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Grain Legumes Diversity of Indian National Genebank: A Potential Resource for Food and Nutritional Security

Padmavati G Gore, Neeta Singh* and Veena Gupta
[1]*ICAR-National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi-110012, India*

In the INGB (Indian National Genebank), a total of 66,283 accessions belonging to 15 genera of 98 species of grain legumes are conserved, which includes 55,757 indigenous collections and 10,526 exotic collections. Many novel and unique traits have been identified in the conserved germplasm including resistance to major pests and disease, agronomic and nutritional value. Conserved legume genetic resources have the potential to mitigate future climate change and revolutionize the legume breeding programme.

Introduction

Legumes are the key protein sources and have always been a part of everyday life, as human food and animal feed. Legumes represent the second most important family of crop plants after Poaceae (grass family), accounting for approximately 27% of the world's crop production. The diversity of legumes comprises around 20,000 species and 700 genera (Lewis *et al*., 2005). In today's changing climate scenario, to prevent the loss of legume diversity, *ex situ* conservation is essential.

Status of grain legumes conserved in INGB

In the Indian National Gene Bank (INGB), a total of 66,283 accessions belonging to 15 genera of 98 species are conserved. Among them, 84% of accessions were collected from the Indian gene centre while 16% were imported, majorly from the USA, Philippines, Nigeria, Thailand and China. A rich diversity of cultivated and wild *Vigna* species occurs in India. Cultivated species *V. radiate* and *V. mungo* originated in India (Arora, 1985). In the past, enormous efforts have been taken to collect the treasure of this *Vigna* diversity and it is evident from the status of genus *Vigna* conserved in NGB. Out of 15 genera, *Vigna* has the highest number of accessions (15,113) and the number of species (32). Among 15,113 accessions, 13,199 belong to India and 1,914 accession of exotic collections. After genus *Vigna*, *Cicer* has the largest number of accession (15,053) in NGB, belonging to the 10 species, followed by genus *Cajanus* with 11,940 accessions of belonging to seven species (Table 1).

The crop wild relatives (CWRs) are important genetic resources for breeding and crop improvement programs (Vavilov, 1992). As CWRs are typically adapted to different environmental conditions than their domesticated relatives, genetic material from these wild species has the potential to play an important role in breeding for greater abiotic and biotic stress tolerance (Hajjar and Hodgkin, 2007). As climate change and human population expansion threaten global food security, CWRs are poised to play a significant role in mitigating these forthcoming challenges. CWRs are a natural resource and deserved a target for urgent and systematic conservation (Naidoo *et al*., 2008). In NGB, more than 80 wild relatives of legumes are conserved under long-term storage. Table 2 represents the major cultivated crop legume along with their wild relatives conserved in NGB. In conserved accessions of wild species, unique and novel traits have been identified and registered by the Plant Germplasm Registration Committee of the Indian Council of Agricultural Research (ICAR). For example, the species *Lens orientalis* (Boiss.) Hand. Mazz (EC718515) for resistance against rust (*Uromyces fabae* (Grev.) Fuckel) and powdery mildew (*Erysiphe trifolii*); *Lens nigricans* (M. Bieb.) Webb & Berthel, (EC718266) for resistance against rust (Singh *et al*., 2020). In genus *Vigna*; *Vigna vexillata* (L.) A.Rich (IC259504) for high protein content (9.5%) in tuber, bold seededness. and fodder type (Tripathi *et al*., 2021); *Vigna vexillata* (IC248326) for resistance against *Callosobruchus maculatus* L. (Aidbhavi *et al*., 2022); *Vigna stipulacea* (Lam.) Kuntze (IC336136) for early flowering and early maturity (Gore *et al*., 2021).

