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SOYBEAN GENETIC RESOURCES AND THEIR EVALUATION

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Soybean (Glycine max) *is one of the important crop in the United States and the world's richest source of protein and leading source of vegetable oil. It has the unique protein and oil combination (40% protein and 20% oil). Although soybean is a new crop in our country, it has occupied a substantial acreage in the last 22 years from 3000 hectares in 1968 to presently nearly 20 lakh hectares. The National Bureau of Plant Genetic Resources is engaged in collection/exchange, characterisation/evaluation, documentation and conservation of genetic diversity of soybean for the last two decades. A total of 2,639 accessions of soybean from diverse agro-climatic zones of the world (from 30 countries including India), were evaluated for two years i.e., 1988 and 1989. Data were recorded on 21 agro-botanical and economic characters and donors were identified for different economic traits, viz., high yield, early maturity, bold seeds, resistance to bacterial pustule and pod blight, high seed longevity/germinability, resistance/tolerance to pod shattering and high oil content. These donors can be utilized either as parental material in hybridization or as direct selections for crop improvement programme.*

Soybean (*Glycine max* (L.) Merrill) now occupies third place in vegetable oil production in India. It holds good promise owing to its 40 per cent protein and 20 per cent oil. In India, average yield of soybean (900 Kg/ha) is rather low compared to the world average of 1800 Kg/ha and Asian average of 1200 Kg/ha. Thus, it is quite imperative to exploit available genetic variability to enhance the yield and other economically important traits. Considerable variability has now been assembled through introduction and collection from several countries by the NBPGR. The present paper highlights the efforts on evaluation/characterisation of world genetic resources in soybean.

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MATERIALS AND METHODS

The NBPGR and the erstwhile Plant Introduction Division of the Indian Agricultural Research Institute, New Delhi assembled 2,639 germplasm accessions from 30 countries (Table 1). In India, various areas were explored and variability was collected from several pockets in Kumaon region of Uttar Pradesh, Bihar, Madhya Pradesh, Himachal Pradesh, Maharashtra, Sikkim, Manipur, West Bengal, Meghalaya and Arunachal Pradesh.

Table 1. Augmentation of soybean germplasm in India

Source (Number of accessions)	Total Accessions
1. Exotic germplasm	1,645
USA (493), Canada (12), South Africa (2), Australia (111), Germany (188), China (19), Nepal (44), USSR (63), Italy (36), UK (11), Argentina (196), Hungary (64), Taiwan (189), Morocco (4), Nigeria (53), Thailand (6), Romania (15), Sri Lanka (2), Trinidad (1), Philippines (13), Brazil (31), Yugoslavia (1), Papua New Guinea (3), Ghana (13), Israel (1), Korea (2), Rhodesia (3), Indonesia (4), Fiji (9) and Japan (56)	
2. Indigenous germplasm	994
Uttar Pradesh (199), Punjab (18), Himachal Pradesh (167), Sikkim (15), West Bengal (14), Assam (2), Meghalaya (26), Madhya Pradesh (156), Manipur (21), Bihar (39), Maharashtra (205), Gujarat (18), Jammu & Kashmir (41), Mizoram (25), Arunachal Pradesh (8), Rajasthan (7), Delhi (25), Karnataka (7) and Tamilnadu (1).	
Total	2,639

The entire soybean germplasm is being maintained at NBPGR, Regional station, Akola (Maharashtra). The accessions were grown in augmented block design at NBPGR Experimental Farm, Akola and evaluated during *kharif* seasons of 1988 and 1989. Row length was 3 m per accession and row to row distance was 60 cm. MACS-13 and Bragg were used as controls and grown after every 25 accessions. Observations were recorded on growth habit, days to flowering and maturity, flower colour, pubescence colour, pubsecence type, pubescence density, number of leaflets and their shape, leaf colour, plant height, pod colour, seed coat colour, hilum colour, number of seeds per pod, grain yield per plant, 100-seed weight, oil content, pod shattering, lodging, reaction to bacterial pustule, soybean mosaic and pod blight.

Two hundred accessions were screened through methanol stress test (20% solution V/V, 2 hr., followed by normal laboratory germination test). Per cent germination was determined, using 1 cm of emerged radicle as the criterion for germination. Accessions showing more than 80 per cent germination under methanol stress test were considered as high seed germinability accessions. Pod shattering was recorded after 7-10 days of physiological maturity.

RESULTS AND DISCUSSION

The soybean variability provides vast potentialities for exploiting various useful economic traits. The accessions varied for days to flowering (25-72 days), days to maturity (68-148 days), plant height (10-210 cm), number of leaflets (3-5), number of seeds per pod (1.6-3.1), yield per plant (1-27.0 g), 100-seeds weight (0.3-44.4 g) and oil content (8.6-24.0 %). The early introductions that had been initially found suitable for cultivation were Bragg, Clark-63, Lee, Davis, Hardee andl Monetta. With increase in area under these varieties, it was soon realised that these varieties were highly susceptible to diseases and insect pests. They also suffered from poor germinability and were mostly photosensitive. Early maturing varieties of soybean have been found to be less sensitive to photoperiods than late maturing varieties (Johnson *et al.*, 1960). Therefore, the lines having early maturity (68-75 days) were considered as insensitive to photoperiod (Table 2). These lines may possibly be used as donors for introducing photoperiod insensitivity. However, these genotypes were inferior from yield point of view.

