Plant Germplasm Registration Notice

The Plant Germplasm Registration Committee of ICAR in its XIXth meeting held on March 13, 2009 at the National Bureau of Plant Genetic Resources, New Delhi approved the registration of following 69 germplasm lines out of 129 proposal considered.

1. ARC 15831 (IC567515; INGR09001), a Rice (*Oryza sativa*) Germplasm with Resistance to Rice Gall Midge Biotype 1, 2, 3, 4 and 4 M

Directorate of Rice Research, Hyderabad

ARC 15831 (INGR 09001, IC567515) is derived from a landrace of Assam, conferring resistance against the Asian rice gall midge (*Orceolia oryzae*). It has been systematically evaluated against all the prevailing gall midge biotypes under the All India Coordinated Improvement Programme (AICRIP),DRR. It showed resistance against biotypes 1, 2, 3, 4 and 4M (Kalode *et al.*, 1983; Vijaya Lakshmi *et al.*, 2006).

2. INRC 3021 (IC567516; INGR09002)), a Rice (*Oryza sativa*) Germplasm with Resistance to Rice Gall Midge Biotype 1, 2, 3, 4 and 4 M

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The rice variety INRC 3021 is a derived from a landrace from Chhattisgarh, conferring resistance against the Asian rice gall midge (*Orceolia oryzae*). It has been systematically evaluated against all the prevailing gall midge biotypes under the All India Coordinated Improvement Programme (AICRIP); DRR. It showed resistance against biotypes 1, 2, 3, 4 and 4 M (Kalode *et al.*, 1983; Vijaya Lakshmi *et al.*, 2006).

3. INRC 202 (IC567517; INGR09003), a Rice (*Oryza sativa*) Germplasm with Resistance to Rice Gall Midge Biotype 1, 2, 3, 4 and 4 M

Directorate of Rice Research, Hyderabad

The rice variety INRC 202 is derived from a land race from Chhattisgarh, conferring resistance against the Asian rice gall midge (*Orceolia oryzae*). It has been systematically evaluated against all the prevailing gall midge biotypes under the All India Coordinated Improvement Programme (AICRIP); DRR. It showed resistance against biotypes 1, 2, 3, 4 and 4 M (Kalode *et al.*, 1983; Vijaya Lakshmi *et al.*, 2006).

4. Aganni (IC567518; INGR09004)), a Rice (*Oryza sativa*) Germplasm with Resistance to Rice Gall Midge Biotype 1, 2, 3, 4 and 4 M

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The rice variety Aganni is a landrace from Manipur, conferring resistance against the Asian rice gall midge (*Orceolia oryzae*). It has been systematically evaluated against all the prevailing gall midge biotypes under the All India Coordinated Improvement Programme (AICRIP); DRR. It showed resistance against biotypes 1, 2, 3, 4 and 4M (Kalode *et al.*, 1983; Vijaya Lakshmi *et al.*, 2006). Aganni is also reported to be resistance to the African rice gall midge *O. oryzivora* (Ukwungwu and Joshi, 1992).

References

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5. HS-492 (IC566223; INGR09005), a Wheat (*Triticum aestivum)* Germplasm Resistant Against all the Pathotypes of Leaf Rust

Sanjay Kumar, Dharam Pal, DK Bhatnagar and Rashmi Bhatnagar
Indian Agricultural Research Institute, RS, Shimla

HS-492 has been registered as a source of resistance against all the pathotypes of brown leaf rust (*Puccinia triticina*). It has been derived from HPW42/CPAN2032/ /UNATH KS.

6. PHSL-5 (IC566633; INGR09006), a Wheat (*Triticum aestivum)* Germplasm with Bold Seed

SK Singh, NVPR Ganga Rao, Jag Shoran, Ravish Chatrath, BS Tyagi, Gyanendra Singh and B Mishra
Directorate of Wheat Research, Karnal

PHSL-5 has been registered as a unique source of very bold seed (67.9 g TGW). The genotype also has high protein content, long spikes and more grains per spike as compared to the best checks. This is a cross of Chinese wheat germplasm Long 94 444 and released wheat variety WH542.

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8. PHSL-11 (IC566635; INGR09008), a Wheat (*Triticum aestivum)* Germplasm with High 1000– Grain Weight

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9. PHR-1011 (IC566636; INGR09009), a Wheat (*Triticum aestivum)* Germplasm with High Protein Content

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10. LBRL-11 (IC566637; INGR09010), a Wheat (*Triticum aestivum)* Germplasm with Resistance to Leaf Blight

Gyanendra Singh, Ravish Chatrath, Jag Shoran, DP Singh, BS Tyagi, SK Singh and B Mishra
Directorate of Wheat Research, Karnal

LBRL-11 has been registered as a source of resistance to leaf blight (*Bipolaris sorokiniana*). The genotype along with parents and a susceptible check (Sonalika) was evaluated for *Helminthosporium* Leaf Blight (HLB) reaction under artificial epiphytotic conditions for three years (2005-2008) at Karnal and also at 15 locations across the agro-climatic zones for one year (2007-08). The genotype has true resistance aganist HLB, both at seedling as well as adult plant stage and therefore can be used as an ideal source of resistance for managing leaf blight in wheat through host resistance.

11. LBRL-13 (IC566638; INGR09011), a Wheat (*Triticum aestivum)* Germplasm with Resistance to Leaf Blight

Gyanendra Singh, Ravish Chatrath, Jag Shoran, DP Singh, BS Tyagi, SK Singh and B Mishra
Directorate of Wheat Research, Karnal

LBRL-13 has been registered as a source of resistance to leaf blight (*Bipolaris sorokiniana*). The genotype along with parents and a susceptible check (Sonalika) was evaluated for *Helminthosporium* Leaf Blight (HLB) reaction under artificial epiphytotic conditions for three years (2005-2008) at Karnal and also at 15 locations across the agro-climatic zones for one year (2007-08). The genotype has true resistance aganist HLB, both at seedling as well as adult plant stage and therefore can be used as an ideal source of resistance for managing leaf blight in wheat through host resistance.

12. VQL 3 (IC568701; INGR09012), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

Maize is a globally important crop and a preferred staple food for more than one billion people in Sub-Saharan Africa, Latin America and Asia. In normal maize, all the proteins fractions except zeins are balanced for the amino acid content and are rich in lysine as well as tryptophan content. Normal maize protein is known to have a biological value of 40% of that of milk. The essential amino acids like lysine, tryptophan and threonine are in reduced quantities in maize, lysine being the most limiting followed by tryptophan. In contrast, Quality Protein Maize (QPM) has nearly twice the amount of lysine and tryptophan, which make the protein of QPM equivalent to 90% of the milk protein. This has so far been done by the deployment of mutants through conventional breeding but it can now be accomplished more precisely and rapidly by applying molecular breeding tools (Babu *et al.*, 2005; Gupta *et al.*, 2009). VQL 3 is the QPM version of CM 145 developed through 'Marker Assisted Selection' (MAS).

Morpho-agronomic Characteristics

VQL 3 is an extra early short duration QPM inbred developed by converting CM 145 by using MAS. CM 145 is one of the parents of the elite maize hybrid, Vivek Maize Hybrid 9. VQL 3 is similar to CM 145 except thet VWL 3 has the following traits, *viz*., wide leaf angle between blade and stem; anthocynin pigment present at the brace root and base of glumes; kernels being orange flint; kernel opaqueness present; and small kernel weight with high tryptophan content. It was developed by crossing CM 145 x CML 170. It has 10.29% protein and 0.85% tryptophan (of protein) where as the protein content of CM 145 is 9.5% and the tryptophan content is 0.52%. Both the protein content and the quality got improved in VQL 3 over CM 145, the increase of tryptophan over CM 145 being 63.5% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the

10. LBRL-11 (IC566637; INGR09010), a Wheat (*Triticum aestivum)* Germplasm with Resistance to Leaf Blight

Gyanendra Singh, Ravish Chatrath, Jag Shoran, DP Singh, BS Tyagi, SK Singh and B Mishra
Directorate of Wheat Research, Karnal

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12. VQL 3 (IC568701; INGR09012), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

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Morpho-agronomic Characteristics

VQL 3 is an extra early short duration QPM inbred developed by converting CM 145 by using MAS. CM 145 is one of the parents of the elite maize hybrid, Vivek Maize Hybrid 9. VQL 3 is similar to CM 145 except thet VWL 3 has the following traits, *viz*., wide leaf angle between blade and stem; anthocynin pigment present at the brace root and base of glumes; kernels being orange flint; kernel opaqueness present; and small kernel weight with high tryptophan content. It was developed by crossing CM 145 x CML 170. It has 10.29% protein and 0.85% tryptophan (of protein) where as the protein content of CM 145 is 9.5% and the tryptophan content is 0.52%. Both the protein content and the quality got improved in VQL 3 over CM 145, the increase of tryptophan over CM 145 being 63.5% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the

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11. LBRL-13 (IC566638; INGR09011), a Wheat (*Triticum aestivum)* Germplasm with Resistance to Leaf Blight

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12. VQL 3 (IC568701; INGR09012), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

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Morpho-agronomic Characteristics

VQL 3 is an extra early short duration QPM inbred developed by converting CM 145 by using MAS. CM 145 is one of the parents of the elite maize hybrid, Vivek Maize Hybrid 9. VQL 3 is similar to CM 145 except thet VWL 3 has the following traits, *viz*., wide leaf angle between blade and stem; anthocynin pigment present at the brace root and base of glumes; kernels being orange flint; kernel opaqueness present; and small kernel weight with high tryptophan content. It was developed by crossing CM 145 x CML 170. It has 10.29% protein and 0.85% tryptophan (of protein) where as the protein content of CM 145 is 9.5% and the tryptophan content is 0.52%. Both the protein content and the quality got improved in VQL 3 over CM 145, the increase of tryptophan over CM 145 being 63.5% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the

morphological traits like anthocynin pigmentation of glumes and silk, time of silk emergence, ear placement, number rows of grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 3 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is recommended for children, adults, women and monogastric animals. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system.

13. VQL 8 (IC568703; INGR09013), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 8 is an extra early short duration QPM inbred developed by converting CM 145 by using MAS. CM 145 is one of the parents of the elite maize hybrid, Vivek Maize Hybrid 9. VQL 8 is similar to CM 145 except that it has the following traits, *viz*., wide leaf angle between blade and stem, straight blade attitude, anthocynin pigment present at the brace root and base of glumes, kernels orange flint, kernel opaqueness present, and medium kernel weight with high tryptophan content. It was developed by crossing CM 145 x CML 173. It has 8.84% protein and 0.94% tryptophan (of protein) where as the protein content of CM 145 is 9.5% and the tryptophan content is 0.52%. Both the protein content and the quality got improved in VQL 3 over CM 145, the increase of tryptophan over CM 145 being 80.1% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the morphological traits like anthocynin pigmentation of glumes and silk, time of silk emergence, ear placement, number rows of grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 8 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is recommended for children, adults, women and monogastric animals. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2.5 tonnes per hectare.

14. VQL 12 (IC568706; INGR09014), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 12 is an extra early short duration QPM inbred developed by converting V 25 using MAS. V 25 is an elite maize inbred suitable for the North-western Himalayan states of India. VQL 12 is similar to V 25 except that VQL 12 has small leaf angle between blade and stem, anthocynin pigment present at the brace root and base of glumes, kernels orange flint, kernel opaqueness present, conico-cylindrical ear shape and medium kernel weight with high tryptophan content. It was developed by crossing CM 145 x CML 184. It has 8.42% protein and 0.75% tryptophan (of protein) where as the protein content of V 25 is 9.6% and the tryptophan content is 0.45%. Both the protein content and the quality got improved in VQL 12 over V 25, the increase of tryptophan over V 25 being 66.7% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the

morphological traits like anthocynin pigmentation of glumes and silk, time of silk emergence, ear placement, number rows of grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 3 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is recommended for children, adults, women and monogastric animals. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system.

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HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
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Associated Characters and Cultivated Practices

VQL 8 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is recommended for children, adults, women and monogastric animals. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2.5 tonnes per hectare.

14. VQL 12 (IC568706; INGR09014), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 12 is an extra early short duration QPM inbred developed by converting V 25 using MAS. V 25 is an elite maize inbred suitable for the North-western Himalayan states of India. VQL 12 is similar to V 25 except that VQL 12 has small leaf angle between blade and stem, anthocynin pigment present at the brace root and base of glumes, kernels orange flint, kernel opaqueness present, conico-cylindrical ear shape and medium kernel weight with high tryptophan content. It was developed by crossing CM 145 x CML 184. It has 8.42% protein and 0.75% tryptophan (of protein) where as the protein content of V 25 is 9.6% and the tryptophan content is 0.45%. Both the protein content and the quality got improved in VQL 12 over V 25, the increase of tryptophan over V 25 being 66.7% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the

morphological traits like anthocynin pigmentation of glumes and silk, time of silk emergence, ear placement, number rows of grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 3 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is recommended for children, adults, women and monogastric animals. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system.

13. VQL 8 (IC568703; INGR09013), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

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Associated Characters and Cultivated Practices

VQL 8 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is recommended for children, adults, women and monogastric animals. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2.5 tonnes per hectare.

14. VQL 12 (IC568706; INGR09014), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 12 is an extra early short duration QPM inbred developed by converting V 25 using MAS. V 25 is an elite maize inbred suitable for the North-western Himalayan states of India. VQL 12 is similar to V 25 except that VQL 12 has small leaf angle between blade and stem, anthocynin pigment present at the brace root and base of glumes, kernels orange flint, kernel opaqueness present, conico-cylindrical ear shape and medium kernel weight with high tryptophan content. It was developed by crossing CM 145 x CML 184. It has 8.42% protein and 0.75% tryptophan (of protein) where as the protein content of V 25 is 9.6% and the tryptophan content is 0.45%. Both the protein content and the quality got improved in VQL 12 over V 25, the increase of tryptophan over V 25 being 66.7% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the

morphological traits like anthocynin pigmentation of anthers, glumes and silk, time of silk emergence, ear length, type of grains, number of rows of grains, colour of the grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 12 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2.5 tonnes per hectare. It is recommended for children, adults, women and monogastric animals for food and nutritional security.

15. VQL 16 (IC569174; INGR09015), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 16 is an extra early short duration QPM inbred developed by converting V 340 by using MAS. V 340 is one of the parents of the elite maize inbred suitable for the north western Himalayan states of India. VQL 16 is similar to V 340 except that VQL 16 has wide leaf angle between blade and the stem, anthocynin pigment absent at the brace root and present at the base of glumes, kernels yellow flint, kernel opaqueness present, cylindrical ear shape and medium kernel weight with high tryptophan content. It was developed by crossing V 340 x CML 173. It has 8.30% protein and 0.73% tryptophan (of protein) where as the protein content of V 340 is 8.73% and the tryptophan content is 0.43%. Both the protein content and the quality got improved in VQL 16 over V 340, the increase of tryptophan over V 340 being 69.8% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the morphological traits like, anthocynin pigmentation of anthers, glumes, sheath and silk, time of silk emergence, ear length, type of grains, number of rows of grains, density of grains, kernel 1000-grain weight, colour of the grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the non-QPM and QPM inbreds.

Associated Characters and Cultivated Practices

VQL 16 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2 tonnes per hectare. It is recommended for children, adults, women and monogastric animals as food for the nutritional security.

morphological traits like anthocynin pigmentation of anthers, glumes and silk, time of silk emergence, ear length, type of grains, number of rows of grains, colour of the grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 12 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2.5 tonnes per hectare. It is recommended for children, adults, women and monogastric animals for food and nutritional security.

15. VQL 16 (IC569174; INGR09015), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 16 is an extra early short duration QPM inbred developed by converting V 340 by using MAS. V 340 is one of the parents of the elite maize inbred suitable for the north western Himalayan states of India. VQL 16 is similar to V 340 except that VQL 16 has wide leaf angle between blade and the stem, anthocynin pigment absent at the brace root and present at the base of glumes, kernels yellow flint, kernel opaqueness present, cylindrical ear shape and medium kernel weight with high tryptophan content. It was developed by crossing V 340 x CML 173. It has 8.30% protein and 0.73% tryptophan (of protein) where as the protein content of V 340 is 8.73% and the tryptophan content is 0.43%. Both the protein content and the quality got improved in VQL 16 over V 340, the increase of tryptophan over V 340 being 69.8% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the morphological traits like, anthocynin pigmentation of anthers, glumes, sheath and silk, time of silk emergence, ear length, type of grains, number of rows of grains, density of grains, kernel 1000-grain weight, colour of the grains, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the non-QPM and QPM inbreds.

Associated Characters and Cultivated Practices

VQL 16 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2 tonnes per hectare. It is recommended for children, adults, women and monogastric animals as food for the nutritional security.

16. VQL 30 (IC569176; INGR09016), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 30 is an extra early short duration QPM inbred developed by converting V 360 by using MAS. V 360 is an elite maize inbred suitable for the North-western Himalayan states of India. VQL 30 is similar to V 360 except that VQL 30 has anthocynin pigment absent at the brace root and at base of glumes, kernels orange flint with cap, kernel opaqueness present, cylindrical ear shape, and medium kernel weight with high tryptophan content. It was developed by crossing V 360 x CML 189. It has 8.07% protein and 0.71% tryptophan (of protein) content where as the protein content of V 360 is 8.75% and the tryptophan content is 0.48%. Both the protein content and the quality got improved in VQL 30 over V 360, the increase of tryptophan over V 360 being 47.9% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the morphological traits like the angle between blade and stem, anthocynin colouration of brace root, anthocynin pigmentation of anthers, glumes and silk, time of silk emergence, ear length, type of grains, number of rows of grains, colour of the grains, density of spikelets, time of silk emergence, shape and diameter of ear, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 30 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for the hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2.5 tonnes per hectare. It is recommended for children, adults, women and monogastric animals as food and feed for the nutritional security.

