Important Crop Germplasm Introduced in India during 2008

Arjun Lal, Deep Chand, Vandana Tyagi, Nidhi Verma, SK Yadav, Vandana Joshi, SP Singh and Surender Singh

Germplasm Exchange Unit, National Bureau of Plant Genetic Resources, New Delhi-110 012, India

Exchange of plant material on a world wide basis had been mostly carried out without regard to well defined procedures. NBPGR is the nodal institute which facilitates import of germplasm as per the existing procedure for research or experimental purposes. In the present scenario, where the access to germplasm is restricted due to many national and international Treaties/Acts, it is important to search for and introduce on priority trait-specific germplasm for use in various crop breeding programmes. NBPGR continues to work towards identifying promising trait-specific germplasm through literature search and personal contacts and introduce the same for utilization by Indian plant breeders in various crop improvement programmes enhancing yield parameters, incorporating resistance/ tolerance to various biotic and abiotic stresses and value addition.

Key Words: Germplasm, Traits, Exotic, Introduction

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Plant Genetic Resources (PGR) are the genetic material of plants which are of value for present and future generations of human kind. Often used as a synonym to plant germplasm it can be defined as seed, a plant or plant part including cell cultures, genes and DNA sequences that are held in a repository or collected from wild as the case may be and that is useful in crop breeding, research or conservation because of genetic attributes. Term 'germplasm' is used to describe a collection of genetic resource for an organism or genetic material which forms the physical basis of inherited qualities.

Exchange of plant genetic resources plays a vital role in crop improvement programmes world wide. They are the heritage to be conserved for current and future generations and to be utilised for the food and nutritional security of the ever increasing world population. Germplasm introduction has played a pivotal role in the establishment of large number of crops and development of improved varieties in India. Apprehensions on restricted exchange were raised with the inclusion of Intellectual Property Rights in Trade Related aspects of Intellectual Property Rights (TRIPS) section of World Trade Organization (WTO) and other International agreements and conventions which entered into force. To regulate access to the germplasm and to ensure that it is used legally, exchange is done under Material Transfer Agreements (MTAs). The MTA defines the terms and conditions which are binding on the parties signatory to it.

As per the existing procedure for import of germplasm for research or experimental purposes, the Government of India by enacting the New Seed Development Policy (1989) and Plant Quarantine (Regulation of Import into India) Order 2003, has made it obligatory for all plant breeders and researchers intending to import seed/planting materials, to fulfill the two mandatory requirements, first, the import permit (IP) before import of any material and second, the phytosanitary certificate from the country of origin. These two documents must accompany every consignment of seed/planting material imported from abroad for research purposes.

The applicant desirous of importing seed/planting material for research/experimental purposes has to apply to the Director, National Bureau of Plant Genetic Resources, New Delhi on a prescribed application form (PQ 08), can be downloaded from NBPGR website *www.nbpgr.ernet.in*. Along with the application form a demand draft of Rs. 150/- (for Govt./public organizations) or Rs 300/- (for private organization/seed companies) as service charges, as the case may be, in favour of Director, NBPGR, New Delhi, as processing fee for the issuance of IP should be sent.

Phytosanitary certificate is a document regarding the health status of consignment being imported, is issued by the official agency of the donor country. It is also issued by the NBPGR for all germplasm material meant for export to foreign countries. It should also be ensured that the consignment must be addressed to the Director, NBPGR. For all imported material, the port of entry is New Delhi. The material so introduced shall after quarantine clearance is assigned an Exotic Collection (EC) number which remains unchanged and then material is forwarded to the recipient.

A part of such sample (~10%) is deposited to National Genebank as voucher sample which is subsequently sent

to appropriate NAGS for multiplication. The multiplied seed in sufficient quantity is returned back for long-term storage to serve as base collection. 90% of the material introduced through literature search is sent to NAGS. In the year 2008, a total of 666 import permits were issued to public and private organisations for import of germplasm for research purposes. Of the total import permits issued, 36% belonged to private seed companies/sector and 64% to public organizations/institutes. Of the public sector, 53% were issued to applicants from NBPGR, 23% to other ICAR institutes, 15% to SAUs, 4% to ICRISAT and 5% to other Govt. organizations.

In the present scenario, it is more important to search for trait-specific germplasm and access them from various sources. During 2008, the Bureau introduced 25,450 accessions from 43 countries which included trait-specific germplasm in crops, namely, wheat, barley, rice, maize, sunflower, tomato, chilli, strawberry and avocado. However, the major per cent of germplasm (56%) was imported from IARC's and 8% from USDA. National gene banks/ other institutes accounted for 36% of the total import. The trait-specific germplasm and wild species introduced during 2008 are given in Table 1 and 2, respectively. A total of 286 accessions of transgenic seed material were also introduced (Table 3).