Widely adapted varieties Bragg, Clark-63, Hardee etc. were susceptible to yellow mosaic virus. PI-171443 (UPSM-534) and wild soybean (*Glycine formosana* Hosokawa syn. *Glycine soja* Sieb. & Zucc.) were reported to be resistant sources to yellow mosaic virus (Singh *et al.*, 1974a; 1974b). Several yellow mosaic virus free genotypes were earmarked, viz., PK 416, PK 472, PK 515, PK 719, PK 727, PK 733, PK 746 and PK 749. However, the incidence of yellow mosaic virus was not severe in both the years. Several genotypes, viz., EC 34094, EC 95806, EC 106991, EC 106992 and EC 106998 were identified having field resistance to bacterial pustule (Table 2). Groth and Braun (1986) reported that 'rxp' as single recessive gene confers resistance to bacterial pustule in soybean. Therefore, resistance can be transferred from donor source to high yielding cultiars by using either pedigree method or simple back cross method of breeding.

Storage of soybean seeds under ambient conditions usually causes rapid deterioration. Loss of seed vigour and viability is accelerated by high ambient temperature and high relative humidity. By using methanol stress test, several genotypes were identified for high seed ger-

Table 2. Donors identified for various traits

Traits		Donor accessions
Early maturity	EC:	34160, 34362, 26998, 37072, 37083, 28138, 38140, 39018, 39020, 29039, 39040, 39041, 39042, 39146, 39152, 39154, 39157, 39198, 39230, 39242, 62818, 65772, 93372, 93384, 232019, 232075, 232080, 232082 A, 250575, 250578, 250607, 250608, 250609, 251771, 251774, 251775, 251776 and Monetta
	IC:	16569, 18382, 18748, 18758, 18759, 18761, 18486, 24529, 96391, 96396, 96449
High grain yield (18—27 g/plant)	EC:	9316, 11741 A, 14434, 26692, 34041, 34146, 34279, 371093, 9014, 39025, 39036, 39081, 39222, 93493, 95673, 118309, 172660, 241780, 241843, 241929, 242033 A, 245482m 245981 A, 245985 A, 245988, 251372, 251410, 251410, 251411, 251434-A, 251477, 251484, 251517, 251713, 251829, and 251869
	IC:	574, 18381, 18383, 24072, and 41680
100-seed weight (15—44.4 g)	EC:	39755, 55888, 93365, 127508, 241110, 241780, 241977, 242022, 245981-A, 245985-A, 245988, 251515, 251517, 251529, 257977, 257978, 301883, and 301884.
	IC:	16570, 18381, 96411, 96416, and 96419
Field resistance to bacterial pustules.	EC:	34094, 95806, 106991, 106992, 106998, 36963, 36088, 39094, 95272, 95291, 10002, 100031, 100801
	IC:	202, 210, 2043, 13005, 24072, 24373, 6345 and 96357
Tolerance to pod blight	EC:	106991 and 106992
High seed longevity/ germinability.	EC:	99991, 101641, 109529, 172654, 172668, 241842, 241920, 250574, 251369, 251436, 251459, 251834, 274673 and 274734
	IC:	202, 574, 13053, 15975, 16829, 16834, 24072, 41680 and 41682
Field resistance/tolerane to pod shattering	EC:	34076, 39703, 107415, 232101, 241778, 250581, 250617, 251303 A, 251363, 251371, 251404, 251869, 250588, 251317, 251362, 251384, 251497, 254720 and Bragg
	IC:	96297 and 96356
High oil content (23-24 %)	EC:	37050, 37939, 39703, 76736, 95277, 95796, 102612, 107407, 107407, 110676, 110952, 113395 and 127512
	IC:	9639 and 81835

minability/longevity, viz., IC 202, IC 574, IC 41680, IC 24072, EC 241920, EC 241842, EC 251369 etc. (Table 2). Seeds of such genotypes can be used to raise good plant stand even when stored at normal room temperature.

Number of seeds per pod and 100-seed weight are considered as yield contributing characters. The genotypes EC 172665, EC 250581 and EC 251528 had 3-4 seeds per pod whereas EC 39755, IC 96416 had the highest seed weight (44.4 g/100 seeds). Other genotypes ranged from 15-28 g per 100 seeds (Table 2). Commercially grown cultivars generally have 40 per cent protein and 20 per cent oil. Genotypes for high oil content were identified, having 23-24 per cent oil content (Table 2). Guodong and Jingling (1989) reported that the landraces in certain region of Heihi Prefecture and Songhuajiang Prefecture (China) had a higher protein content and the landraces in Suihua, Nunjiang and Hejiang Prefectures had higher oil content. Extent of yield loss due to pod shattering in soybean varied from negligible to as high as 90 per cent depending upon the time of harvesting, environmental conditions and the genotype. (Tiwari and Bhatnagar, 1988). In the present study, most varieties were found susceptible to pod shattering. However, a few accessions e.g. EC 34076, EC 39703, EC 107415, EC 232101, EC 251303-A, EC 251317, EC 251497, IC 96297, IC 96356 showed better resistance to shattering.

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