References

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Gupta HS, PK Agrawal, V Mahajan, VP Mani, GS Bisht, A Kumar, P Verma and R Babu (2009) Quality protein maize for nutritional security: Rapid development of short duration hybrids through molecular marker assisted breeding. *Current Sci*. **96**: 230-237.

17. SPV 1742 (IC565017; INGR09017), a Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, Good Roti and Dough Making Qualities

M Elangovan, UD Chavan, VR Bhagwat, TG Nageswararao, B Venkatesh Bhat and CV Ratnavathi
National Research Centre for Sorghum, Hyderabad

Sorghum variety SPV 1742 (INGR09017) with superior roti and dough quality was identified at National Research Centre for Sorghum (NRCS), Hyderabad. The variety was developed through selection from the exotic collection EC515837 imported from Sri Lanka. It was analysed for roti and dough quality parameters at All India Coordinated Sorghum Improvement Project centres during 2007-08. It was identified as superior genotype in eight out of ten roti quality parameters and six out of seven dough quality parameters. The evaluation of roti quality was done on a hedonic scale 1 to 9 ranging from like extremely excellent (1) to dislike extremely (9). The quality parameters of SPV 1742 and check are presented in Table 1.

16. VQL 30 (IC569176; INGR09016), a Maize (*Zea maize* L.) Germplasm, a High Tryptophan Coupled with Reasonably High Protein Content

HS Gupta, PK Agrawal, B Kalyana Babu, Vinay Mahajan, S Saha, GS Bisht and MC Pant
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

VQL 30 is an extra early short duration QPM inbred developed by converting V 360 by using MAS. V 360 is an elite maize inbred suitable for the North-western Himalayan states of India. VQL 30 is similar to V 360 except that VQL 30 has anthocynin pigment absent at the brace root and at base of glumes, kernels orange flint with cap, kernel opaqueness present, cylindrical ear shape, and medium kernel weight with high tryptophan content. It was developed by crossing V 360 x CML 189. It has 8.07% protein and 0.71% tryptophan (of protein) content where as the protein content of V 360 is 8.75% and the tryptophan content is 0.48%. Both the protein content and the quality got improved in VQL 30 over V 360, the increase of tryptophan over V 360 being 47.9% (Agrawal *et al.*, 2008; Babu *et al.*, 2009). Both these lines are resistant to turcicum blight and both have hard grains. The duration of both the inbreds range from 85-90 days. Besides, the morphological traits like the angle between blade and stem, anthocynin colouration of brace root, anthocynin pigmentation of anthers, glumes and silk, time of silk emergence, ear length, type of grains, number of rows of grains, colour of the grains, density of spikelets, time of silk emergence, shape and diameter of ear, kernel waxiness, kernel poppyness, sweetness (absent) are similar between both the inbreds.

Associated Characters and Cultivated Practices

VQL 30 being QPM is a better replacement of normal maize for better nutrition. It will improve the nutritional status of food and feed. It is also resistant to turcicum blight which is a major disease of maize. Being a short duration crop, it is suitable for the hills, peninsular India and those parts of plains where a short duration maize crop will fit to the prevalent cropping system. It is highly responsive to fertilizer application. Under good agronomic conditions, the inbred seed production goes up to 2.5 tonnes per hectare. It is recommended for children, adults, women and monogastric animals as food and feed for the nutritional security.

References

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17. SPV 1742 (IC565017; INGR09017), a Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, Good Roti and Dough Making Qualities

M Elangovan, UD Chavan, VR Bhagwat, TG Nageswararao, B Venkatesh Bhat and CV Ratnavathi
National Research Centre for Sorghum, Hyderabad

Sorghum variety SPV 1742 (INGR09017) with superior roti and dough quality was identified at National Research Centre for Sorghum (NRCS), Hyderabad. The variety was developed through selection from the exotic collection EC515837 imported from Sri Lanka. It was analysed for roti and dough quality parameters at All India Coordinated Sorghum Improvement Project centres during 2007-08. It was identified as superior genotype in eight out of ten roti quality parameters and six out of seven dough quality parameters. The evaluation of roti quality was done on a hedonic scale 1 to 9 ranging from like extremely excellent (1) to dislike extremely (9). The quality parameters of SPV 1742 and check are presented in Table 1.

Table 1. Roti and dough quality analysis at AICSIP trials

Parameters	Dharwad check	SPV 1742
Dough quality		
Water absorption capacity (%)	186.60	172.67
Soluble proteins (%)	1.29	1.26
Crude protein (%)	10.25	9.38
Starch (%)	69.75	70.58
Total soluble sugars (%)	2.19	2.11
Hecto litre weight of the grain (kg/hl)	81.70	81.38
Roti quality		
Water required for dough (ml/ 100 g flour)	125.00	104.44
Colour and appearance	1.67	2.27
Flavour/ aroma	2.00	2.50
Texture	2.03	2.67
Taste 2.17	2.90	
Overall acceptability	1.67	2.47
Kneading quality of dough	1.00	1.00
Storage study of roti (4 h) and 8 h	1.65, 2.47	1.67, 2.47

Source: AICSIP (2008)

The variety is medium in height, semi-compact and elliptical panicle shape. Its seeds are bold and pearly white in colour. It recorded 27 q/ ha and 14 t/ ha of grain yield and fodder yield, respectively with recommended dose of fertilizer. Apart from the roti quality and grain yield, it is also resistant to grain mold and anthracnose in Zone I; resistant to shoot fly in Zone II; resistant to spotted stem borer in Zone I and III; midge resistant in Zone II and III; and resistant to head bug in Zone II.

As sorghum grains are very nutritious and traditional food for the millions of farmers living in the semi-arid tropics of the country. It is consumed as unleavened bread (*bhakri*). The variety also can be used in these regions.

Reference

AICSIP (2008) Report on the AICSIP coordinating team. AICSIP Tech. Pub. Number – 1/2008 (Book 1 of 3 – AGM 08, pre-meet).

18. MS Line 126A and B (IC567687 and IC567688; INGR09018), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

MS line 126A and B is a new sweet sorghum MS line with sweet and grey yellow grain colour. The male sterile line 126A and B was developed from a cross between 2219B x SPV 126 during 1990 by pedigree breeding. The F_2 population was raised during the year 1992, and 20 agronomic superior derivatives were advanced. Based on agronomic superiority the selections were reduced down to six in F_2. The superior cross derivatives in F_4 were test crossed for identification of line with maintainer gene and the steriles were advanced further to BC_5. One argonomically superior male sterile line having good combining ability was developed as 126B male sterile line.

Table 1. Roti and dough quality analysis at AICSIP trials

Parameters	Dharwad check	SPV 1742
Dough quality		
Water absorption capacity (%)	186.60	172.67
Soluble proteins (%)	1.29	1.26
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The variety is medium in height, semi-compact and elliptical panicle shape. Its seeds are bold and pearly white in colour. It recorded 27 q/ ha and 14 t/ ha of grain yield and fodder yield, respectively with recommended dose of fertilizer. Apart from the roti quality and grain yield, it is also resistant to grain mold and anthracnose in Zone I; resistant to shoot fly in Zone II; resistant to spotted stem borer in Zone I and III; midge resistant in Zone II and III; and resistant to head bug in Zone II.

As sorghum grains are very nutritious and traditional food for the millions of farmers living in the semi-arid tropics of the country. It is consumed as unleavened bread (*bhakri*). The variety also can be used in these regions.

Reference

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18. MS Line 126A and B (IC567687 and IC567688; INGR09018), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

MS line 126A and B is a new sweet sorghum MS line with sweet and grey yellow grain colour. The male sterile line 126A and B was developed from a cross between 2219B x SPV 126 during 1990 by pedigree breeding. The F_2 population was raised during the year 1992, and 20 agronomic superior derivatives were advanced. Based on agronomic superiority the selections were reduced down to six in F_2. The superior cross derivatives in F_4 were test crossed for identification of line with maintainer gene and the steriles were advanced further to BC_5. One argonomically superior male sterile line having good combining ability was developed as 126B male sterile line.

19. MS Line 91A and B (IC567689 and IC567690; INGR09019), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

MS line 91A and B is new medium dwarf sweet sorghum male sterile line with yellow grain color, source of male sterility. The male sterile line 91A and B was developed from a cross between 2219B x SPV 221 during 1994. The F_2 population was raised during the year 1996, and 25 agronomically superior derivatives were advanced. The selections were reduced down to six in F_4. The superior cross derivatives in F_4 were test crossed for identification of lines with maintainer gene and the steriles were advanced further to BC_5. One argonomically superior male sterile line having good combining ability was developed as 91B male sterile line.

20. MS Line 356A and B (IC567691 and IC567692; INGR09020), Sorghum [*Sorghum bicolor* (L) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
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MS line 356A and B is new medium dwarf tall sweet sorghum male sterile line with high cane yield, source of male sterility. The male sterile line 356A and B was developed from multiple cross among 2219B (female parent of CSH 6), IS 3691 (a germplasm line) and M 35-1 (Indian local) during 1994. The F_2 population was raised during the year 1996, and 22 agronomically superior derivatives were advanced. The selections were reduced down to six in F_4. The superior cross derivatives in F_4 were test crossed for identification of lines with maintainer gene and the steriles were advanced further to BC_5. One argonomically superior male sterile line having good combining ability was developed as 356B male sterile line.

21. MS Line 288A and B (IC567693 and IC567694; INGR09021), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

MS line 288A and B is new tall and very bold sweet sorghum male sterile line with, source of male sterility. The male sterile line 288A and B was developed from crossing two elite MS lines; one Kharif MS line and 422B and one rabi MS line during 1996. Selection was made according to pedigree method in F_2. The F_2 population was raised during 1998, and 20 agronomically superior derivatives were advanced. The selections were reduced down to six in F_4. The superior cross derivatives in F_4 were test crossed for identification of lines with maintainer gene and the steriles were advanced further to BC_5. One argonomically superior male sterile line having good combining ability was developed as 288B male sterile line.

19. MS Line 91A and B (IC567689 and IC567690; INGR09019), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

MS line 91A and B is new medium dwarf sweet sorghum male sterile line with yellow grain color, source of male sterility. The male sterile line 91A and B was developed from a cross between 2219B x SPV 221 during 1994. The F_2 population was raised during the year 1996, and 25 agronomically superior derivatives were advanced. The selections were reduced down to six in F_4. The superior cross derivatives in F_4 were test crossed for identification of lines with maintainer gene and the steriles were advanced further to BC_5. One argonomically superior male sterile line having good combining ability was developed as 91B male sterile line.

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22. MS Line 45A and B (IC567695 and IC567696; INGR09022), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

MS line 45A and B is new medium tall and bold grain sweet sorghum male sterile line with, source of male sterility. The male sterile line MS line 45A and B was developed from crossing two elite MS lines 296B with Indian local M 35-1 during 1992. The F_2 population was raised during 1994, and 25 agronomically superior derivatives were advanced. The selections were reduced down to six in F_4. The superior cross derivatives in F_4 were test crossed for identification of lines with maintainer gene and the steriles were advanced further to BC_5. One argonomically superior male sterile line having good combining ability was developed as 45B male sterile line.

23. Kagazi madira (B 29) (IC568707; INGR09023), a Barnyard millet (*Echinochloa frumentacea*) Germplasm, Easy De-hulling Type

Arun Gupta, Vinay Mahajan, HS Gupta, KP Singh and GS Bisht
Vivekanand Parvatiya Krishi Anusandhan Sansthan, ICAR, Almora

One of the major hurdles in popularizing small millet except finger millet is the need for de-hulling and pearling before use it for cooking. This process is time consuming and causes drudgery to women as the grains are firmly encased inside the lemma. Identifying varieties which have loose lemma covering and easy to remove is a very important character to utilize in crop improvement programme. B 29 an easy dehulling accession identified from barnyard millet germplasm. The validity test was conducted by rubbing 100 seeds, 100 times on palm. About 48 to 62% seeds of B 29 were dehulled as compared to 5-7% in VL Madira 172.

24. GT-289 (IC565832; INGR09024), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-289A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and SKNP 289 as non-recurrent and recurrent parent, respectively. It has determinate growth with early maturity. Red flowers with unique open petals, purple red stem and red bold seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Associated Characters

GT-289A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	DT
2	Pod bearing habit	Bunch
3	Days of flower	95
4	Maturity days	141
5	Plant height (cm)	75
6	Average number of branches/plant	4.7
7	Average number 0of pods/plant	87
8	Average pod length (cm)	4.7
9.	Average number of seeds/pod	4.0
10	100-seed weight (g)	10.6
11	Seed colour	Red
12	Flower colour	Red
13	Stem colour	Red
14	Average yield/plant (g)	29

22. MS Line 45A and B (IC567695 and IC567696; INGR09022), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

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24. GT-289 (IC565832; INGR09024), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

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Associated Characters

GT-289A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
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10	100-seed weight (g)	10.6
11	Seed colour	Red
12	Flower colour	Red
13	Stem colour	Red
14	Average yield/plant (g)	29

22. MS Line 45A and B (IC567695 and IC567696; INGR09022), Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm, a Source of Male Sterility

S Audilakshmi, C Aruna and N Seetharama
National Research Centre for Sorghum, Hyderabad

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24. GT-289 (IC565832; INGR09024), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

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Associated Characters

GT-289A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
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9.	Average number of seeds/pod	4.0
10	100-seed weight (g)	10.6
11	Seed colour	Red
12	Flower colour	Red
13	Stem colour	Red
14	Average yield/plant (g)	29

25. GT-308A (IC565833; INGR09025), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-308A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and ICPL 87051 as non-recurrent and recurrent parent, respectively. It has determinate growth with green stem, early maturity, red flowers and creamy white medium seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	101
4	Maturity days	148
5	Plant height (cm)	132
6	Average number of branches/plant	10.0
7	Average number of pods/plant	187
8	Average pod length (cm)	4.2
9	Average number of seeds/pod	3.8
10	100-seed weight (g)	9.3
11	Seed colour	Creamy white
12	Flower colour	Red
13	Stem colour	Green
14	Average yield/plant (g)	44

Associated Characters

GT-308A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

26. GT-310A (IC565834; INGR09026), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-310A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and BDN 31 as non-recurrent and recurrent parent, respectively. It has determinate growth with green stem, early maturity, yellow flowers and creamy white medium seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	DT
2	Pod bearing habit	Spreading
3	Days of flower	96
4	Maturity days	143
5	Plant height (cm)	89
6	Average number of branches/plant	14.0
7	Average number of pods/plant	148
8	Average pod length (cm)	4.6
9	Average number of seeds/pod	3.6
10	100-seed weight (g)	9.4
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	34

Associated Characters

GT-310A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

25. GT-308A (IC565833; INGR09025), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-308A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and ICPL 87051 as non-recurrent and recurrent parent, respectively. It has determinate growth with green stem, early maturity, red flowers and creamy white medium seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	101
4	Maturity days	148
5	Plant height (cm)	132
6	Average number of branches/plant	10.0
7	Average number of pods/plant	187
8	Average pod length (cm)	4.2
9	Average number of seeds/pod	3.8
10	100-seed weight (g)	9.3
11	Seed colour	Creamy white
12	Flower colour	Red
13	Stem colour	Green
14	Average yield/plant (g)	44

Associated Characters

GT-308A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

26. GT-310A (IC565834; INGR09026), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-310A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and BDN 31 as non-recurrent and recurrent parent, respectively. It has determinate growth with green stem, early maturity, yellow flowers and creamy white medium seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	DT
2	Pod bearing habit	Spreading
3	Days of flower	96
4	Maturity days	143
5	Plant height (cm)	89
6	Average number of branches/plant	14.0
7	Average number of pods/plant	148
8	Average pod length (cm)	4.6
9	Average number of seeds/pod	3.6
10	100-seed weight (g)	9.4
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	34

Associated Characters

GT-310A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

27. GT-501A (IC565835; INGR09027), a Pigeon pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-501A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and ICPL 7622 as non-recurrent and recurrent parent, respectively. It is a medium maturity line with non-determinate growth habit, green stem, yellow flowers and creamy white bold seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	108
4	Maturity days	160
5	Plant height (cm)	152
6	Average number of branches/ plant	6.4
7	Average number of pods/ plant	129
8	Average pod length (cm)	3.5
9	Average number of seeds/ pod	3.3
10	100-seed weight (g)	10.0
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	35

Associated Characters

GT-501A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

28. GT-505A (IC565836; INGR09028), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-505A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and AGS 55 as non-recurrent and recurrent parent, respectively. It is a medium maturity line with non-determinate growth habit, green stem, yellow flowers and creamy white medium seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	110
4	Maturity days	157
5	Plant height (cm)	164
6	Average number of branches/ plant	7.4
7	Average number of pods/ plant	146
8	Average pod length (cm)	3.9
9	Average number of seeds/ pod	3.8
10	100-seed weight (g)	9.1
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	40