Table 1. Trait-specific germplasm introduced during 2008

Crop/EC No./Country	Specific Traits	Distribution
Triticum aestivum EC633778-784, ICARDA, Syria	PBW343 new version lines carrying genes resistant to Ug 99 and yellow rust	DWR, Karnal, Haryana
T. aestivum EC634055, USA	Variety Guymon resistant to wheat *Soil borne mosaic virus* and *Spindle streak mosaic virus*	DWR, Karnal, Haryana
T. aestivum EC631734, USA	Translocation line carrying a segment of chromosome 5, including softness genes *Pin a & Pin b*	DWR, Karnal, Haryana
T. aestivum EC631987-002, USA	Isogenic hard wheat lines differing for the presence of high grain protein gene GPC-B1	DWR, Karnal, Haryana
T. aestivum EC632017, USA	Germplasm resistant to biotypes 1 & 2 of Russian wheat aphid, semi dwarf, early maturing	DWR, Karnal, Haryana
T. turgidum EC631967-986, USA	Near isogenic hard spring lines differing in puroindoline alleles, controlling grain hardiness, useful to study the basis for texture & quality differences in hard wheat	DWR, Karnal, Haryana
T. turgidum EC631987-632002 USA	Isogenic lines differing for presence of high grain protein gene Gpc B 1. May serve as a source of increased grain protein for hard red, white spring wheat breeding program and provide material to investigate the effect of Gpc B1 in high protein background	DWR, Karnal, Haryana
T. turgidum ssp *turgidum* EC633777, Canada	Adapted to drier regions, source of resistance to races of loose smut	DWR, Karnal, Haryana
H. vulgare EC631731, USA	Variety Lentah-superior yield & test weight, most widely used as green feed	IGFRI, Jhansi, UP
H. vulgare EC631732, USA	Variety Clearwater-hull less, low phytate and high available (CV 335) phosphorus concentrations in the grain, superior feed quality	IGFRI, Jhansi, UP
H. vulgare EC631946, USA	Variety Tetonia-high yielding, resistance to spot blotch & net blotch	DWR, Karnal, Haryana
H. vulgare EC634221-27, USA	Lines resistance to Russian wheat aphid, each line has a different source of resistance in malting barley cultivar backgrounds	DWR, Karnal, Haryana
Oryza sativa EC634219-20, USA	Mutant germplasm lines having improved resistance to sheath blight, bacterial panicle blight & narrow brown leaf spot	DRR, Hyderabad, AP
Zea mays EC633803, USA	Resistance to western corn rootworm	DMR, New Delhi
Helianthus annuus EC634078-80, USA	Source of resistance to races of loose smut	DOR, Hyderabad, AP
Lens culinaris EC631332, Turkey	High yielding and high level of winter hardiness	IIPR, Kanpur, UP
Capsicum annuum EC611331-611364, Taiwan	Tolerant to aphids	IIHR, Bangalore, Karnataka
Capsicum annuum EC612322, Vietnam	Very hot, 55-60 days maturity, extremely prolific, tolerant to *Phytophthora*, TMV & bacterial wilt	IIVR, Varanasi, UP

Table 1. Contd.

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Table 1. Contd.

