

TV-5: Assam flavour with different genetic background, resistance to tea jassids. Leaves highly ovate, leaf blade rough, venation not prominent.

TV-6: Mild liquor with high flavour Assam variety, resistance to red rust. Bullation very high, leaf apex down turn, leaf base round.

TV-7: Darjeeling flavour, multiple stem, leaves very small, venation not prominent.

TV-8: Large leaf Assam variety with less fibre. Resistant to Red Spider mite. Leaf apex highly acute, leaf base highly acute, leaves concave type.

TV-9: Tolerant to water logging. Early flusher. Leaves blackish green colour, highly lanceolate, serration very high.

TV-10: Assam flavour and bright liquor with different genetic background. High leaf chlorophyll and resistance to Pink mite infestation. Leaves ovate, leaf apex mucronate type, serration very low.

TV-11: Assam variety with high flavour and bright liquor, Resistance to thorny stem blight infection. Leaves lanceolate – ovate, leaf blade curved upward, venation not prominent.

TV-12: High rooting performance of cuttings. Bright liquor. Leaves boat shaped, serration very high, leaves hard.

TV 13: Large leaf Assam flavour variety with different genetic background; Soft shoot and less fibre. Leaf base acute, leaf blade curved downward, pubescence dense.

TV 14: High leaf water potential, bright infusion. leaf apex bluntly acuminate, pubescence sparse, serration very low.

TV 15: Assam hybrid, high flavour with different genetic background. Resistant to black root rot. Leaf shape ovate, bullation not prominent and pubescence dense.

TV 16: Radiation tolerant and Sun scorch resistance. Leaf blade expanded (leathery), high serration and pubescence is sparse.

TV 18: Minty flavor. Dark pink pigmentation during autumn at petiole region, leaf blade lanceolate.

TV 21: Quality clone with unique Assam flavour, light leaf Assam variety. Leaf apex acuminate, leaf blade expanded (large), bullation absent.

TV 22: Very high yielding, drought tolerant with different genetic background. High photosynthesis and resistance to Eelworm infestation. Leaf blade expanded (small), leaf shape ovate, leaf base shape obtuse.

TV 23: Very high yield, vigorous growth, drought tolerant with different genetic background, termite resistant. Leaves glossy, leaf margin wavy, serration very high.

References

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TV 23: Very high yield, vigorous growth, drought tolerant with different genetic background, termite resistant. Leaves glossy, leaf margin wavy, serration very high.

TV 24: High leaf proline, cold resistant. Leaf venation not prominent, leaf blader margin entire, leaf apex acute.

TV 25: High yield with high leaf area index. Tolerant to drought with different genetic background. High water use efficiency and resistance to cockchafer grub. Leaf apex macronulate, leaf apex habit down turned, bullation prominent.

TV 26: High yield, tolerant to drought with different genetic background. Low transpiration, Resistance to Root knot nematode. Leaf apex acute, leaf apex habit down turned, Leaf bullation absent.

TV 27: High yield a, high shoot density and resistant to black rot. Leaf shape lanceolate, leaf base semi erect (50˚-70˚), leaf colour intermediate.

TV 28: High yield and tolerant to drought with different genetic background. Resistance to blister blight. Leaf shape ovate, leaf base erect (<50˚), leaf colour light green.

TV 29: High yielding variety, Triploid (3n = 45), resistant to root diseases. Leaf shape elliptical, leaf colour dark and medium glossy, large shoot size.

TV 30: High yield with different genetic background. Resistance to blister blight and tea mites. Leaf shape ovate, light pink pigmentation during winter and moisture stress conditions.

TV 31: Coppery yellow shoot; Resistance to tea mosquito bug. Coppery yellow young shoot, leaf shape elliptic, leaf base semi erect (50˚-70˚).