Associated Characters

GT-505A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

27. GT-501A (IC565835; INGR09027), a Pigeon pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-501A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and ICPL 7622 as non-recurrent and recurrent parent, respectively. It is a medium maturity line with non-determinate growth habit, green stem, yellow flowers and creamy white bold seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	108
4	Maturity days	160
5	Plant height (cm)	152
6	Average number of branches/ plant	6.4
7	Average number of pods/ plant	129
8	Average pod length (cm)	3.5
9	Average number of seeds/ pod	3.3
10	100-seed weight (g)	10.0
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	35

Associated Characters

GT-501A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

28. GT-505A (IC565836; INGR09028), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] CGMS Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GT-505A is an unique stable cytoplasmic-genic male sterile line developed at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar through back crossing method using GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) and AGS 55 as non-recurrent and recurrent parent, respectively. It is a medium maturity line with non-determinate growth habit, green stem, yellow flowers and creamy white medium seeds. The genetic stock is a *sui-generis* new cytoplasmic genetic male sterile line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	110
4	Maturity days	157
5	Plant height (cm)	164
6	Average number of branches/ plant	7.4
7	Average number of pods/ plant	146
8	Average pod length (cm)	3.9
9	Average number of seeds/ pod	3.8
10	100-seed weight (g)	9.1
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	40

Associated Characters

GT-505A is a potent male sterile line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

29. GTR-7 (IC565837; INGR09029), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-7 was selected from stable line ICPL 8976 having fertility restoration properties of *scarabaeoides* background cytoplasm sterile line GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It was developed through selection from ICP 8976, medium duration material. It has determinate growth habit with late maturity, green stem, yellow flowers and creamy white medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	130
4	Maturity days	210
5	Plant height (cm)	185
6	Average number of branches/ plant	8.4
7	Average number of pods/ plant	136
8	Average pod length (cm)	4.0
9	Average number of seeds/ pod	3.5
10	100-seed weight (g)	9.4
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green

Associated Characters

GTR-7 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

30. GTR-35 (IC565838; INGR09030), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-35 was F_5 derivative of SKNPCH 10-1-2-1-2, where SKNPCH 10 (CMS GT 288A x GTR 11) having fertility restoration properties developed through pedigree selection at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has determinate growth habit with early maturity, green stem, yellow flowers and red medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	DT
2	Pod bearing habit	Bunch
3	Days of flower	98
4	Maturity days	142
5	Plant height (cm)	84
6	Average number of branches/ plant	5.0
7	Average number of pods/ plant	95
8	Average pod length (cm)	5.2
9	Average number of seeds/ pod	4.2
10	100-seed weight (g)	9.0
11	Seed colour	Red
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	

Associated Characters

GTR-35 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

29. GTR-7 (IC565837; INGR09029), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-7 was selected from stable line ICPL 8976 having fertility restoration properties of *scarabaeoides* background cytoplasm sterile line GT 288A (first stable cytoplasmic-genic male sterile line developed by using *Cajanus scarabaeoides* as female and *Cajanus cajan* as male) at the Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It was developed through selection from ICP 8976, medium duration material. It has determinate growth habit with late maturity, green stem, yellow flowers and creamy white medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	130
4	Maturity days	210
5	Plant height (cm)	185
6	Average number of branches/ plant	8.4
7	Average number of pods/ plant	136
8	Average pod length (cm)	4.0
9	Average number of seeds/ pod	3.5
10	100-seed weight (g)	9.4
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green

Associated Characters

GTR-7 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

30. GTR-35 (IC565838; INGR09030), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-35 was F_5 derivative of SKNPCH 10-1-2-1-2, where SKNPCH 10 (CMS GT 288A x GTR 11) having fertility restoration properties developed through pedigree selection at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has determinate growth habit with early maturity, green stem, yellow flowers and red medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	DT
2	Pod bearing habit	Bunch
3	Days of flower	98
4	Maturity days	142
5	Plant height (cm)	84
6	Average number of branches/ plant	5.0
7	Average number of pods/ plant	95
8	Average pod length (cm)	5.2
9	Average number of seeds/ pod	4.2
10	100-seed weight (g)	9.0
11	Seed colour	Red
12	Flower colour	Yellow
13	Stem colour	Green
14	Average yield/plant (g)	

Associated Characters

GTR-35 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

31. GTR-42 (IC565839; INGR09031), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-42 was F_4 derivative of SKNPCH 8-1-1-5, where SKNPCH 8 (CMS 288A x GTR-8) having fertility restoration properties developed through pedigree selection at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has non-determinate growth habit with medium maturity, green stem, yellow flowers and creamy white small seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	102
4	Maturity days	151
5	Plant height (cm)	152
6	Average number of branches/ plant	7.0
7	Average number of pods/ plant	97
8	Average pod length (cm)	4.1
9	Average number of seeds/ pod	4.0
10	100-seed weight (g)	7.25
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green

Associated Characters

GTR-42 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

32. GTR-43 (IC565840; INGR09032), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-43 was F_4 derivative of SKNPCH 6-3-1-3, where SKNPCH 6 (CMS 288A x GTR-6) having fertility restoration properties developed through pedigree selection method at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has non-determinate growth habit with medium maturity, green stem, yellow flowers and red medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	120
4	Maturity days	172
5	Plant height (cm)	164
6	Average number of branches/ plant	5.0
7	Average number of pods/ plant	125
8	Average pod length (cm)	4.2
9	Average number of seeds/ pod	4.0
10	100-seed weight (g)	8.25
11	Seed colour	Red
12	Flower colour	Yellow
13	Stem colour	Green

Associated Characters

GTR-43 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea.

31. GTR-42 (IC565839; INGR09031), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-42 was F_4 derivative of SKNPCH 8-1-1-5, where SKNPCH 8 (CMS 288A x GTR-8) having fertility restoration properties developed through pedigree selection at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has non-determinate growth habit with medium maturity, green stem, yellow flowers and creamy white small seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	102
4	Maturity days	151
5	Plant height (cm)	152
6	Average number of branches/ plant	7.0
7	Average number of pods/ plant	97
8	Average pod length (cm)	4.1
9	Average number of seeds/ pod	4.0
10	100-seed weight (g)	7.25
11	Seed colour	Creamy white
12	Flower colour	Yellow
13	Stem colour	Green

Associated Characters

GTR-42 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

32. GTR-43 (IC565840; INGR09032), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Fertility Restorer Line

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-43 was F_4 derivative of SKNPCH 6-3-1-3, where SKNPCH 6 (CMS 288A x GTR-6) having fertility restoration properties developed through pedigree selection method at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has non-determinate growth habit with medium maturity, green stem, yellow flowers and red medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Table 1. Morpho-agronomic characteristics

S.N	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	120
4	Maturity days	172
5	Plant height (cm)	164
6	Average number of branches/ plant	5.0
7	Average number of pods/ plant	125
8	Average pod length (cm)	4.2
9	Average number of seeds/ pod	4.0
10	100-seed weight (g)	8.25
11	Seed colour	Red
12	Flower colour	Yellow
13	Stem colour	Green

Associated Characters

GTR-43 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea.

33. GTR-55 (IC565841; INGR09033), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Germplasm, a Fertility Restorer

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-55 was F_4 derivative of SKNPCH 9-2-2-1, where SKNPCH 9 (CMS 288A x GTR-9) having fertility restoration properties developed by adopting pedigree selection method at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has non-determinate growth habit with early maturity, green stem, yellow flowers and red medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Associated Characters

GTR-55 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	98
4	Maturity days	142
5	Plant height (cm)	118
6	Average number of branches/plant	7.0
7	Average number of pods/plant	132
8	Average pod length (cm)	4.2
9	Average number of seeds/pod	4.0
10	100-seed weight (g)	8.16
11	Seed colour	Red
12	Flower colour	Yellow
13	Stem colour	Green

Reference

Acharya S, JB Patel, PT Patel and SBS Tikka (2005) Characterization of stable and diversified CGMS (A) and restorer (R line) of Pigeonpea. *GAU Res. J.* **30(1-2)**: 1-7.

34. MUB-4 (IC557433; INGR09034), a Black Gram (*Vigna mungo* L. Hepper) Mutant with Shining Yellow Seeds

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Sardar Ballavbhai Patel University and Technology, Meerut

Urdbean (Black gram) is well known for its black rough seeds and black colour and almost all the varieties of blackgram are generally of rough black seed with black pods. The present mutant MUB 4 has brown colour pods, yellow shining seeds, tall and high yielding with higher 100 seed weight (4.84 g). Four hundred pure, uniform, healthy and dry (9.5 % moisture) seeds of cultivar Pant Urd-30 were treated with ^{60}Co gamma rays (100, 200, 300 and 400 Gy doses), EMS (0.2, 0.4, 0.6 and 0.8%) and combination of gamma doses, *viz.*, 100, 200, 300 and 400 Gy with 0.2 % EMS during Summer, 2001 at Research Farm, Institute of Ag. Sciences, BHU, Varanasi. In M_2 generation, eight double mutations for seed and pod colour were observed in different frequencies in various treatments of EMS, gamma rays and combination of both. A brown colour pods with yellow rough seed mutant was identified and selected in the 300Gy+0.2% combination dose of gamma rays and EMS. This mutant was evaluated during two consecutive years in the field conditions alongwith parent.

The data were recorded on 10 randomly selected plants from each replication for different yield and yield attributing traits, *viz.*, plant height, number of pods per plant, pod length, number of seeds per pod, 100 seed weight and grain yield per plant whereas days to flowering and days to maturity were observed on the plot basis in M_4 generation during Kharif, 2002. Such seed and pod colour mutants accompanied higher grain yield (7.1 g) may be used as a variety or breeding line directly and indirectly for the improvement of blackgram crop. Such mutations for different seed colour were also reported in other pulse crops, *viz.*, buff and black colour mutants in arhar (Ali Khan and Veeraswamy, 1974), yellow colour mutations in soybean (Takagi and Hiraiwa, 1980) and dull green to shining green and golden yellow tester mutant in mungbean (Singh *et al*., 1982). A single gene but the simultaneous variations for yields and other morphological characters indicate a gross change or perhaps very closely related linked group of genes are controlling this trait (Saini *et al*., 1974). Such pod and

33. GTR-55 (IC565841; INGR09033), a Pigeon Pea [*Cajanu cajan* (L.) Millsp] Germplasm, a Fertility Restorer

S Acharya, JB Patel and SBS Tikka
SD Agricultural University, Sardarkrushinagar, Gujarat

GTR-55 was F_4 derivative of SKNPCH 9-2-2-1, where SKNPCH 9 (CMS 288A x GTR-9) having fertility restoration properties developed by adopting pedigree selection method at Main Pulses Research Station, SD Agricultural University, Sardarkrushinagar. It has non-determinate growth habit with early maturity, green stem, yellow flowers and red medium seeds. The genetic stock is a *sui-generis* restorer line. The line was identified as a genetically diverse material by SDAU Germplasm Identification Committee vide its meeting held on August 31, 2007.

Associated Characters

GTR-55 is a good restore line which can be further utilized in development of CGMS based hybrids in pigeonpea (Table 1).

Table 1. Morpho-agronomic characteristics

S.N.	Description of character	
1	Growth habit	NDT
2	Pod bearing habit	Spreading
3	Days of flower	98
4	Maturity days	142
5	Plant height (cm)	118
6	Average number of branches/plant	7.0
7	Average number of pods/plant	132
8	Average pod length (cm)	4.2
9	Average number of seeds/pod	4.0
10	100-seed weight (g)	8.16
11	Seed colour	Red
12	Flower colour	Yellow
13	Stem colour	Green

Reference

Acharya S, JB Patel, PT Patel and SBS Tikka (2005) Characterization of stable and diversified CGMS (A) and restorer (R line) of Pigeonpea. *GAU Res. J.* **30(1-2)**: 1-7.

34. MUB-4 (IC557433; INGR09034), a Black Gram (*Vigna mungo* L. Hepper) Mutant with Shining Yellow Seeds

AK Sharma
Sardar Ballavbhai Patel University and Technology, Meerut

Urdbean (Black gram) is well known for its black rough seeds and black colour and almost all the varieties of blackgram are generally of rough black seed with black pods. The present mutant MUB 4 has brown colour pods, yellow shining seeds, tall and high yielding with higher 100 seed weight (4.84 g). Four hundred pure, uniform, healthy and dry (9.5 % moisture) seeds of cultivar Pant Urd-30 were treated with ^{60}Co gamma rays (100, 200, 300 and 400 Gy doses), EMS (0.2, 0.4, 0.6 and 0.8%) and combination of gamma doses, *viz.*, 100, 200, 300 and 400 Gy with 0.2 % EMS during Summer, 2001 at Research Farm, Institute of Ag. Sciences, BHU, Varanasi. In M_2 generation, eight double mutations for seed and pod colour were observed in different frequencies in various treatments of EMS, gamma rays and combination of both. A brown colour pods with yellow rough seed mutant was identified and selected in the 300Gy+0.2% combination dose of gamma rays and EMS. This mutant was evaluated during two consecutive years in the field conditions alongwith parent.

The data were recorded on 10 randomly selected plants from each replication for different yield and yield attributing traits, *viz.*, plant height, number of pods per plant, pod length, number of seeds per pod, 100 seed weight and grain yield per plant whereas days to flowering and days to maturity were observed on the plot basis in M_4 generation during Kharif, 2002. Such seed and pod colour mutants accompanied higher grain yield (7.1 g) may be used as a variety or breeding line directly and indirectly for the improvement of blackgram crop. Such mutations for different seed colour were also reported in other pulse crops, *viz.*, buff and black colour mutants in arhar (Ali Khan and Veeraswamy, 1974), yellow colour mutations in soybean (Takagi and Hiraiwa, 1980) and dull green to shining green and golden yellow tester mutant in mungbean (Singh *et al*., 1982). A single gene but the simultaneous variations for yields and other morphological characters indicate a gross change or perhaps very closely related linked group of genes are controlling this trait (Saini *et al*., 1974). Such pod and

Table 1. Mean values of yield and yield attributing traits of different seed colour mutants in M_4 generation

Mutant line	Days to flowering	Days to maturity	Plant height (cm)	No. of pods plant^{-1}	Pod length (cm)	No. of seeds pod^{-1}	100-seed weight (g)	Grain yield plant^{-1}(g)
MUB 4	40.0	86.5	38.7	34.6	4.9	4.8	4.8	7.1
Parent (PU-30)	46.0	100.0	41.9	26.8	3.85	4.71	3.92	4.85
LSD (5%)	0.50	0.81	2.34	0.70	0.72	0.31	0.78	1.24

Fig. 1: Yellow shining seed with brown colour pods

seed colour mutations will increase the demand and market value of the blackgram among the consumer and also help in genetic and molecular study of the traits in future.

References

Ali Khan WM and R Veeraswamy (1974) Mutations induced in redgram (*Cajanus cajan* L.) by gamma radiation and EMS. *Rad. Bot.* **14**: 237-242.

Grover IS and SK Tejpaul (1979) Induced mutation in green gram. *Genet. Pol*. **20**: 529-540.

Saini, RG, JL Minocha and A Singh (1974) Sterile mutant of *Phaseolus aureus. Sci. Cul.* **40(1)**: 37-38.

Singh VP, RDS Yadav, BD Singh, RM Singh and RB Singh (1982). Note on a golden seed coat colour mutant of mungbean (*Vigna radiata* L.) induced by gamma radiation. *Legume Res.* **5(2)**: 111-114.

Takagi Y and S Hiraiwa (1980) Seed coat colour mutant in soyabean (*Glycine max* L.). *Agril. Bull. Saga. Uni.* **48**: 87-92.

35. RG 2787 (IC374319; INGR09035), a Castor (*Ricinus communis* L.) Germplasm, a Source of Multiple Resistance

K Anjani and MA Raoof
Directorate of Oilseeds, Rajendranagar, Hyderabad-500 030

Fusarium wilt, *Macrophomina* root rot and *Botrytis* grey rot are the major yield losing disease in castor. In addition to these, presence of nematodes further aggravates wilt incidence in the wilt infested castor fields. A common resistance source for all the major biotic stress is a boom to plant breeder to work with in multiple disease resistance breeding programme aimed at development of cultivar resistant all these biotic stress.

RG 2787 is a unique accession exhibiting stable multiple resistance to *Botrytis* grey rot, *Fusarium* wilt, *Macrophimina* root rot and nematodes. It is the first source of resistance reported to be resistance to the most devastating *Botrytis* grey rot disease in castor. It is a selection from germplasm accession KA37/01 collected from Tamil Nadu (Ashoka Vardhana Reddy *et al.*, 2002).

RG 2787 was screened against *Botrytis* grey rot (*Botryrits ricini*) under heavy disease pressure created under artificial inoculation condition in the field from 2003-04 to 2007-08. It showed resistant reaction consistently in all years of screening where the disease incidence in the susceptible check VP-I was from 82.5 to 100% (Table 1).

T able 1. Resistant reaction of RG 2787 against *botrytis* grey rot under artificial inoculation conditions

Year of screening	*Botrytis* incidence (%)*	
	RG2787	Susceptible check VP-1
2003-04	0.0	82.5
2004-05	6.22	89.5
2006-07	2.9	100.0
2007-08	0.0	–

*<10% disease is rated resistant

RG 2787 was screening against wilt (*Fusarium ozysporum* f.sp. *ricini*), in three wilt sick plots from 2003-04 to 2007-08 in AICRP (Castor) disease screening trails. It consistently exhibited resistant reaction (0-17.6%) at both locations in all the years of screening (Table 2).