Crop/EC No./Country	Specific Traits	Distribution
Capsicum annuum EC628891-920 EC631683-687, Taiwan	Lines resistant to *Chili veinal mottled virus*, *Poty virus* Y and bacterial wilt	BCKV, Kalyani, WB
Cucumis melo EC612132, Vietnam	Arkanga hybrid melon variety, fruits have a netted skin, light green crispy flesh, strong tolerance to *Fusarium* blight strains 0 & 1	IARI, New Delhi; IIVR, Varanasi, UP
C. melo EC612133, Vietnam	Very vigorous hybrid variety Alien tolerant to both powdery and downy mildew, prolific, medium early, can be harvested within 40-45 days weighing about 1.2-1.3 kg/fruit, green flesh, juicy and sweet	IARI, New Delhi; IIVR, Varanasi, UP
C. melo EC612134, Vietnam	Yellow skinned with oblong shape and cream coloured flesh, weight approximately 2.5 kg/fruit	IARI, New Delhi; IIVR, Varanasi, UP
L. sativa EC612126, Vietnam	Variety Minetto–crisp headed, iceberg type medium small size, black seeded variety, resistant to heat and humidity, tolerant to tip burn	IARI, New Delhi; IIVR, Varanasi, UP
L. sativa EC612127, Vietnam	Fast fall amid early variety, black seeded, loose leaf type	IARI, New Delhi; IIVR, Varanasi, UP
L. sativa EC612128, Vietnam	Butter head type major variety for heavy lettuce production, recommended for winter and autumn production in temperate areas and tolerant to *Bremia*	IARI, New Delhi; IIVR, Varanasi, UP
L. esculentum EC631955-963, Taiwan	Resistant to root knot nematode	PAU, Ludhiana, Punjab
L. esculentum EC632003-21, Taiwan	Lines tolerant to bacterial wilt, *Tomato mosaic virus, Fusarium* wilt and gray leaf spot	College of Agriculture, Dharwad, Karnataka
L. esculentum EC635523-27, Taiwan	Resistance to *Tomato leaf curl virus*	College of Horticulture, KAU Kerala
L. esculentum EC635528-33, Taiwan	Resistant to bacterial wilt	College of Horticulture, KAU, Kerala
L. esculentum EC612858-869, Taiwan	Lines resistant to bacterial wilt, *Tomato mosaic virus, Fusarium* wilt and gray leaf spot	M/S Metahelix Life Sciences, Bangalore, Karnataka
L. esculentum EC614997-615029, Taiwan	Resistant to whitefly transmitted geminivirus, bacterial wilt, *Tomato mosaic virus*	M/S Krishi Dhan, Vegetable seeds, Pune, MS
L. esculentum EC611883-891, Taiwan	Heat tolerant lines	TNAU, Periyakulam, TN
Fragaria vesca EC619154-56, USA	Varieties Lamour, Clancy, Seneca–excellent fruit quality and flavour, firm flesh and good texture	M/s MAHYCO, N Delhi
Malus domestica EC612824-25, USA	Resistant to fire blight	NBPGR, RS Shimla, HP
M. sieversii EC612822-23, USA	Resistant to apple scab	NBPGR, RS Shimla, HP
Persea americana EC632072, USA	Variety Pollock with low oil, early type, very large fruits weighing 750 g	CHES, Chettalli
P. americana EC632073, USA	Variety Pinkerton with long pear shaped fruits, excellent peeling characteristics	CHES, Chettalli
Deschampsia antarctica EC631954, Chile	Antarctic hair grass–new crop, native to Antarctica	M/S Avesthagen Limited, Bangalore, Karnataka
Chicorium intybus EC612129, Vietnam	Variety Scarole–giant voluminous heads with white compact heart, slow bolting and good tolerance to tip burn & bolting	IARI, New Delhi; IIVR, Varanasi, UP
C. intybus EC612130, Vietnam	Variety Frisee–green suitable for spring production, performs well both in open fields and protected cropping and tolerant to bolting	IARI, New Delhi; IIVR, Varanasi, UP
C. intybus EC612131, Vietnam	Variety Grosse bouclee–large broad leaves, escarole endive tight and very well filled with curled heart, suitable for spring and summer production in temperate areas, used for both fresh markets and salad packs, good resistance to bolting	IARI, New Delhi; IIVR, Varanasi, UP

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Germplasm Exchange Unit at NBPGR is continuously making all efforts for introducing diverse plant genetic resources by way of bibliography screening of various journals/ periodicals, reports, catalogues, index seminums and online databases. The widely searched websites are detailed at the end for reference.

Access to germplasm and information under the new regime in India has to take into account the established

Table 2. Wild species introduced (47 species; 15 genera)

Genus (Country)	Species	Distribution
Acacia (Australia)	*A. ampliceps, A. salicina, A. sternophylla*	CSSRI, Karnal
Aegilops (USA)	*A. geniculata, A. kotschyii, A. longissima, A. pergegrina, A. speltoides, A. tauschii*	DWR, Karnal
Arachis (USA)	*A. paraguirenies*	ICRISAT, Patancheru
Capsicum (Taiwan)	*C. pubescens, C. praetocox, C. chacoense, C. chinensis*	IIHR, Bangalore
Fragaria (USA)	*F. vesca*	Mahyco, New Delhi
Geranium (Denmark)	*G. cinereum, G. platopetalum*	HPAU, Palampur
Helianthus (USA)	*H. anomalus, H. bolanderi, H. deserticola, H. giganteus, H. debilis-silvestris, H. debilis, H. cucumeri, H. neglectus, H.resinous, H. strumosum*	DOR, Hyderabad
Lens (Syria)	*L. lamottei, L. nigricans*	HPAU, Palampur
Malus (USA)	*M. sieversii*	NBPGR RS, Shimla
Nicotiana (USA)	*N. africana, N. alata, N. suavensis*	CTRI, Rajahmundry
Oryza (Philippines)	*O. glaberrima, O. latifolia, O. minuta, O. nivara, O. punctata, O. rufipogon*	ADAC &RI, Navalurkuttapu, Trichy
Solanum (Spain)	*S. berthauii, S. quitoense, S. vernei*	NBPGR RS, Shimla; CPRI, Shimla
Triticum (USA)	*T. shaerococcum, T. turgidum*	DWR, Karnal
Vicia (Syria)	*V. dasycarpa, V. narbonensis*	AVRDC-RCSA, Patancheru
Vitis (USA)	*V. mustangensis*	NRC Grapes, Pune