**Author for Correspondence: Email-neeta.singh@icar.gov.in*

Table 1. Status of grain legumes conserved in Indian National Genebank

S.No.	Genus	Number of accessions	Number of species	Indigenous collection	Exotic collection
1.	*Cajanus*	11,940	7	11576	364
2.	*Canavalia*	132	4	128	4
3.	*Cicer*	15,053	10	11908	3,145
4.	*Cyamopsis*	4,308	1	4,270	38
5.	*Lablab*	1,305	4	1,298	7
6.	*Lathyrus*	2,747	10	2,557	190
7.	*Lens*	2,612	7	1,852	760
8.	*Macrotyloma*	3,157	2	3,146	11
9.	*Mucuna*	55	2	49	6
10.	*Phaseolus*	4,154	3	1,730	2,424
11.	*Pisum*	4,680	1	3528	1,152
12.	*Psophocarpus*	220	1	84	136
13.	*Rhynchosia*	21	10	21	0
14.	*Vicia*	786	4	411	375
15.	*Vigna*	15,113	32	13,199	1,914
	Total	66,283	98	55757	10526

Table 2. Major cultivated legume and their wild relatives conserved in NGB

Cultivated species (number of accessions)	Wild relatives (number of accessions)
Cajanus cajan (L.) Huth **(11,879)**	*Cajanus albicans* (Wight & Arn.) Maesen (**6**); *Cajanus cajanifolius* (Haines) Maesen (**2**); *Cajanus mollis* (Benth.) Maesen (3); *Cajanus platycarpus* (Benth.) Maesen (**2**); *Cajanus scarabaeoides* (L.) Thouars (**47**); *Cajanus volubilis* (Blanco) Blanco (**1**).
Cicer arietinum L. **(14,844)**	*Cicer bijugum* Rech.f. (**31**); *Cicer chorassanicum* (Bunge) Popov (**2**); *Cicer cuneatum* Hochst. ex A.Rich.(**6**); *Cicer echinospermum* P.H.Davis (**19**) *Cicer judaicum* Boiss.(**54**); *Cicer microphyllum* Royle ex Benth. (**38**); *Cicer pinnatifidum* Jaub. & Spach (**27**); *Cicer reticulatum* Ladiz. (**19**); *Cicer yamashitae* Kitam. (**4**)
Lens culinaris Medik **(2,422)**	*Lens culinaris* subsp. *Odemensis* (Ladiz.) M.E.Ferguson, Maxted, van Slageren & L.D.Robertson (**29**); *Lens orientalis* (Boiss.) Hand. Mazz. (**63**); *Lens culinaris* subsp. *Tomentosus* (Ladiz.) M.E.Ferguson, Maxted, van Slageren & L.D.Robertson (**6**); *Lens ervoides* (Brign.) Grande (**67**); *Lens lamottei* Czefr. (**3**); *Lens nigricans* (M.Bieb.) Webb & Berthel. (**22**)
Vigna *Vigna radiata* (L.) R.Wilczek **(4,379)**; *Vigna unguiculata* (L.) Walp **(4,003)**; *Vigna mungo* (L.) Hepper **(2,297)**; *Vigna umbellate* (Thunb.) Ohwi & H. Ohashi **(2,235)**; *Vigna aconitifolia* (Jacq.) Maréchal **(1,530)**; *Vigna angularis* (Willd.) Ohwi & H.Ohashi **(200)**	*Vigna glabrescens* Maréchal, Mascherpa & Stainier; *Vigna khandalensis* (Santapau) Sundararagh. & Wadhwa; *Vigna membranacea* A.Rich.; *Vigna minima (*Roxb.) Ohwi & H.Ohashi; *Vigna reticulate* Hook.f.; *Vigna gracilicaulis* (Ohwi) Ohwi & H Ohashi; *Vigna vexillata* var. *wightii* (Benth. ex Bedd.) Babu & SK Sharma (**1 accession each**). *Vigna luteola* (Jacq.) Benth.; *Vigna parkeri* Baker; *Vigna racemosa* (G Don) Hutch. & Dalziel ex Baker f.; *Vigna mungo* var. *silvestris* Lukoki, Maréchal & Otoul; *Vigna trinervia* (B.Heyne ex Wight & Arn.) Tateishi & Maxted (**2 accession each**). *Vigna nepalensis* Tateishi & Maxted; *Vigna radiate* var. *setulosa* (Dalzell) Ohwi & H Ohashi; *Vigna bourneae* Gamble; *Vigna pilosa* (JG Klein ex Willd.) Bake (**4 accessions each).** *Vigna hainiana* Babu, Gopin. & SK Sharma; *Vigna marina* (Burm.) Merr. (**7 accessions each**). *Vigna trilobata* (L.) Verdc. (**10**); *Vigna bourneae* Gamble (**11**); *Vigna angularis* var. *nipponensis* (Ohwi) Ohwi and H. Ohash (**13**); *Vigna mungo* var. *silvestris* Lukoki, Maréchal & Otoul (**16**); *Vigna vexillata* (L.) A.Rich. (**18**); *Vigna dalzelliana* (Kuntze) Verdc. (**34**); *Vigna radiate* var. *sublobata* (Roxb.) Verdc. (**45**); *Vigna stipulacea* (Lam.) Kuntze (**99**)