Table 1. Mean values of yield and yield attributing traits of different seed colour mutants in M_4 generation

Mutant line	Days to flowering	Days to maturity	Plant height (cm)	No. of pods plant^{-1}	Pod length (cm)	No. of seeds pod^{-1}	100-seed weight (g)	Grain yield plant^{-1}(g)
MUB 4	40.0	86.5	38.7	34.6	4.9	4.8	4.8	7.1
Parent (PU-30)	46.0	100.0	41.9	26.8	3.85	4.71	3.92	4.85
LSD (5%)	0.50	0.81	2.34	0.70	0.72	0.31	0.78	1.24

Fig. 1: Yellow shining seed with brown colour pods

seed colour mutations will increase the demand and market value of the blackgram among the consumer and also help in genetic and molecular study of the traits in future.

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2004-05	6.22	89.5
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2007-08	0.0	–

*<10% disease is rated resistant

RG 2787 was screening against wilt (*Fusarium ozysporum* f.sp. *ricini*), in three wilt sick plots from 2003-04 to 2007-08 in AICRP (Castor) disease screening trails. It consistently exhibited resistant reaction (0-17.6%) at both locations in all the years of screening (Table 2).

Table 2. Resistant reaction of RG2787 against wilt in wilt sick plots

Year of	Wilt resistance (%)*			
	DOR, Hyderabad		S.K. Nagar	
	RG2787	SC	RG2787	SC
2003-04	14.3	VP-1 (SC): 88.5	0.0	GAUCH-1 (SC): 98.5
2005-06	5.8	VP-1 (SC): 93.8	0.0	JI-35 (SC): 100
2006-07	17.6	VP-1 (SC): 100	0.0	JI-35 (SC): 100
2007-08	15.3	JI-35 (SC): 100	10.0	JI-35 (SC): 100

*<20% wilt incidence is rated as resistant; SC: Susceptible check

RG 2787 was screened against root rot (*Macrophomina phaseolina*) in root rot sick plot from 2003-04 to 2007-08 under AICRP (Castor) disease screening trials. It exhibited high resistance reaction (0-5.8%) against root rot consistently in all the years of screening (Table 3).

Table 3. Resistant reaction of RG2787 against root rot sick plot

Year of screening	Root rot incidence (%)*	
	RG 2787	Susceptible check (SC)
2003-04	0.0	GCH-4 (SC): 72.08
2004-05	0.0	GCH-4 (SC): 85.5
2005-06	0.0	JI-259 (SC): 89.33GCH-4 (SC): 87.2
2006-07	5.8	GCH-4 (SC): 84.5
2007-08	0.0	GCH-4 (SC): 84.63

*<20% root rot incidence is rated as resistant

RG2787 was screening against nematode (*Rotylenchulus renifirmis*) in pots under artificial inoculation from 2004-05 to 2005-06. It consistently showed resistant reaction against nematode in both years of screening (Table 4).

Table 4. Resistant reaction of RG2787 against nematode

Year of screening	No. of embedded females/plant*
2004-05	1.3
2005-06	0.0

*Resistant: 1-2 females/plant

Reference

Ashoka Vardhana Reddy P, K Anjani and M Manikyam (2002) Collecting castor (*Ricinus communis* L.) landrace from Tamil Nadu, India. *Plant Genet. Resour. Newsletter*, **132:** 60-62.

36. FC and RI-HC 32 (IC566227; INGR09036), a Jatropha (*Jatropha curcas*) Germplasm, a Brownish Purple Colour Fruit

KT Parthiban, M Govinda Rao, K Krishaveni, N Natarajan, P Thiyagarajan, R Senthil Kumar and V Subbulakshmi
Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam-641 301

Intensive hybridization programme was initiated through interspecific hybridization. The cultivated species *J. curcas* was used as female parent and eight wild species were used as pollen donor. Among the crosses attempted, the cross between *J. curcas* and *J. integerrima* produced successful hybrids. But the F_1 plants produced only small sized seeds. Hence back was with MTP1 *J. curcas* clone and the BC_1 progenies exhibited significantly different results interms of fruit characteristics.

Unique Fruit Characters

Among 34 variable back crossed derivatives, (FC and RI-HC32) expressed significantly distinct fruit colour, *viz*, brownish purple colour fruit compared to the yellow colour check variety. This hybrid clone expressed early superiority in terms of flowering and fruiting and recorded a yield of 150 g/plant within 6 months after plantation.

Method of Propagation

The new Jatropha hybrid clone can be multiplied vegetatively through cuttings. Cuttings from individual ramets could be collected once in every 60 to 90 days and successful rooting can be achieved in a simple polythene container with the mixture of soil, sand and farmyard manure (3:1:1). Rooting of cutting starts from third week after planting and 90 to 120 days old rooted cuttings (ramets) could be used for planting.

Table 2. Resistant reaction of RG2787 against wilt in wilt sick plots

Year of	Wilt resistance (%)*			
	DOR, Hyderabad		S.K. Nagar	
	RG2787	SC	RG2787	SC
2003-04	14.3	VP-1 (SC): 88.5	0.0	GAUCH-1 (SC): 98.5
2005-06	5.8	VP-1 (SC): 93.8	0.0	JI-35 (SC): 100
2006-07	17.6	VP-1 (SC): 100	0.0	JI-35 (SC): 100
2007-08	15.3	JI-35 (SC): 100	10.0	JI-35 (SC): 100

*<20% wilt incidence is rated as resistant; SC: Susceptible check

RG 2787 was screened against root rot (*Macrophomina phaseolina*) in root rot sick plot from 2003-04 to 2007-08 under AICRP (Castor) disease screening trials. It exhibited high resistance reaction (0-5.8%) against root rot consistently in all the years of screening (Table 3).

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2005-06	0.0	JI-259 (SC): 89.33GCH-4 (SC): 87.2
2006-07	5.8	GCH-4 (SC): 84.5
2007-08	0.0	GCH-4 (SC): 84.63

*<20% root rot incidence is rated as resistant

RG2787 was screening against nematode (*Rotylenchulus renifirmis*) in pots under artificial inoculation from 2004-05 to 2005-06. It consistently showed resistant reaction against nematode in both years of screening (Table 4).

Table 4. Resistant reaction of RG2787 against nematode

Year of screening	No. of embedded females/plant*
2004-05	1.3
2005-06	0.0

*Resistant: 1-2 females/plant

Reference

Ashoka Vardhana Reddy P, K Anjani and M Manikyam (2002) Collecting castor (*Ricinus communis* L.) landrace from Tamil Nadu, India. *Plant Genet. Resour. Newsletter*, **132:** 60-62.

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Method of Propagation

The new Jatropha hybrid clone can be multiplied vegetatively through cuttings. Cuttings from individual ramets could be collected once in every 60 to 90 days and successful rooting can be achieved in a simple polythene container with the mixture of soil, sand and farmyard manure (3:1:1). Rooting of cutting starts from third week after planting and 90 to 120 days old rooted cuttings (ramets) could be used for planting.

37. FC and RI-HC 21 (IC566228; INGR09037), a Jatropha (*Jatropha curcas*) Germplasm, Oblong Fruit

KT Parthiban, M Govinda Rao, K Krishaveni, N Natarajan, P Thiyagarajan, R Senthil Kumar and V Subbulakshmi
Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam-641 301

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Unique Fruit Characters

Among 34 variable back crossed derivatives, (FC and RI-HC21) expressed significantly distinct fruit shape, *viz,* oblong fruit compared to the round check variety. This hybrid clone expressed early superiority in terms of flowering and fruiting and recorded a yield of 260 g/plant within 6 months after plantation.

Method of Propagation

The new Jatropha hybrid clone can be multiplied vegetatively through cuttings. Cuttings from individual ramets could be collected once in every 60 to 90 days and successful rooting can be achieved in a simple polythene container with the mixture of soil, sand and farmyard manure (3:1:1). Rooting of cutting starts from third week after planting and 90 to 120 days old rooted cuttings (ramets) could be used for planting.

38. PKVG8 (IC570070; INGR09038), a Ground Nut (*Arachis hypogaea*) Germplasm, a Source of Tolerance to Iron Chlorosis

Subhash N Deshmukh and Manish Y Ladole
Dr. Panjbrao Deshmukh Krishi Vidyapeeth, Akola

Iron deficiency which is expressed as yellowing of leaves and known as iron-chlorosis, is of common occurrence in groundnut in calcareous and alkaline soils world wide. This Fe-deficiency chlorosis occurs as an interveinal to complete chlorosis in young and emerging groundnut leaves, which depending upon the intensity of the chlorosis may recover with crop growth stages or in extreme cases may result in death of plant causing little yield losses to complete crop failure. In groundnut the Fe-deficiency appears 10-15 days after emerging in the field and remaining throughout the cropping season, but maximum intensity was in between 30-70 days after emerging. (Singh and Choudhary 1991; 1993). The susceptibility of groundnut to iron deficiency is very sensitive to genetic control which appears to be located in the root behavior and the rate of efficiency in iron absorption from the soil. However, by growing iron chlorosis tolerant genotypes or by utilizing these genotypes in breeding programme can be a good option to ward off iron deficiency in groundnut.

The genotype PKVG-8 was developed at Oilseeds Research Init, Dr. PDKV, Akola, from a cross derivative JL 24 x NcAc 17127 by pedigree method of selection. Confirmation of it's tolerance to iron-chlorosis was done at Directorate of Groundnut Research, Junagadh and it was appeared to be tolerant. Now it can be use as donor parent. The seed of PKVG-8 is maintained at Crop Research Unit (Oilseeds), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444 104 (MS).

37. FC and RI-HC 21 (IC566228; INGR09037), a Jatropha (*Jatropha curcas*) Germplasm, Oblong Fruit

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39. IG3/29/2-3(1) (IC567677; INGR09039), a Guinea Grass (*Panicum maximum*) Germplasm, a Triploid Cytotype

Pankaj Kaushal, DR Malaviya and AK Roy
Indian Grassland and Fodder Research Institute, Jhansi-284 003

Polyploidy is an important area in plant research, since most of the crops that cater to our needs for food, feed, fodder and fiber, are polyploids. Polyploidy research aim towards understanding the effect of genome dosage in expression of important traits. For this, synthetic polyploids and haploids are often produced. Two events, *viz,* apomeiosis (development of unreduced embryo-sac that contain unreduced egg cell) and parthenogenesis (embryo development without fertilization) that may affect the ploidy status of progeny are inherent components of apomictic from of reproduction in some angiosperms, chiefly grasses (Nogler, 1994; Koltunow and Grassniklaus, 2003; Kaushal *et al.,* 2005; VanDijk and Ozias-Akins, 2007). These components work in close functional linkage to maintain the ploidy in progeny of the apomictic crops. However, recombinational events leading to independent expression of individual components (apomeiosis and parthenogenesis) may modify the progeny and produce high frequency of triploids (3n, termed B_{III} hybrids arising from fertilization of unreduced egg cell by reduced sperm cell) and haploids (n, termed M_I plants arising by parthenigenetic development of reduced egg cell), respectively.

Guinea grass (*Panicum maximum* Jacq.) is an important fodder crop with apomixes as predominant form of reproduction. Global germplasm collection (Malaviya and Kaushal, 2005) was subjected to survey reproductive diversity and fingerprinting reproductive pathway of seed development in this crop utilization technique such as flow cytometric seed screen (Matzk *et al.,* 2000) and ovule clearing (Young *et al.,* 1979). The study resulted in identification of Germplasm lines with enhanced expression of portioned apomixis components arising because of recombinational events between apomixis components favouring a heterozygosity model (Kaushal *et al.,* 2008a).

Fact that portioned apomixis components can modify the ploidy of the progeny, we developed a method for ploidy manipulation in apomictic crop termed as Hybridization-supplemented Apomixi-components Partitioning Approach (HAPA), whereby portioned apomixis components are supplemented with appropriate breeding schemes to obtain a ploidy series (Kaushal *et al.,* 2008b). Utilizing HAPA we have generated a ploidy series in guinea grass represented by plants with 3x, 4x, 5x, 6x, 8x, and 9x ploidy level, all derived from a single 4x (2n=32) progenitor. Presently, this series is the world's largest ploidy series available in a crop plant. Fact that these plants are derived from single progenitor, adds to the advantage on study ploidy regulated gene expression whereby increments of genomes is achieved by inherent capacity of the plant itself instead of utilizing chemical (such as colchicines, anther culture media etc.).

A locally collected tetraploid (2n=4x=32 germplasm line, *viz,* IG 04-164 has been identified to produce high frequency of B_{II} hybrids, was highly aposporous and male fertile (Kaushal *et al.,* 2008a), and thus used as progenitor to develop ploidy series. 6x (2n=48) plants were obtained following self-pollination as a consequence of B_{III} hybridization from IG 04-164. Second cycle of B_{III} hybridization yielding 9x (2n=72) plants from 6x plant. Haploid parthenogenesis (M_I) from 6x plants yielded 3x (2n=24) plant. Ploidies, *viz,* 5x (2n=40) and 8x (2n=64) were obtained by sexual hybridization utilizing 6x plant (*viz,* 3/29/2) pollinated with reduced pollen from tetraploid IG 04-164 through involvement of reduced egg (3x+2x=5x) and unreduced egg represented in Table 1. Ploidied of the resultant plants were confirmed utilizing somatic cell flow cytometry as well as cytological analysis and were characterized for morphological and fertility traits (Kaushal *et al.,* 2008b).

The series offer opportunities to study not only ploidy (dosage) dependent expression studies on various morphological, cytological, physiological, biochemical and molecular traits, but also may shed light on ploidy regulation of complex traits such as stress tolerance and apomixis (Galitski *et al.,* 1999; Riddle *et al.,* 2006; Udall and Wendel, 2006). It also offers the only way to manipulate half the monoploid dosage for understanding embryo:endosperm interactions, e.g. by producing ca. 5.5x, 6x, ca. 6.5x and 7x endosperm with 4x embryo by virtue of the pseudogamous nature of endosperm development in guinea grass (Kaushal *et al.,* 2008b) when apomictic 4x line is pollinated by 3x, 4x, 5x and 6x plants.

Since the independent expression of apomixis components yields a variety of seeds (2n, 3n, n etc.), the selfed seeds may not breed true-to-type and hence vegetative propagation of these cytotypes would be preferred. These plants are perennial and respond well to vegetative multiplication through rooted slips and hence can be clonally multiplied easily.

Salient features of individual members follows:

Triploid cytotype-3/29/2-3(1): The triploid cytotype contained 2n=3x=24 chromosomes with 8_I+8_{II} configuration at Diakinesis. The cytotype has origin from parthenogenetic development from reduced egg cell (M_I plant) from the 6x cytotype viz. 3/29/2. The plant is perennial, moderately male fertile (55%) and set lesser seed owing to unbalanced gamets.

40. IG 04-164 (IC567678; INGR09040), a Guinea Grass (*Panicum maximum*) Germplasm, a High Production Progenitor of Ploidy Series

Pankaj Kaushal, DR Malaviya and AK Roy
Indian Grassland and Fodder Research Institute, Jhansi-284 003

Tetraploid cytotype-IG 04-164: It is a selection from the global guinea grass Germplasm with 2n=4x=32 Chromosomes. It is progenitor of ploidy series for it being highly aposporous (80%), highly male fertile and high production of B_{III} hybrids (40%). Average chromosome configuration at Diakinesis was 8_I+4_{IV}. It is characterized by perennial growth habit and can be easily propagated through rooted slips

41. IG3/29/2-5(1) (IC567679; INGR09041), a Guinea Grass (*Panicum maximum*) Germplasm, a High Production Progenitor of Ploidy Series

Pankaj Kaushal, DR Malaviya and AK Roy
Indian Grassland and Fodder Research Institute, Jhansi-284 003

Pentaploid cytotype-3/29/2-5(1): This plant contained 2n=5x=40 chromosomes and was 85% male fertile. It was produced by sexual hybridization between 6x and 4x cytotype (3/29/2 x IG 04-164). The plant was perennial and amenable to vegetative propagation through rooted slips.

42. IG3/29/2 (IC567680; INGR09042), a Guinea Grass (*Panicum maximum*) Germplasm, a Pentaploid Cytotype

DR Malaviya, Pankaj Kaushal and AK Roy
Indian Grassland and Fodder Research Institute, Jhansi-284 003

Hexaploid cytotype-3/29/2: The plant contained 2n=6x=48 chromosomes with $9_{II}+6_{IV}+1_{VI}$ average meiotic configuration. It was obtained in selfed pollinated seeds of tetraploid IG 04-164 following B_{III} hybridization (unreduced egg cell fertilized). It was perennial and highly male and female fertile with good seed set. It showed partitioning of both the apomixis components (apomeiosis and parthenogenesis) and produced 9x (B_{III}) and 3x (M_I) seeds in higher proportions. The plant is propagated through rooted slips. This plant was the female parent for cytotype 3x, 5x, 8x and 9x.

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43. IG3/29/2-8(1) (IC567681; INGR09043) a Guinea Grass (*Panicum maximum*) Germplasm, a Octoploid Cytotype

DR Malaviya, Pankaj Kaushal and AK Roy
Indian Grassland and Fodder Research Institute, Jhansi-284 003

Octaploid cytotype-3/29/2-8(1): The plant was perennial and highly male fertile. It was produced from 6x 3/29/2 (unreduced egg) when pollinated with 4x IG 04-164 (reduced pollen) and contained 2n=8x=64 chromosomes. This is also a novel cytotype in guinea grass never reported earlier. The plant was maintained clonally through vegetative propagation through rooted slips.