Table 3. Details of transgenic seed material introduced

Crop/EC No./Country	Specific traits	Distribution
Oryza sativa EC611943-612003, Belgium	Transgenic rice containing *Cry Ab, Cry 1c* and BAR genes	M/s Bayer Biosciences Pvt. Ltd., New Delhi
O. sativa EC626367-398, Belgium	Containing *Cry 1 Ab, Cry 1Ac* and BAR genes	M/s Bayer Biosciences Pvt. Ltd., New Delhi
O. sativa EC630492-494, China	Expressing *Cry 2A, Cry 1c* & *Cry 1Ac* genes for imparting resistance against rice stem borer & rice leaf folder	Pioneer Overseas Corp., Hyderabad
O. sativa EC630495-96, Philippines	Containing *ferritin* gene, insect and pest tolerance	RRS, Chinsurah, West Bengal
Zea mays EC613093-97, USA	Inbred lines with Bt corn (MON 89034) namely LT2001-LT2005	M/s Monsanto India Ltd, New Delhi
Z. mays EC618165, Philippines	Modified *MEPSPS* gene from corn imparting tolerance to Glyphosate (GAZI)	M/s Syngenta India Ltd., Pune
Z. mays EC626511-515, USA	Transformed with 6 plasmid vectors containing *GUS* reporter gene & different promoters from corn	Dupont India Pvt. Ltd., Hyderabad
Z. mays EC628300, USA	Transgenic stalk corn Hybrids Hishell (MON 89034X NK603)	M/s Monsanto India Ltd., New Delhi
Z. mays EC633153-157, USA	Containing *Cry 1F* and *PAT* gene conferring resistance to lepidopteran pest & tolerant to herbicide Glufosinate ammonium	Dow Agro Sciences, Mumbai
Z. mays EC633163-66, USA	Containing *Cry 1F* & *Cry 1Ab* gene	UAS, Bangalore
Gossypium hirsutum EC617735-84, USA	Containing Roundup Ready (RR) Flex Glyphosate resistant trait (RPF CPUEPSPS) event 88913	M/s Emergent Genetics India Pvt. Ltd. C/o Monsanto India Ltd,, Hyderabad
G. hirsutum EC617785-834, USA	Bollgard II, insect resistant (*Cry 1Ac* & *Cry 2Ab* gene)	M/s Emergent Genetics India Pvt. Ltd. C/o Monsanto India Ltd,, Hyderabad
G. hirsutum EC618167, USA	Containing *2 MEPSPS* gene	M/s Bayer Biosciences Pvt Ltd., Hyderabad
G. hirsutum EC618168-70, USA	Lines H1318, H1010 and H1352 containing combination bar gene, *Cry 1Ab* & *Cry 2Ac* gene	M/s Bayer Bio Sciences Pvt. Ltd., New Delhi

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institutional mechanism and various Acts in force relating to agro-biodiversity. The requests of indentor are to be dealt depending on the status of requesting party and the conditions for access under different categories. The NBPGR is continuing its efforts to identify promising trait-specific germplasm through literature search and personal contacts and introduce the same for utilization by Indian plant breeders.

Recipients of the imported germplasm are requested to provide feedback information on the germplasm supplied to help keep up continued reciprocal exchange of germplasm with foreign sources. Such feed back information would help in effective introductions and further help in studies relating to the performance of imported material under Indian agro-climatic conditions.

Online Databases used for Search

- http://www.ars-grin.gov/npgs/searchgrin.html
- http://www.bioversityinternational.org/nc/scientific_information/information_sources/germplasm_databases/list_of_germplasm_databases.html
- http://eurisco.ecpgr.org
- http://www.ngb.se/Material/
- http://www.ngb.se/sadc/Material/accsadc.html
- http://www.singer.cgiar.org/

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