In context to the passport data out of a total 66,283 accessions, 55,757 are indigenous collections and 10,526 are exotic collections. In the indigenous collection, 28% (3,368) accessions belong to the state of Andhra Pradesh. While from the state of Pondicherry, Tripura, Mizoram and Andaman and the Nicobar Islands, less than 100 accessions of grain legumes are conserved. Out of 95 accessions from Andaman and Nicobar Island, 71 accessions are of genus *Vigna* including economically important species like., *Vigna marina* (salt tolerant)*;* tuber cowpea, *Vigna Vexillata*; *Vigna trilobata* (drought tolerant). All the 15 accessions from Pondicherry belong

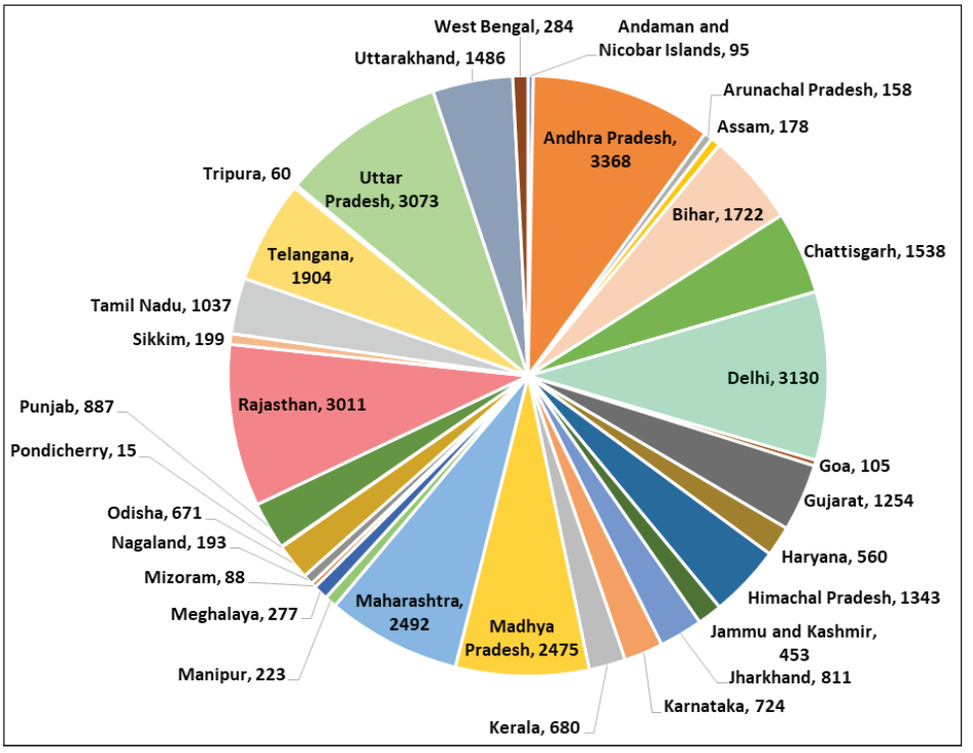

Fig. 2. State-wise collection of conserved grain legumes

to the *Lablab purpureus* (L.) Sweet. Figure 2 represents the state-wise collection of conserved germplasm of grain legumes.

To cope with climatic changes, the breeding programmes are in utmost need of diverse genes to develop varieties with better performance over a large range of environmental conditions. On the other side plant genetic resources are under threat of loss due to various reasons including, genetic erosion, change in land use patterns and climate change. Hence, collection and conservation of plant diversity is needed.

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