44. IG3/29/2-9(1) (IC567682; INGR09044) a Guinea Grass (*Panicum maximum*) Germplasm, a Nonoploid Cytotype

DR Malaviya, Pankaj Kaushal and AK Roy
Indian Grassland and Fodder Research Institute, Jhansi-284 003

Nanoploid cytotype-3/29/2-9 (1): This is a novel cytotype (2n=9x=72) in guinea grass produced through B_{III} hybridization from 6x cytotype 3/29/2. Average chromosome configuration was $3_I+18_{II}+3_{III}+1_{IV}+4_V$ at Diakinesis. The plant was highly male and female fertile, perennial and amenable to vegetative propagation through rooted slips.

Table 1. Formation of ploidy series utilizing HAPA

Plant identity	Ploidy	Female parent	Male parent	Reproductive pathway of embryo formation	Broader category	Male fertility
3/29/2-3(1)	2n=3x=24	6x	6x	Reduced ES + parthenogenesis	MI	55%
IG 04-164	2n=4x=32	4x	4x	Aposporous ES + parthenogenesis	Apomictic	85%
3/29/2-5(1)	2n=5x=40	6x	4x	Reduced ES + fertilization (2x sperm)	Sexual	88%
3/29/2	2n=6x=48	4x	4x	Aposporous ES + fertilization (2x sperm)	BIII	86%
3/29/2-8(1)	2n=8x=64	6x	4x	Aposporous ES + fertilization (2x sperm)	BIII	95%
3/29/2-9(1)	2n=9x=72	6x	6x	Aposporous ES + fertilization (3x sperm)	BIII	88%

ES: Embryo-sac, reduced ES contains haploid (n) egg cell while unreduced ES contains diploid (2n) egg cell.

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43. IG3/29/2-8(1) (IC567681; INGR09043) a Guinea Grass (*Panicum maximum*) Germplasm, a Octoploid Cytotype

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Octaploid cytotype-3/29/2-8(1): The plant was perennial and highly male fertile. It was produced from 6x 3/29/2 (unreduced egg) when pollinated with 4x IG 04-164 (reduced pollen) and contained 2n=8x=64 chromosomes. This is also a novel cytotype in guinea grass never reported earlier. The plant was maintained clonally through vegetative propagation through rooted slips.

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3/29/2-9(1)	2n=9x=72	6x	6x	Aposporous ES + fertilization (3x sperm)	BIII	88%

ES: Embryo-sac, reduced ES contains haploid (n) egg cell while unreduced ES contains diploid (2n) egg cell.

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45. Penta-1 (IC567683; INGR09045), a Berseem (*Trifolium alexandrinum*) Germplasm, a pentafoliate Mutant

DR Malaviya, AK Roy and Pankaj Kaushal
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A possible approach for increasing yield of Berseem could be through increasing photosynthesis area, *i.e.* leaf area. Presence of multifoliate (mf) leaves has been reported to distinctly increase in percentage of mf leaves occurred in crosses between mf plants and the trifoliate (Tf) cultivars when the mf genotype was the maternal parent white clover. Presence of multifoliate leaves in alfalfa is reported to substantially increase in photosynthetic area of the plants. The proportion of leaves in Berseem is associated with number of leaves per plant, with number and size of leaflets on the leaf. Cultivars of Berseem clover possess trifoliate leaves however, occasional occurrence of multifoliate plants in observed sporadically in natural population. Its frequency in the natural population is only 0.004% and that too the expression of multifoliate leaves in one plants is 1 to 2% only. Multifoliate Berseem cultivars, with 4 or more leaflets per leaf instead of 3, can be useful for forage production and could used as a new variety serving for greater nutritive value and intake potential than standard trifoliate cultivars. Hence, identification of plant type with multifoliate trait will be of considerable importance. In addition to high biomadd gain, developing true breeding pentafoliate will also open up opportunities for understanding the mechanism of inheritance of this trait which is yet not known.

The process of developing multifoliate berseem started about a decade back. However, in the last few years with the help of recurrent phenotypic selection and maintenance of plants in isolation has resulted in plants type with very high percentage and expression of pentafoliate trai. Lines with above near 100% percentage and 90% expressivity of pentafoliate leaves have been developing which clearly shown significant difference in the expression of different type of leaves. The lines possess considerable importance because of high expression of pentafoliate leaves with large leaflet size which in true may exhibit high rate of photosynthesis per plant and consequently increase in the biomass yield.

46. TetraA_4; IG 08-03 (IC567684; INGR09046), a Pearl Millet (*Pennisetum glaucum*) Germplasm, Tetraploid Male Sterile Line with A_4 Cytotype

Pankaj Kaushal, AK Roy and DR Malaviya
Indian Grassland and Fodder Research Institute, Jhansi

Tetraploidy is often induced in crop plants for understanding polyploidy effects, production of cytogenetics stocks as well as to overcome incompatibility barriers in interspecific crosses arising due to ploidy level differences in parental genotypes.

Pearl millet (*Pennisetum glaucum* L.) is an important dual-purpose crop utilized both for food and fodder purposes. The genus Pennisetum consists of many wild species belonging to secondary and tertiary gene pool that harbours desirable genes, such as perenniality, fodder traits and apomixes, for pearl millet improvement (Hanna, 1987). Most of these species are polyploids and hence, show poor crossability withthe cultivated diploid pearl millet (2n=2x=14). However, upon raising the ploidy level of pearl millet, the crossability is improved thereby yielding several crosses of potential importance (Dujardin and Hanna, 1989a; Kaushal *et al.*, 2007; 2008). The efficiency of such crosases could greatly be enhanced by availability of a male sterile tetraploid line, as it further reduced the efforts to screen seeds arising from self-pollination in otherwise male fertile tetraploid lines. We therefore induced tetraploidy in a diploid male sterile as well as its maintainer line utilizing colchicines (Kaushal *et al.*, 1999; 2007; Anonymous, 2008). The induced tetraploids were characterized for their cytology (chromosome behaviour), DNA content using cytometry, stomatal characteristics and reproductive behaviour.

This is perhaps the first report of set of male-sterile and maintainer tetraploid in pearl millet in India.

This is a male sterile tetraploid pearl millet (2n=4x=28) line induced from diploid ICRISAT line 81A4 with A4 cytoplasm (CMS). The plants in C_o

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Pearl millet (*Pennisetum glaucum* L.) is an important dual-purpose crop utilized both for food and fodder purposes. The genus Pennisetum consists of many wild species belonging to secondary and tertiary gene pool that harbours desirable genes, such as perenniality, fodder traits and apomixes, for pearl millet improvement (Hanna, 1987). Most of these species are polyploids and hence, show poor crossability withthe cultivated diploid pearl millet (2n=2x=14). However, upon raising the ploidy level of pearl millet, the crossability is improved thereby yielding several crosses of potential importance (Dujardin and Hanna, 1989a; Kaushal *et al.*, 2007; 2008). The efficiency of such crosases could greatly be enhanced by availability of a male sterile tetraploid line, as it further reduced the efforts to screen seeds arising from self-pollination in otherwise male fertile tetraploid lines. We therefore induced tetraploidy in a diploid male sterile as well as its maintainer line utilizing colchicines (Kaushal *et al.*, 1999; 2007; Anonymous, 2008). The induced tetraploids were characterized for their cytology (chromosome behaviour), DNA content using cytometry, stomatal characteristics and reproductive behaviour.

This is perhaps the first report of set of male-sterile and maintainer tetraploid in pearl millet in India.

This is a male sterile tetraploid pearl millet (2n=4x=28) line induced from diploid ICRISAT line 81A4 with A4 cytoplasm (CMS). The plants in C_o

generation were weaker however, subsequently the vigour was restored in advanced generation (C_{2-4}). The plants were characterized by DNA content utilizing flow cytometry to contain double the content of the parent line 81A4. The average chromosome configuration at Diakinsis was $0.04_{I}+11.16_{II}+0.12_{III}+1.32_{IV}$. The pleat was highly male sterile (on stainable pollin) and set no seed on selfing. However, seed set is good (>80%) when pollinated with another male fertile tetraploid line IG 99-748. The male sterility is maintained by IG 99-748. Presently plants are in C_5 generation and we did not find any diploid revertent or a male-fertile contaminant.

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47. TetraA$_1$; IG 99-748 (IC568548; INGR09047), a Pearl Millet (*Pennisetum glaucum*) Germplasm, Maintainer of TetraA$_4$ MS Line

Pankaj Kaushal, AK Roy and DR Malaviya
Indian Grassland and Fodder Research Institute, Jhansi

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This is perhaps the first report of set of male-sterile and maintainer tetraploid in pearl millet in India.

This is an induced tetraploid line from diploid ICRISAT line 81B. IG 99-748 is able to maintain the male sterility of IG 08-03, since its progernitor 81B is a maintainer of 81A4. The line IG 08-03 is highly male fertile (>95%) pollen stainability)and set good seed (>80%) upon selfing (Kaushal *et al.,* 2007), which is contrary to previously reported male fertile pearl millet lunes which are poor pollen shedders and poor seed setters (Patil, *et al.,* 1961, Dujardin and Hanna, 1989b). Average chromosome configuration was $0.2_{I}+11.17_{II}+0.13_{III}+1.26_{IV}$ at Diakinesis. This line is crossable with some of the wild species such as *P. squamulatum* and *P. orientale* hybrids (Kaushal *et al.,* 2007; 2008; Anonymous, 2008). The plants are now in C_{12} generation, able to maintain their fertility and tetraploid status.

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48. Agnisikha (IC565675; INGR09048), a Canna ('Keli') (*Canna generalis*) Germplasm, a Unique New Flower Colour, Flowers in Cluster Form

Rup Kumar Roy

National Botanical Research Institute, RP Marg, Lucknow

Canna is a popular ornamental plant in India grown for its magnificent flowers with wide array of colours. Nevertheless, some cultivars have stunning foliage which is equally attractive as flowers. Cannas are mainly used for bedding purpose in gardens and parks (Roy and Sachan, 1993; Roy and Banerji, 2006). Considering its ornamental importance, a collection of 50 cultivars has been built up which are used for breeding work for the development of new varieties. Mutation breeding and hybridization techniques are successful methods for developing new cultivars (Khoshoo, 1972; Khoshoo and Guha, 1975).

The new cultivar *Canna generalis* 'Agnisikha' is a mutant of *Canna generalis* 'Lucifer'. Rhizomes were treated with different doses of gamma rays (Cobalt 60) and planted in the beds. Mutated plant was identified by change of flower colour, isolated, multiplied vegetatively, evaluated in the successive generations and found distinct, uniform and stable mutant (Roy, 2004). This breeding work including irradiation of the rhizomes, field trials were carried out in the Botanic Garden, National Botanical Research Institute, Lucknow.

Morpho-agronomic Characteristics

Morphological Characters

A. VEGETATIVE

Stature – Medium (0.90–1.20 m).

Stem – Stout, 2.5–3.5 cm in diameter with moderate suckering habit.

Leaves – Light green, tip cute, margin entire, surface smooth, 40-48 x 12-15 cm in size.

Rhizome – Creamy-white in colour; 2.0-2.5 cm in dia.; fresh weight varies from 10-15 g per 2.5 cm length, internode length-1.5-2.5 cm; no scales; roots 0.3-0.6 cm in dia., sparsely present.

B. FLORAL

Inflorescence – Simple, 25-30 cm long; contains 12-16 flowers.

Flower – 8.0 to 10.0 cm in dia., 9.5-10.0 cm in length; bi-coloured, canary yellow (2) along the margin like an irregular band having 2.0-4.0 mm width covering 15% of the individual petal; rest of the petal (85%) is geranium lake – 20 (a shade of red) like flame of fire; margin slightly frilled (Roy, 2007).

Fig. 1: Canna generalis *'Agnisikha'*

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Fig. 1: Canna generalis *'Agnisikha'*

Associated Characters and Cultural Practices

The colour combination of the flowers is like flame of fire, a combination of yellow and red, very attractive and distinct (Fig. 1). It's a medium height variety, suitable for bedding purpose, free flowering type, peak flowering season is February to October. The cultivar also performs well when grown in pots and suitable for growing in tropical /sub-tropical conditions.

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49. IIHRRs-1 (IC567489; INGR09049), a Rose (*Rosa indica*) Germplasm, an Ideal Rootstock Resistant to Powdery Mildew

Tejaswini, Dhananjaya MV and N Ramachandra
Indian Institute of Horticultural Research, Hessaraghatta, Bangalore

IIHRRs-1 is an Ideal rootstock resistant to powdery mildew (*Podosphera pannosa*). It has tall plant with moderately spreading plant habit with dark glossy leaves. The genotypes IIHRRs-1 was scored at higher threshold disease occurrence along with 416 other genotypes. The accessions were scored in 1-4 scale, with 1 being highly resistant and 4 as highly susceptible based on severity of incidence. IIHRRs-1 along with IIHRRs-2 was scored as highly resistant with the score of 1. These two highly resistant lines were further evaluated along with a highly susceptible line under higher threshold of disease occurrence for final confirmation. Experimental evaluation was conducted in a Randomised complete block design with seven replications. For maximization of disease threshold, highly susceptible line IIHRRs-1 was planted all around the experimental plot to ensure adequate inoculum for heavy disease incidence. Percentage of disease incidence was recorded for three years during maximum period of infestation. Based on stable resistant reaction of the genotype to disease incidence over the years, IIHRRs-1 was identified as a highly resistant.

50. IIHRRs-2 (IC567490; INGR09050), a Rose (*Rosa multiflora*) Germplasm, a Ideal Rootstock Resistant to Powdery Mildew

Dhananjaya MV, Tejaswini and N Ramachandra
Indian Institute of Horticultural Research, Hessaraghatta, Bangalore

IIHRRs-2 is an **i**deal rootstock resistant to powdery mildew (*podosphera pannosa*). Stems are thornless. Leaves are green in colour. Leaves are less pubescent. The genotypes IIHRRs-1 was scored at higher threshold disease occurrence along with 416 other genotypes. The accessions were scored in 1-4 scale, with 1 being highly resistant and 4 as highly susceptible based on severity of incidence. IIHRRs-2 along with IIHRRs-1 was scored as highly resistant with the score of 1. These two highly resistant lines were further evaluated along with a highly susceptible line under higher threshold of disease occurrence for final confirmation. Experimental evaluation was conducted in a Randomised complete block design with seven replications. For maximization of disease threshold, highly susceptible line IIHRRs-1 was planted all around the experimental plot to ensure adequate inoculum for heavy disease incidence. Percentage of disease incidence was recorded for three years during maximum period of infestation. Based on stable resistant reaction of the genotype to disease incidence, IIHRRs-2 was identified as a highly resistant.

Associated Characters and Cultural Practices

The colour combination of the flowers is like flame of fire, a combination of yellow and red, very attractive and distinct (Fig. 1). It's a medium height variety, suitable for bedding purpose, free flowering type, peak flowering season is February to October. The cultivar also performs well when grown in pots and suitable for growing in tropical /sub-tropical conditions.

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Associated Characters and Cultural Practices

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51. IC210421/VU/97-82 (IC210421; INGR09051), a *Alpinia calcarata* Germplasm, a Source of High 1,8-Cineole Content and α-fenchyl Acetate Content in Rhizome Essential Oil

Archana P Raina, Z Abraham and SK Mishra
National Bureau of Plant Genetic Resources, New Delhi

Alpinia calcarata Rosc. (Family Zingiberaceae) is an important rhizomatous medicinal herb found in tropical countries, including Sri Lanka, India, Thailand and Malaysia. The drugs prepared from the *A. calcarata* are used in the treatment of rheumatism, bronchial catarrh, asthma and in reducing pain. It is used to stimulate digestion, purify blood, improve voice and to treat inflammation. It is reported that the properties and uses of the rhizomes of *Alpinia calcarata* are similar to those of *Alpinia galanga* and can be used as its substitute. Five germplasm collections of *Alpinia calcarata* from different regions of Kerala were conserved in the field repository at NBPGR Regional Station, Thrissur. These germplasm collections were screened for their quality traits at NBPGR, Delhi. The essential oil extracted from rhizomes were analyzed for essential oil content and aroma constituents by GC and GC-MS. Major aroma constituents identified in these collections were 1,8–cineole, α-fenchyl acetate, camphor, camphene, α-pinene, β-pinene, α-terpineole. Among these IC210421 collected from Erattupetta village of Pathanamthitta district of Thrissur was found to contain highest 1,8-cineole (37.21%) and α-fenchyl acetate (19.87%) contents.

IC210421 is a perennial, branched, cylindrical aromatic rhizomatous herb. The rhizomes are 11.5-13.4 mm thick, prostrate, dull white with dry scales from node. Leafy pseudo stem is aromatic, basal region red 90-151 cm tall, with 10-15 leaves per pseudo stem. Lamina is 3-4.6 cm broad and 19.7-40.3 cm long with shortly bifid ciliate with lingual with 0.7-1.4 cm long. Inflorescence is aromatic, paniculate, unbranched, 10-15 cm long, densely pubescent peduncle, light green. Flowers are shortly pedicellate, ovary densely pubescent. Labellum is variegated with dark purple and yellow venation, glabrous and fruits are not formed. The rhizomes and roots are rich in essential oils.

IC210421 was found to contain high 1,8-cineole content of 37.21% which is an important aroma chemical reported to possess expectorant, antiseptic and anesthetic properties and is widely used in pharmaceutical preparations. The oil of *A. calcarata* or its constituents namely 1,8-cineole and α-fenchyl acetate hold promise as a possible pest control agents. Recently 1,8-cineole has been found effective against the mosquito A*edes aegypti* larvae and the whitefly *Bemisia ergentifolii.* Cinmethylin, a product based on 1,8-cineole has also been developed as a commercial herbicide. Thus, *A. calcarata* collection IC 210421 rich in 1,8-cineole and α-fenchyl acetate can be exploited for use in pharmaceutical and agrochemical industry.

Reference

Raina Archana P, Suresh Walia, KK Sharma, Z Abraham and SK Mishra (2007) Essential oil constituents of rhizome oil of *Alpinia calcarata* from South India. *Indian Perfumer* **51(2):** 27-29.

Table1. Salient quality attribute of the essential oil content of *Alpinia calcarata* IC210421

Accession/ collector no.	Essential oil content (%)	1,8-cineole (%)	α-fenchyl acetate(%)	α-pinene (%)	Camphene(%)	Camphor (%)	a-ter-pineole (%)
IC210421(VU/97-82)	1.26	37.21	19.87	4.13	6.02	4.38	5.71

52. Co 97016 (IC565018; INGR09052), a Sugarcane (*Saccharum* spp. hybrid) Germplasm with High Cane and Sugar Yield and Tolerance to Water-logging, Salinity and Drought

Bakshi Ram, G Hemaprabha, BK Sahi and N Vijayan Nair
Sugarcane Breeding Institute Reg. Centre, Karnal

A source of high cane yield and sugar yield and tolerance to water-logging, salinity and drought. The clone is a genetic stock with par/better cane yield and juice quality with CoS767 (the major midlate variety in North-western zoneand for its additional merits, *viz*, its tolerance to abiotic stresses. The genotype possess the blood of the wild species, *S. robustum* (57NG80), which is rarely represented in commercial gene pool. Hence, this clone would provide a new and diverse genetic base when used as a parent).

53. SCGS 00-0402 (IC565019; INGR09053), a Sugarcane (*Saccharum* spp. hybrid) Germplasm with High Levels of Juice Sucrose

RM Shanthi and S Alarmelu
Sugarcane Breeding Institute, Coimbatore-641 007, Tamil Nadu

Sugarcane cultivars with substantially higher levels of juice sucrose suitable for early harvest are very less in the present breeding populations. New parental clones that are capable of accumulating much higher levels of sucrose than found in the local commercial varieties are to be developed. Successful efforts to improve sucrose content through the adoption of different selection strategies coupled with the choice of appropriate parents have been reported (Legendre, 1995; Lo and Chen, 1995).

SCGS 00-0402 is an early high sugar clone identified from the first selection cycle of a simple recurrent selection scheme. The clone has registered a substantial gain for all the juice parameters *viz.*, juice brix %, sucrose %, CCS % and purity % compared to the zonal standards under the early maturity group. SCGS 00-0402 was developed at the Sugarcane Breeding Institute, Coimbatore has been registered as a source of high levels of juice sucrose at 240 days of crop age by the Plant Germplasm Registration Committee of ICAR vide registration number INGR. 09053.

Morpho-agronomic Characters

The clone SCGS 00-0402 has a semi-erect stool habit and yellowish red cane colour. Internode alignment is zig-zag with a cane diameter of 2.7 cms. Exposed root zone is yellowish red in colour. Leaf sheath clasping is medium and canopy is semi-drooping type. The genotype flowers during mid season (November) and flowering intensity is 90%. Pollen fertility is less than 5% and can be used as a safe female parent.

Performance of SCGS 00-0402 for Juice Traits

At 240 days of crop age, SCGS 00-0402 recorded an average juice brix of 22.57% against the early checks CoC 671 (20.73%) and Co 85004 (19.85%). It registered an improvement of 13.71% compared to Co 85004 and 8.88% as compared to CoC 671. SCGS 00-0402 recorded an average juice sucrose of 21.62% at 240 days compared to the standards CoC 671 (19.37%) and Co 85004 (18.42%). The clone recorded an improvement of 17.35% over Co 85004 and 11.62% over CoC 671. For commercial cane sugar percent, SCGS 00-0402 recorded an average of 15.51% as compared to 13.74% in the check variety CoC 671 and 13.03% in Co 85004. It showed an improvement of 18.97% compared to Co 85004 and 12.82% as compared to CoC 671.

The potential of SCGS 00-0402 as a donor for juice quality is evident from the progeny evaluation for juice characters. The best progeny, *viz.*, 03-0402 recorded a maximum of 23.00% juice brix against the standard CoC 671 with 12.20% improvement over the early check Co 85004 and 9.52% over the other check variety CoC 671. Early sucrose accumulation is a promising characteristic in sugarcane improvement programmes. Hence, the clone SCGS 00-0402 is a potential pre-breeding stock and its use in hybridization is expected to generate more number of segregants for early high sugar content in sugarcane.

References

Legendre BI (1995) Potential of increasing the sucrose content of sugarcane: An assessment of recurrent selection in Louisiana. *Sugarcane* **3:** 4-8.

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54. LG 95053 (IC553283; INGR09054), a sugarcane (*Saccharum* spp. hybrid) Germplasm with High Sugar Content and Utility as a Female Parent

BL Srivastava, Raman Kapur, SK Duttamajumder and Ram Kumar
Indian Institute of Sugarcane Research, Lucknow

The present-day cultivated sugarcane is a cross-pollinated, highly heterozygous, polyploid, species-hybrid (*Saccharum* sp. hybrid). The inherent genetic complexity of sugarcane makes its breeding rather empirical. The present material, LG 95053, is the product of a concerted effort to develop breeding stocks for high sugar accumulation potential in the subtropical agro-climate. This approach is aimed at lending precision to the process of breeding in sugarcane.

Morpho-agronomic Characteristics

LG 95053 is the result of selection in the progeny of a biparental mating (Co 89003 x CoC 671) effected in 1994. It was originally selected in 1996 as N_2-17-7 and was evaluated subsequently for its early high sugar accumulation potential. Its cane is medium-thick and medium-tall with moderate cane yield. Its canes are erect, purple yellow with cylindrical internodes, and ovate buds. It is early maturing with high juice purity. Sucrose content in juice ranges from 17-19 % during November to January. It was identified as a promising high sugar breeding stock (1-3) and sent to National Hybridization Garden (NHG), Sugarcane Breeding Institute, Coimbatore in 1997-98.

Associated Characters and Cultivation Practices

LG 95053 flowers in the third week of October at Coimbatore and registers very low pollen fertility (< 5%) making it an ideal female parent in a highly cross pollinated system (4). Over the years, it has proven its merit as a female parent (Table 1) in transmitting high sugar traits to its progenies (5).

Fig. 1: LG 95053; • Early maturing, high sugar clone with regular flowering, • Good female parent giving high proportion of progeny with early high sugar accumulation potential

Table 1. Progeny performance

Type of mating	Size of seedling population	Family mean (% brix)	Percent seedlings above CoJ 64 (>21%)	Percent seedlings at par with CoJ 64 (20-21%)	Percent seedlings with high sugar content
LG 95053 Self	22	20.00	18.2	40.9	59.1
LG 95053 GC	27	20.05	48.2	14.8	63.0
LG 95053 x HR 83-65	50	20.50	36.0	32.0	68.0
LG 95053 x LG 94184	61	20.19	32.8	32.8	65.6

55. VL 876 (IC565010; INGR09055), a Wheat (*Triticum aestivum*) Germplasm, with High Bread Loaf Volume and Good Quality Bread

Laksmi Kant, Vinay Mahajan, HS Gupta, BD Pandey and Daya Shanker, SK Pant and RK Gupta
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

Bread Loaf volume >575 ml highly desirable for good quality bread making. Bread Loaf volume (ml) / Dough weight (g) > 3.5 is considered appropriate for a good quality bread. Bread quality score between 7.1-8.0 (out of 10) is very good for a good quality bread.

54. LG 95053 (IC553283; INGR09054), a sugarcane (*Saccharum* spp. hybrid) Germplasm with High Sugar Content and Utility as a Female Parent

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56. VL 852 (IC565011; INGR09056), a Wheat (*Triticum aestivum*) Germplasm, a Diverse Source of Chapatti Quality

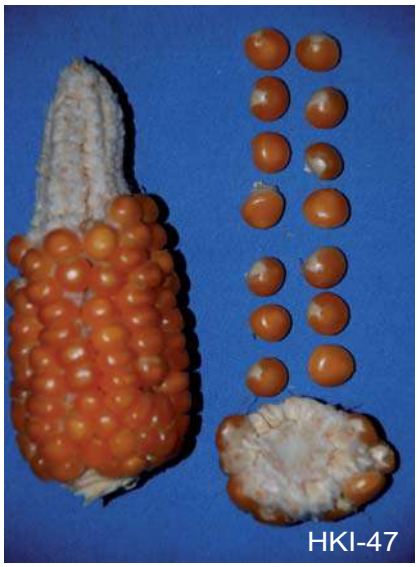
Laksmi Kant, Vinay Mahajan, HS Gupta, BD Pandey, Daya Shanker, SK Pant and RK Gupta
Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora

Excellent chapatti quality (8 out of 10). Diverse source of chapatti quality than C 306.

57. HKI-47 (IC563953; INGR09057), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

A late maturing normal maize grain line derived from CIMMYT highland single cross hybrid (ET 38146 x 38147) after 7-8 years of continuous inbreeding following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.



HKI-47

HKI-47 is medium stature plant type with medium to long cob. It takes 60 days for 50% silking. It has sparse tassel branches and is a good pollen shedder, which is a merit of a good pollen parent. The grain rows arrangement is straight and the Anthocyanin colouration of glume is white. It has very attractive orange flint grain colour.

The four year data from 2003 to 2006 with respect to common rust and Maydis Leaf Blight (MLB) reaction revealed that line has shown consistently very high level of resistance against the susceptible check CM600 for Maydis Leaf blight and common rust against susceptible check CM202. The disease reaction for Maydis Leaf Blight in HKI-47 ranged from 1.0 to 1.5 and for common rust it showed consistently 1.0. This can be utilized as a source of stable resistance against the above mentioned diseases for the development of disease free hybrids and deriving new inbred lines.

It is also a good combiner. When it was crossed with temperate material the line produced very productive hybrids; it can also be used as good pollen parent for tropical and sub-tropical lines.

Criteria for Registration [Unique feature(s)]

1. Resistant to common rust,
2. Attractive grain colour,
3. Sparse tassel branches, good pollen shedder,
4. Good combiner.

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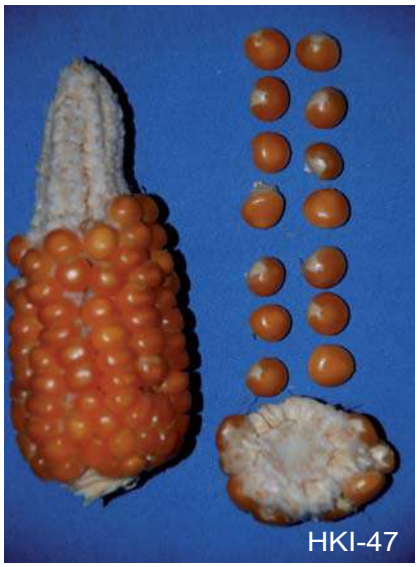

HKI-47

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It is also a good combiner. When it was crossed with temperate material the line produced very productive hybrids; it can also be used as good pollen parent for tropical and sub-tropical lines.

Criteria for Registration [Unique feature(s)]

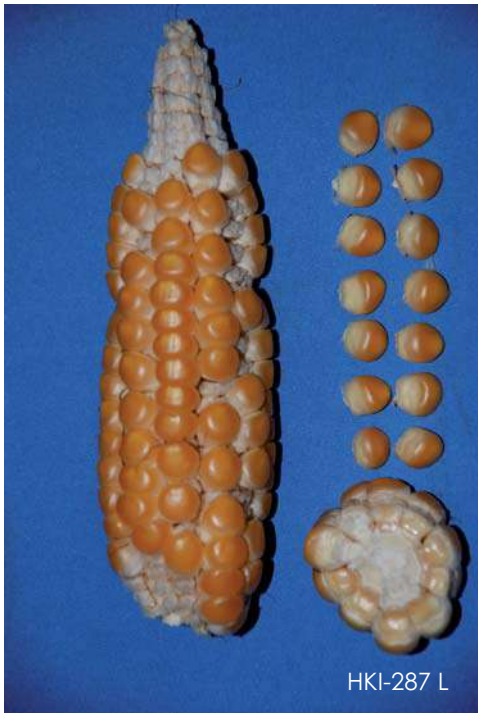
1. Resistant to common rust,
2. Attractive grain colour,
3. Sparse tassel branches, good pollen shedder,
4. Good combiner.

58. HKI-287L (IC563954; INGR09058), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

HKI-287 L

A late maturing line derived from CIMMYT line CML-287 which was not uniform with respect to many traits. Phenotypically superior plants were selected and were subjected to 7-8 years of selfing following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal. The line was evaluated during *kharif* and *rabi* seasons, it has shown very high level of resistance for MLB and common rust, respectively, under normal field conditions. The four-year data, during 2003-2006, with respect to common rust and Maydis Leaf Blight (MLB) reaction revealed that line has shown consistently very high level of resistance against the susceptible check CM600 for Maydis Leaf blight and common rust against susceptible check CM202. The disease reaction for Maydis Leaf Blight in HKI-287L ranged from 1.0 to 2.0 and for common rust ranged from 1 to 1.5. This can be utilized as a source of stable resistance against the above mentioned diseases for development of disease free hybrids.



HKI-287L is tall growing plant with medium to long cob. Based on four year data (2003-2006) in rabi and kharif evaluated for various morphological traits revealed that it takes 60-64 days for silking. The height ranged from 150-160 cm. The test weight is more than 200 g/1000 grains and productivity is > 2.5 ton in the both the seasons. It has sparse tassel branches and a good pollen shedder. It can be used as a pollen parent in developing single cross hybrids. The grain row arrangement is straight and the Anthocyanin coloration of glume is white. It has very attractive orange flint grain colour.

It is also a good combiner. It has given good hybrids when crossed with HKI-1128, HKI-1126, HKI-288-2, HKI-1105, HKI-326, HKI-326-1 etc. This line has useful genes for productivity and is good combiner, hence can be used by breeders for the production of Single cross hybrids.

Criteria for Registration [Unique feature(s)]

1. Late maturing,
2. Attractive orange grain color,
3. Dark green leaves, productive.

59. HKI-327 T (IC563955; INGR09059), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

A late maturing line derived from CIMMYT line CML-327 which was not a uniform line and varied for many traits. Superior plants were selected after 7-8 years of selfing following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

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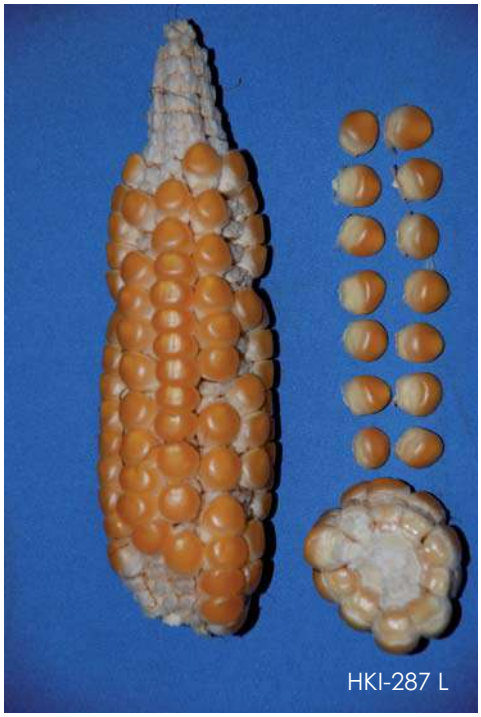

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Criteria for Registration [Unique feature(s)]

1. Late maturing,
2. Attractive orange grain color,
3. Dark green leaves, productive.

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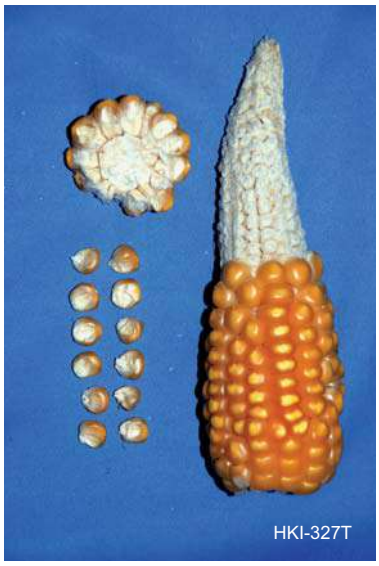


HKI-327T

HKI-327T is tall stature plant type with medium to long cob. Based on four years data the line takes 56-59 days to flower and height goes upto 160 cm. Grains are very bold and line is very productive. Yield is up to 2.7 t/ha in kharif and 2.8 t/ha in winter season. This line has shown high level of resistance for MLB and common rust under artificial condition continuously for four years. This line will be useful for maize breeders for developing single cross hybrids.

Criteria for Registration [Unique feature(s)]

1. Tall, dark green, broad leaves,
2. Resistant to MLB and common rust,
3. Late maturing, productive.

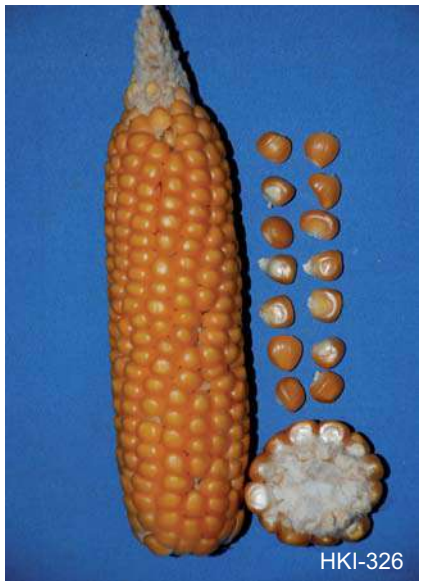
60. HKI-326 (IC563957; INGR09060), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rrust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

A late maturing line derived from CIMMYT line CML-326 which was not uniform and was variable for various traits. A few good plants were selected which were selfed for 7-8 years following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

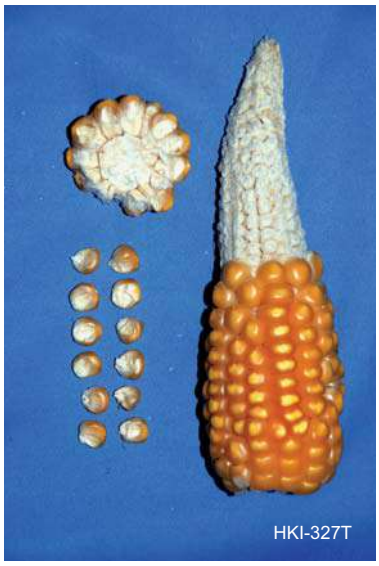
It has very long cob with thin, white gully, this will contribute to high harvest index and high shelling percentage. It comes to flowering within 55-58 days. It reaches to the height of 140 cm. It has sparse tassel branches. It has very attractive orange flint grain colour.

In *kharif* season the productivity of this line is near 2 t/ha and in *rabi* season it is more than 2 t/ha. It can be used in both ways as male and as well as female in combination breeding. Extensive testing for four years (2003 to 2006) has shown high level of resistance to major diseases like Maydis Leaf Blight and common rust in *kharif* and *rabi*, respectively, under natural field condition.The line can be made available to different centers of the country for its extensive use in breeding single cross hybrids.



Criteria for Registration [Unique feature(s)]

1. Attractive orange grain colour,
2. Late maturing, green leaves,
3. Very long cobs and good combiner, productive.



HKI-327T

HKI-327T is tall stature plant type with medium to long cob. Based on four years data the line takes 56-59 days to flower and height goes upto 160 cm. Grains are very bold and line is very productive. Yield is up to 2.7 t/ha in kharif and 2.8 t/ha in winter season. This line has shown high level of resistance for MLB and common rust under artificial condition continuously for four years. This line will be useful for maize breeders for developing single cross hybrids.

Criteria for Registration [Unique feature(s)]

1. Tall, dark green, broad leaves,
2. Resistant to MLB and common rust,
3. Late maturing, productive.

60. HKI-326 (IC563957; INGR09060), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rrust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

A late maturing line derived from CIMMYT line CML-326 which was not uniform and was variable for various traits. A few good plants were selected which were selfed for 7-8 years following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

It has very long cob with thin, white gully, this will contribute to high harvest index and high shelling percentage. It comes to flowering within 55-58 days. It reaches to the height of 140 cm. It has sparse tassel branches. It has very attractive orange flint grain colour.

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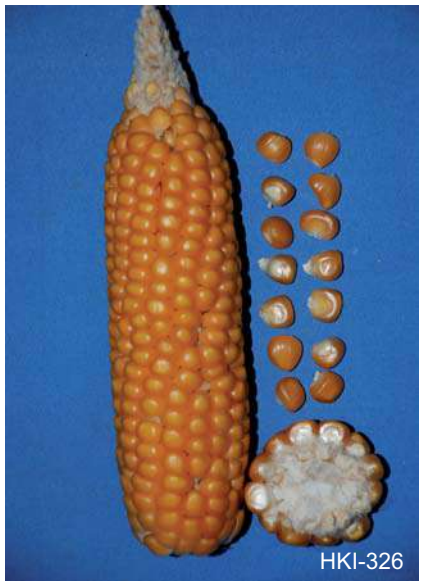


Criteria for Registration [Unique feature(s)]

1. Attractive orange grain colour,
2. Late maturing, green leaves,
3. Very long cobs and good combiner, productive.

61. HKI-1040-5 (IC563960; INGR09061), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

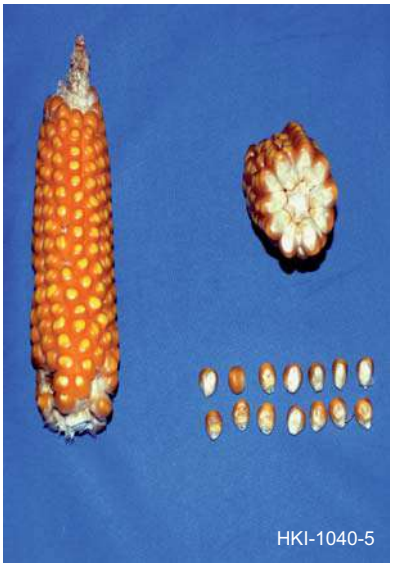
Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

It is medium maturing line derived from the Brazilian extra early single cross hybrid BC-318 through the process of selfing and selection. The hybrid was continuously selfed for 7-8 generations following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

HKI-1040-5

HKI-1040-5 is medium tall plant with long cob. The plant height varies from 110 to 145 cm. In winter season the height is around 100 cm. The 50% silk emergence is between 50-54 days depending upon weather conditions.

It is orange flint with purple glumes. is purple silk and the sheath is also purple. Tassel is purple with purple anther colour. Under natural field conditions, this inbred line line is resistant to MLB and common rust but under artificial condition it showed moderate resistance to these diseases.



Criteria for Registration [Unique feature(s)]

1. Attractive orange grain colour,
2. medium maturing, dark green leaves,
3. Good combiner.

62. HKI-1341 (IC563962; INGR09062), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

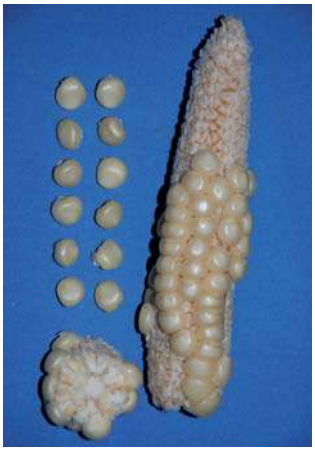
It is a white shiny grain line with high level of resistance to common rust under artificial disease conditions. The disease score is1.0 against the highly susceptible check CM-202.

This was derived from a variable CIMMYT line CML-6. 7-8 generations of selfing and selection has resulted in the development of this line.

The tassel has sparse branches, late in maturity. It has flint grain and kernel row arrangement is straight and has white glume.

HKI-1341

This line can be used in winter season as a source of resistance to common rust for the derivation of elite resistant lines and as well as in combination breeding.



Criteria for Registration [Unique feature(s)]

1. Attractive shining white grain,
2. Late maturing, dark green leaves,
3. Resistant to common rust and productive.

61. HKI-1040-5 (IC563960; INGR09061), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

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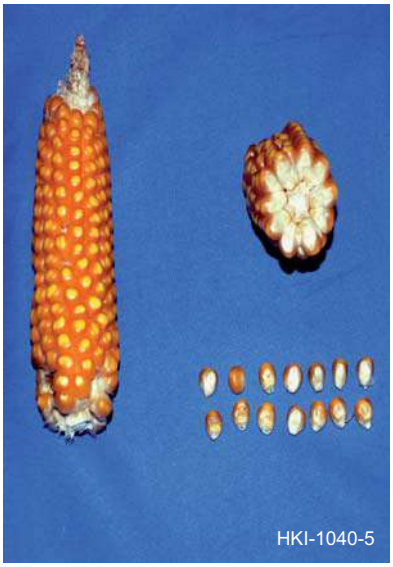
HKI-1040-5

HKI-1040-5 is medium tall plant with long cob. The plant height varies from 110 to 145 cm. In winter season the height is around 100 cm. The 50% silk emergence is between 50-54 days depending upon weather conditions.

It is orange flint with purple glumes. is purple silk and the sheath is also purple. Tassel is purple with purple anther colour. Under natural field conditions, this inbred line line is resistant to MLB and common rust but under artificial condition it showed moderate resistance to these diseases.



Criteria for Registration [Unique feature(s)]

1. Attractive orange grain colour,
2. medium maturing, dark green leaves,
3. Good combiner.

62. HKI-1341 (IC563962; INGR09062), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

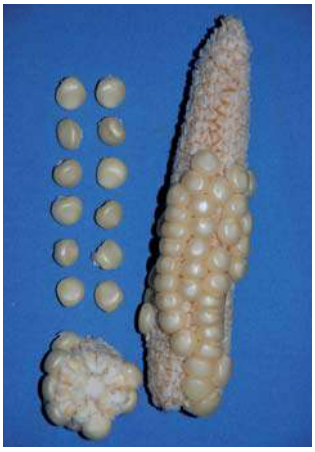
It is a white shiny grain line with high level of resistance to common rust under artificial disease conditions. The disease score is1.0 against the highly susceptible check CM-202.

This was derived from a variable CIMMYT line CML-6. 7-8 generations of selfing and selection has resulted in the development of this line.

The tassel has sparse branches, late in maturity. It has flint grain and kernel row arrangement is straight and has white glume.

HKI-1341

This line can be used in winter season as a source of resistance to common rust for the derivation of elite resistant lines and as well as in combination breeding.



Criteria for Registration [Unique feature(s)]

1. Attractive shining white grain,
2. Late maturing, dark green leaves,
3. Resistant to common rust and productive.

63. HKI-1342 (IC563963; INGR09063), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

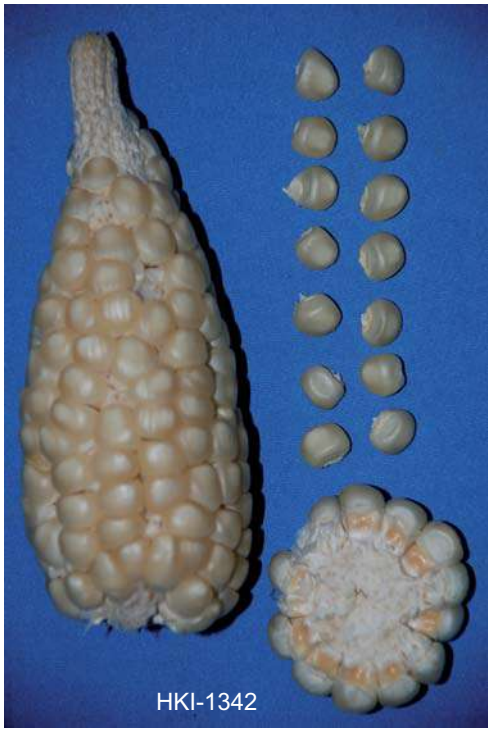
A late maturing line derived from CIMMYT line CML 6 after 7-8 years of inbreeding following by ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

HKI-1342

HKI-1342 is medium stature plant type with medium long cob. It has sparse tassel branches and a good pollen shedder, which is a merit of a good pollen parent. The grain row arrangement is straight and the Anthocyanin coloration of glume is white. It has very attractive white flint grain colour.

The four year data with respect to common rust and Maydis Leaf Blight (MLB) reaction revealed that line has shown consistently very high level of resistance against the susceptible check CM600 for Maydis Leaf blight and common rust against susceptible check CM202. The disease reaction for Maydis Leaf Blight and common rust in HKI-1342 was consistently 1.0. This can be utilized as a source of stable resistance against the above mentioned diseases for development of disease free hybrids.

It is also a good combiner. When it was crossed with temperate material the line produced very productive hybrids, it can also be used as good pollen parent for tropical lines.



Criteria for Registration [Unique feature(s)]

1. Resistant to rust and MLB,
2. Late maturing, dark green leaves and productive,
3. White with shiny grain.

64. HKI-170 (1+2) (IC563967; INGR09064), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

A late maturing line derived from CIMMYT line CM170 after 7-8 years of inbreeding following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

HKI-170 (1+2)

HKI-170 (1+2) is medium stature plant type with medium long cob. It has sparse tassel branches and a good pollen shedder, which is a merit of a good pollen parent. The grain row arrangement is straight and the Anthocyanin coloration of glume is white. It has very attractive yellow flint grain colour. HKI-170 (1+2) is a QPM inbred and has high tryptophan (>0.6%) content in its endosperm.

The four year data with respect to common rust and Maydis Leaf Blight (MLB) reaction revealed that line has shown consistently very high level of resistance against the susceptible check CM600 for Maydis Leaf blight and common rust against susceptible check CM202. The disease reaction for Maydis Leaf Blight in HKI-170 (1+2) was consistently 1.0 and for common rust the range was 1.0 to 1.5. This can be utilized as a source of stable resistance against the above mentioned diseases for development of disease free hybrids.

63. HKI-1342 (IC563963; INGR09063), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

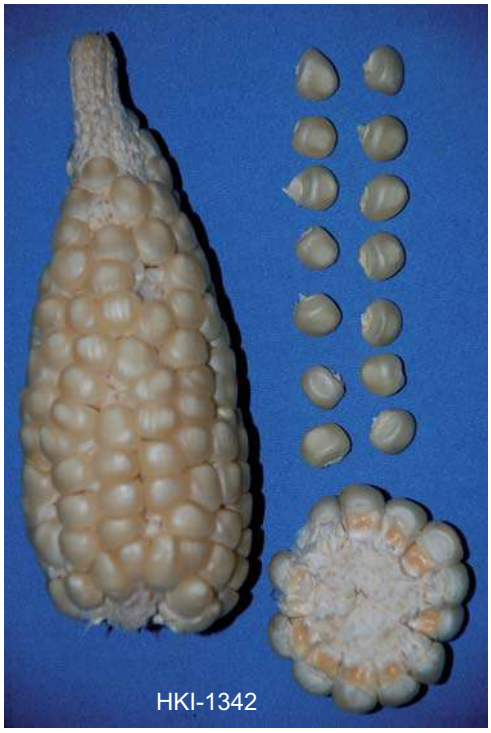
A late maturing line derived from CIMMYT line CML 6 after 7-8 years of inbreeding following by ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

HKI-1342

HKI-1342 is medium stature plant type with medium long cob. It has sparse tassel branches and a good pollen shedder, which is a merit of a good pollen parent. The grain row arrangement is straight and the Anthocyanin coloration of glume is white. It has very attractive white flint grain colour.

The four year data with respect to common rust and Maydis Leaf Blight (MLB) reaction revealed that line has shown consistently very high level of resistance against the susceptible check CM600 for Maydis Leaf blight and common rust against susceptible check CM202. The disease reaction for Maydis Leaf Blight and common rust in HKI-1342 was consistently 1.0. This can be utilized as a source of stable resistance against the above mentioned diseases for development of disease free hybrids.

It is also a good combiner. When it was crossed with temperate material the line produced very productive hybrids, it can also be used as good pollen parent for tropical lines.



Criteria for Registration [Unique feature(s)]

1. Resistant to rust and MLB,
2. Late maturing, dark green leaves and productive,
3. White with shiny grain.

64. HKI-170 (1+2) (IC563967; INGR09064), a Maize (*Zea mays*) Germplasm, a Good Pollen Shedder, Attractive Grain Color, Resistant to Rust

Sain Dass, Dharam Pal, JC Mehla, Kulbir Singh Dhanju, Rishi Pal and Dharam Pal Singh
Chaudhary Charan Singh, HAU, Karnal

A late maturing line derived from CIMMYT line CM170 after 7-8 years of inbreeding following ear-to-row selection at Haryana Agriculture University, Regional Research Station, Uchani, Karnal.

HKI-170 (1+2)

HKI-170 (1+2) is medium stature plant type with medium long cob. It has sparse tassel branches and a good pollen shedder, which is a merit of a good pollen parent. The grain row arrangement is straight and the Anthocyanin coloration of glume is white. It has very attractive yellow flint grain colour. HKI-170 (1+2) is a QPM inbred and has high tryptophan (>0.6%) content in its endosperm.

The four year data with respect to common rust and Maydis Leaf Blight (MLB) reaction revealed that line has shown consistently very high level of resistance against the susceptible check CM600 for Maydis Leaf blight and common rust against susceptible check CM202. The disease reaction for Maydis Leaf Blight in HKI-170 (1+2) was consistently 1.0 and for common rust the range was 1.0 to 1.5. This can be utilized as a source of stable resistance against the above mentioned diseases for development of disease free hybrids.

When it was crossed with temperate material the line produced very productive hybrids, it can also be used as good pollen parent for tropical lines.

Criteria for Registration [Unique feature(s)]

1. Attractive yellow grain colour,
2. Late maturing,
3. Good combiner.

65. NBPGR Tomato-1 (IC564448; INGR09065), a Tomato (*Lycopersicon esculentum*) Germplasm, a High TSS (60.B)

SK Yadav, KK Gangopadhyay, SK Mishra, Gunjeet Kumar, Chitra Pandey, BL Meena, RK Mahajan, Mathura Rai, SK Sharma, Rajesh Kumar, HC Prasanna and Nagender Rai

National Bureau of Plant Genetic Resource, New Delhi-110 012

Tomato (*Lycopersican esculantum* L.) is one of the important vegetable crops widely grown all over India during winter and spring season. It is known for its use in salad, cooked and processed products. Tomato fruits with high TSS are highly demanding in processing industries for making tomato paste, puree, ketch-up, chutney etc. For processing, high TSS (Total soluble solids) is an important character for crop improvement and there is not many lines/ varieties available to suitable for processing. Therefore, identification of lines having high TSS will be useful in quality improvement of tomato. The experiment was conducted at IIVR, Varanasi as a part of multiplication evaluation of vegetable crops germplasm AICRP (Vegetable Crops) during winter 2005-06. The TSS of the said accession (NBPGR Tomato-1) has been found 6.0^0 Brix which is much higher than the normal (3-4^0 B).

The other parameters of this selection are Days to first flowering-44.0 days, Days to first maturity-79.0 days, Fruit length-3.6 cm, Fruit width-3.4 cm, Fruit weight-130.0 g, Number of fruit per plant-60.0, Number of branches per plant 5.0 and fruit yield per plant 900 g.

When it was crossed with temperate material the line produced very productive hybrids, it can also be used as good pollen parent for tropical lines.

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66. ANSR-1 (IC385843; INGR09066), a Kawaunch (*Mucuna pruriens*) Germplasm, High L-DOPA Content (6.30%)

Anil Kumar Singh, SK Pareek, Ashok Kumar, SK Singh, SS Malik and YS Tomer
National Bureau of Plant Genetic Resource, New Delhi-110 012

The genus *Mucuna pruriens* has a wide distributed in tropics/subtropical regions of the world. In India, 14 species are found in the foot hills of Himalayas, plains of West Bengal, Madhya Pradesh, Karnataka, Kerala, Andhra Pradesh and Andaman and Nicabar. Commonly it is "Kawanch" a trible pulse, velvet bean, cow-itch plant, mostly sown as alley cropping pattern. It conserves soil and improves the agro-forestry system. In particular, the seed and the root of *M. pruriens* are used in the India sustem of medicine as effective nervine tonic and aphrodisiac. It has diuretic property and consequently is used in kindly troubles and dropsy.

The seed contain L-DOPA (L-3:4-dihydroxy phenylalanine) which is the active principal responsible for treatment of Parkinson's disease and hypertension. In addition the seeds have fats, sterols, alkaloids and other amino acids.

67. D4 (IC567213; INGR09067), a Potato (*Solanum tuberosum*) Germplasm, a Male Fertile and Drogenic (Di)haploid of Tetraploid Potato Flowering

Sushruti Sharma, Debabrata Sarkar and Suman Kumar Pandey
Central Potato Research Institute, Shimla

The extraction of androgenic (di)haploids ($2n = 2x = 24$) from tetraploid potatoes (*Solanum tuberosum* L.; $2n = 4x = 48$) is frustratingly difficult. Androgenic potato (di)haploids extracted till date are either non-flowering or male sterile (Rokka, 2009). At the Central Potato Research Institute (CPRI), Shimla (India), two first-ever male-fertile androgenic (di)haploids-D4 (INGR 09067) and C-13 (INGR 09068) of tetraploid Indian potato cvs JTH/C-107 (a TPS parental line) and Kufri Chipsona-2 (a processing variety) respectively-have been developed through anther culture (Sharma *et al.*, 2009). Whereas C-13 is highly resistant to late blight, D4 is a flower colour (from intense purple to white) mutant.

Morpho-agronomic Characteristics

C-13 ($2n = 2x = 24$) is a dwarf and late-maturing, with a semi-compact bushy appearance (Fig. 1), short internodes, small lighter green leaves, white semi-stellate four-lobed corollas, pale yellow anther, short anther length and bilobed stigma. Its tubers are cylindrical with white flesh colour and closed sprout tip. D4 ($2n = 2x = 24$) has an open canopy structure, with short internodes, small dark-green narrow leaves (Fig. 1) without midrib pigmentation, no anthocyanin coloration of floral bud, floral stalk, calyx and pedicel, white corolla and pale yellow anthers. Its tubers are kidney-shaped with shallow eye depth, white predominant and vascular ring-type secondary flesh colour, and white-cream skin colour. Both D4 and C-13 yield on an average 3.4 and 7.8 tubers per plant, with 7.1 and 7.6 g avergae tuber weight and 14.1 and 21.1% tuber dry matter, respectively.

Associated Characters and Cultivation Practices

C-13 and D4 [endosperm balance number (EBN) 2] are invaluable (di)haploid breeding material for potato (Sharma *et al.*, 2009). They are recommended for introgressing various agronomic traits and disease resistance and/or abiotic stress tolerance attributes from 1 EBN diploid potato species, such as *S. bulbocastanum*, *S. circaeifolium*, *S. commersonii*, *S. etuberosum* and *S. pinnatisectum* into the gene pool of cultivated Indian tetraploid potatoes (4 EBN) through symmetric/ asymmetric somatic hybridization (Sharma *et al.*, 2008). C-13 can be used not only as an important source of late blight resistance in a potato breeding programme, but also to generate an appropriate biparental segregating population (F_1) for QTL-mapping of late blight resistance.

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Rokka VM (2009) Potato haploids and breeding. In: A Touraev, BP Forster and SM Jain (eds) *Advances in Haploid Production in Higher Plants*. Springer Science + Business Media B.V., Dordrecht, pp 199-208.

Sharma S, D Sarkar and SK Pandey (2008) Symmetric somatic hybridization between *Solanum bulbocastanum* and *Solanum tuberosum* utilizing an effective protoplast isolation and culture system. In: J Gopal, D Pattanayak, D Kumar, PM Govindakrishnan and B Singh (eds) *Global Potato Conference 2008. Opportunities and Challenges in the New Millennium*. Indian Potato Association, Shimla, p 189.

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The seed contain L-DOPA (L-3:4-dihydroxy phenylalanine) which is the active principal responsible for treatment of Parkinson's disease and hypertension. In addition the seeds have fats, sterols, alkaloids and other amino acids.

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Associated Characters and Cultivation Practices

C-13 and D4 [endosperm balance number (EBN) 2] are invaluable (di)haploid breeding material for potato (Sharma *et al.*, 2009). They are recommended for introgressing various agronomic traits and disease resistance and/or abiotic stress tolerance attributes from 1 EBN diploid potato species, such as *S. bulbocastanum*, *S. circaeifolium*, *S. commersonii*, *S. etuberosum* and *S. pinnatisectum* into the gene pool of cultivated Indian tetraploid potatoes (4 EBN) through symmetric/ asymmetric somatic hybridization (Sharma *et al.*, 2008). C-13 can be used not only as an important source of late blight resistance in a potato breeding programme, but also to generate an appropriate biparental segregating population (F_1) for QTL-mapping of late blight resistance.

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68. C-13 (IC567214; INGR09068), a Potato (*Solanum tuberosum*) Germplasm, a Highly Resistant to Late Blight

Sushruti Sharma, Debabrata Sarkar and Suman Kumar Pandey
Central Potato Research Institute, Shimla

The extraction of androgenic (di)haploids (2*n* = 2*x* = 24) from tetraploid potatoes (*Solanum tuberosum* L.; 2*n* = 4*x* = 48) is frustratingly difficult. Androgenic potato (di)haploids extracted till date are either non-flowering or male sterile (Rokka, 2009). At the Central Potato Research Institute (CPRI), Shimla (India), two first-ever male-fertile androgenic (di)haploids-D4 (INGR 09067) and C-13 (INGR 09068) of tetraploid Indian potato cvs JTH/C-107 (a TPS parental line) and Kufri Chipsona-2 (a processing variety) respectively, have been developed through anther culture (Sharma *et al.*, 2009). Whereas C-13 is highly resistant to late blight, D4 is a flower colour (from intense purple to white) mutant.

Morpho-agronomic Characteristics

C-13 (2*n* = 2*x* = 24) is a dwarf and late-maturing, with a semi-compact bushy appearance (Fig. 1), short internodes, small lighter green leaves, white semi-stellate four-lobed corollas, pale yellow anther, short anther length and bilobed stigma. Its tubers are cylindrical with white flesh colour and closed sprout tip. D4 (2*n* = 2*x* = 24) has an open canopy structure, with short internodes, small dark-green narrow leaves (Fig. 1) without midrib pigmentation, no anthocyanin coloration of floral bud, floral stalk, calyx and pedicel, white corolla and pale yellow anthers. Its tubers are kidney-shaped with shallow eye depth, white predominant and vascular ring-type secondary flesh colour, and white-cream skin colour. Both D4 and C-13 yield on an average 3.4 and 7.8 tubers per plant, with 7.1 and 7.6 g avergae tuber weight and 14.1 and 21.1% tuber dry matter, respectively.

Associated Characters and Cultivation Practices

C-13 and D4 [endosperm balance number (EBN) 2] are invaluable (di)haploid breeding material for potato (Sharma *et al.*, 2009). They are recommended for introgressing various agronomic traits and disease resistance and/or abiotic stress tolerance attributes from 1 EBN diploid potato species, such as *S. bulbocastanum*, *S. circaeifolium*, *S. commersonii*, *S. etuberosum* and *S. pinnatisectum* into the gene pool of cultivated Indian tetraploid potatoes (4 EBN) through symmetric/asymmetric somatic hybridization (Sharma *et al.*, 2008). C-13 can be used not only as an important source of late blight resistance in a potato breeding programme, but also to generate an appropriate biparental segregating

Fig. 1: Androgenic (di)haploids C-13 (left) and D4 (right) of tetraploid Indian potato cvs Kufri Chipsona-2 and JTH/C-107, respectively, flowering under long-day conditions (May-August) of Shimla hills in northern India

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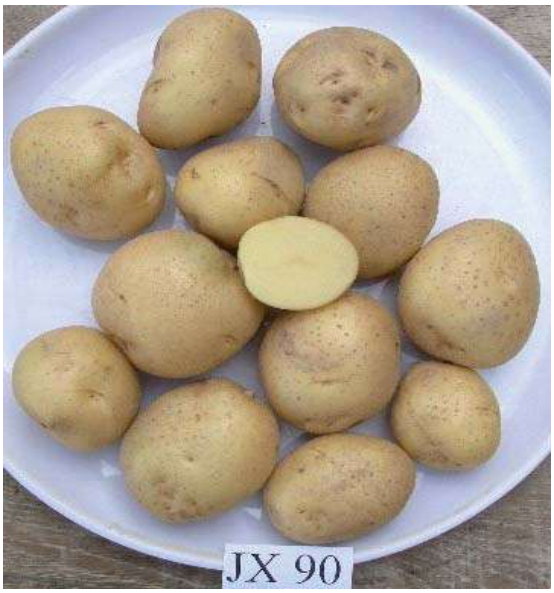
69. JX 90 (INGR09069), a Potato (*Solanum tuberosum*) Germplasm, a Horizontal Resistant to Late Blight and Early Blight, High Yield under Early (75 days) and Medium (90 days) Crop Duration

Raj Kumar, GS Kang, SK Pandey and Jai Gopal
Central Potato Research Station, Jalandhar-144 003

JX 90 was approved for registration as a source of resistance to late blight and early blight by Germplasm Registration Committee in its XIXth meeting held on 13th March 2009. Late blight caused by the fungus *Phytophthora infestans* (Mont.) de Bary is one of the most devastating diseases of cultivated potatoes worldwide. The disease is responsible for important economic losses and high levels of fungicide use (Singh and Shekhawat, 1999). Early blight (*Alternaria solani*) is a disease of potato across the crop's geographic range (Pavek and Cornisi, 1994). The disease is prevalent in many potato growing areas and is of economic importance in plains of India (Lakra, 1997).

JX 90 possess high horizontal resistance to late blight, high general combining ability for horizontal resistance to late blight; early blight resistance and high yield under early (75 days) and medium (90 days) harvests. At early (75 days) harvest it has performed at par with best control variety Kufri Ashoka for yield. Generally early bulking varieties are susceptible to late blight. However, JX 90 combines high horizontal resistance to late blight with early bulking. Under All India Coordinated Research Ptoject on Potato (AICRP Potato) trials JX 90 have shown resistance to late blight and early blight and its horizontal resistance to late blight has been confirmed in the study carried out by us during the years 2005 and 2006 (Kumar *et al*., 2007). It is well known that while vertical resistance to late blight may not be stable, horizontal resistance to late blight is a known stable character due to its multi-genic inheritance.



JX 90 is a selection from the progeny of the cross CP 1346 (Krirrinee) x MS/78-62. The cross was made at during 1985. The clone was selected from the progeny of this cross at Central Potato Research Station Jalandhar, Punjab. The breeding methodology is clonal selection from the cross between selected parents.

Morpho-agronomic Characteristics

Tubers of JX 90 are oval shape, with brownish skin colour, large sized, with shallow eyes and yellow flesh colour. JX 90 flower profusely at Kufri. The flower is white. Plant is medium compact. Leaflets are oval.

population (F_1) for QTL-mapping of late blight resistance.

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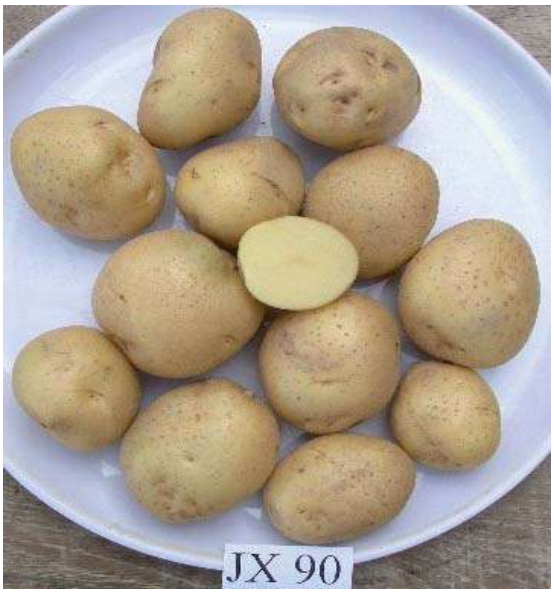

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Morpho-agronomic Characteristics

Tubers of JX 90 are oval shape, with brownish skin colour, large sized, with shallow eyes and yellow flesh colour. JX 90 flower profusely at Kufri. The flower is white. Plant is medium compact. Leaflets are oval.

Anthers are pale yellow with stylar length more than stamen column. Sprouts are bulbous and white-green in colour. For yield at early and medium maturity harvest this culture have performed consistently well over the years under multilocation trials under AICRP (Potato) from 1999-2000 to 2002-2003.

Associated Characters and Cultivated Practices

This line performs well for yield under early (75 days) and medium (90 days) harvest in Indian plains and plateau region.

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In Memoriam – A Tribute to Dr Norman Ernest Borlaug

(March 25, 1914- September 12, 2009)

The World Food Prize Organization has rightly described this eminent scientist as "The man who has saved more lives than any other person who has ever lived" while conferring the honor to him. In his passing away, the world has lost a famous agricultural scientist and a friend of developing nations like India. His life and achievements were a testimony to the contributions of his towering intellect, persistence and scientific vision. Dr. Norman Ernest Borlaug was an American agronomist, humanitarian, and a Nobel laureate who has been deemed the father of the Green Revolution. Dr. Borlaug was one of only six people to have won the Nobel Peace Prize, the Presidential Medal of Freedom and the Congressional Gold Medal. He was also the recipient of the Padma Vibhushan, India's second highest civilian honor. He received his Ph.D. in plant pathology and genetics from the University of Minnesota in 1942 and took up an agricultural research position in Mexico. He left his footprints in agriculture through his personal and professional commitment to fight hunger and poverty and the pioneering work in the development of semi-dwarf, high-yielding, and disease-resistant wheat varieties. During the mid-20th century, he was instrumental in introducing these high-yielding varieties combined with modern agricultural production techniques to Mexico, Pakistan, and India. Dr. Borlaug is credited with saving over a billion people worldwide from starvation and was awarded the Nobel Peace Prize in 1970 in recognition of his outstanding contributions to world peace through increasing food supply. The Nobel Prize Committee, while identifying him for this high recognition, concluded "More than any other single person of this age, he has helped to provide bread for a hungry world. We have made this choice in the hope that providing bread will also give the world peace…" The day the award was announced, Dr. Borlaug, vigorous and slender at 56, was working in a wheat field outside Mexico City when his wife, Margaret, drove up to tell him the news. His renowned Literary work includes Wheat *in the Third World* (1982), L*and use, food, energy and recreation* (1983), *Feeding a human population that increasingly crowds a fragile planet* (1994), Norman

Borlaug on World Hunger (1997), The Green Revolution Revisited and the Road Ahead *(*2000), Ending World Hunger, The Promise of Biotechnology and the Threat of Antiscience Zealotry (2000), Feeding *a World of 10 Billion People (*2003), and Prospects *for world agriculture in the twenty-first century* (2004). Dr. Norman Borlaug's remarkable lifetime efforts to feed millions of less fortunate around the world will continue to inspire all those concerned with hunger and malnutrition. His legacy includes billions of lives saved from the misery of starvation and the education of thousands of scientists worldwide (who carry on his work today. For fifty-two years, Dr. Norman Borlaug helped to provide more food to the neediest areas of the world. But perhaps of greater importance, this distinguished scientist-philosopher has been demonstrating practical ways to give people of the entire world a higher quality of life. The passion that drives Dr. Borlaug's life is an inspiration for all of us to follow, said Jimmy Carter, 39th President of the United States and 2002 Nobel Peace Prize Laureate.

In his demise, the world has lost a great visionary, a humanitarian and a champion in the battle against world hunger. The PGR scientific community pays its respect and homage to this great human being.

Editors
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