# Genetic Divergence and Potentiality of Castor (*Ricinus communis* L.) Germplasm Collected from North-East India

**K Anjani* and P Ashoka Vardhana Reddy**
*Directorate of Oilseeds Research, Rajendranagar, Hyderabad-500 030 (Andhra Pradesh)*

Eighty-nine accessions collected from North-east India were studied for genetic divergence and potentiality for yield and other economic traits. A number of accessions were identified as sources of traits of breeders' interest. Sources of resistance to fusarium wilt, jassids and serpentine leaf miner were identified. Eighty-nine accessions were grouped into six clusters. The diverse clusters derived could be used in hybridization programme to generate a wide range of transgressive segregates in populations for development of high yielding, disease and insect resistant castor varieties.

**Key Words: Castor, Diversity, Germplasm, Resistance**

Castor is grown across the country in semi wild to wild forms and semi-cultivated to cultivated forms in India. In order to collect indigenous castor germplasm, several explorations were taken up in India. As a part of it, an exploration was conducted in North-east India (Ajnani *et al.* 1994). The paper presents the diversity and potentiality of wild castor types collected from North-east India.

## Materials and Methods

Eighty-nine accessions collected from Assam (32), Meghalaya (31), Mizoram (5), Nagaland (5) and Manipur (16) were evaluated under rainfed situation at Directorate of Oilseeds (DOR), Hyderabad, Rajasthan Agricultural University, Mandore, and All India Coordinated Research Project (Castor) Centre, Jalna, in an augmented block design, with five checks after every 10 accessions. Each accession was planted in a single row of 5 m length with 45 x 90 cm spacing. Recommended dose of NPK and plant protection measures were adopted. Data were recorded on plant height (cm), number of nodes to primary spike, days to 50% flowering, day to 50% maturity, total length of primary spike (cm), length of primary spike covered by capsules (cm), total number of productive spikes/plant, 100-seed weight (g), oil content (%), seed yield/plot (g) at 120, 150, 180 and 210 days after planting (DAP). Data from each centre were subjected to analysis separately.

Dispersion matrix of data of Hyderabad centre was used for studying genetic diversity using Mahalanobis's $D^2$ analysis, clustering was done according to Tocher's method. Adjusted mean values were used for the analysis. Screening against *Fusarium* wilt was carried out in high wilt sick plot at DOR, Hyderabad in 1999, 2000 and 2001. Leaf miner screening was done under natural heavy infestation from 1994-1997 at Hyderabad. Screening against jassids was done under natural heavy infestation by taking up late sowing in 1997 and 1998.

## Results and Discussion

### *Potentiality of North-east Collection*

In the present paper, only those accessions that consistently performed high at all the three locations are presented and their adjusted values were averaged to identify promising stable sources of agronomic and economic traits. Accessions suitable for each location were also selected based on their performance at the particular location. In castor, short plant height is desirable for easy harvesting, crossing and selfing. Three accessions, namely, RG 2034, RG 2042 and RG 1940 were identified for short plant height (46-49 cm). The number of nodes to primary spike on main stem was assumed as a good indicator of earliness (Singh and Yadav, 1981) of any specific castor genotype. The less the node number the earlier the accession. Three accessions (RG 1961, RG 1965 and RG 2047) possessed low node number (12). Primary spike contributes about 40-50% of yield in castor. Therefore, any improvement in length of primary spike would increase the yield. Eight North-eastern collections, namely, RG 1922, RG 1952, RG 1960, RG 1974, RG 1979, RG 1981, RG 1984 and RG 2029 had long primary spikes (41-51 cm). The inflorescence of castor is a raceme with unisexual, monoecious flowers. Male flowers are arranged at the lower part of the spike and female flowers at the upper part. Therefore, more the length of spike covered by capsules the more productive it would be. The accessions RG 1922, RG 1952, RG 1974, RG 1979 and RG 1981 possessed long length of primary spikes covered by capsules (34-38 cm). Seed weight is one of the important yield contributing component. In North-eastern collection, there accessions, namely, RG 1959, RG 1969 and RG 2029 possessed heavy seeds (37-41 g/100 seed). Total number of spikes/plant is another important yield contributing factor in castor. In our collection, seven accessions (RG 1978, RG 1987, RG 1993, RG 2014, RG 2017, RG 2018 and RG 2049) produced high number of productive spikes/plant (14-18). As castor is indeterminate in nature, harvesting was done at 120, 150, 180 and 210 DAP. Fifty per cent higher yield/plot was realized from RG 1952 (440 g) over the highest yielding check GCH 4 (290 g) at 120 DAP. At 210 DAP, very high yields were realized from RG 1961 (358 g) and RG 1968 (350 g) over GCH 4 (80 g).

### *Sources of Resistance Diseases and Insect pests*

Fusarium wilt is the major disease of castor, which can cause up to 90% yield losses in traditional castor growing regions. Ten accessions (RG 1922, RG 1923, RG 1929, RG 1938, RG 1941, RG 1963, RG 2019, RG 2046, RG 2048 and RG 1925) were identified as wilt resistance sources. Wilt incidence in these accessions was 0%; and 40% and 80% in resistant check GCH 4 and susceptible check Aruna, respectively. These accessions are being used by breeders as sources of wilt resistance in crossing programmes. Four accessions, namely, RG 1982, RG 2000, RG 2001 and RG 2031 were identified as sources of resistance to jassid. There was no incidence of hopper burn and number of jassids/ leaf was three in the resistant accessions, while these were 80% and 200-300 in susceptible check Aruna. The accessions RG 1930 and RG 2008 were identified as the sources of resistance to serpentine leaf miner (*Liriomyza trifolii*) in the entire castor germplasm in India. Leaf infestation was 0% and number of larval mines/plant was 0 in these accessions, whereas in susceptible checks the infestation was 71-78% and larval mines/plant were 41-69. The resistance was attributed to the presence of high total phenols in these accessions (Prasad and Anjani, 2001). Since, the leaf miner is reportedly resistant to most insecticides, the integration of resistant genes is the only solution for its management. Hence, these are being utilized extensively in ongoing breeding programmes in the country to incorporate leaf miner resistance.

### *Diversity in North-East Collection*

To measure the diversity in North-East collection, the adjusted mean values of eight important traits recorded at Hyderabad centre were used. The analysis of dispersion for the test of significance of differences in the mean values based on Wilk's criterion revealed highly significant differences between the genotypes for the aggregation of eight characters. The cluster composition and intra- and inter-cluster divergences are given in Table 1 and 2, respectively. Eighty-nine accessions were grouped into six diverse clusters. The main criterion for selection of diverse parents for hybridization using $D^2$ analysis is the inter-cluster distance. Genotypes included in clusters with maximum inter-cluster distance are obviously more divergent. In the present study, the highest inter-cluster (D) value was between cluster II and VI and the lowest was between V and VI. Selection of parents for hybridization has to be made from cluster II and VI to derive wide variability among segregates. The genotypes in cluster II had maximum intra-cluster distance showing the within cluster divergence. Crossing among the accessions in cluster II would yield diverse recombinants.

**Table 1. Clustering of 89 accessions of castor**

| Cluster | Accessions |
|---|---|
| I | RG1922, RG1952, RG1926, RG1976, RG1993, RG1947, RG1979, RG1981, RG1939, RG2009, RG1938, RG1960, RG1977, RG1936 |
| II | RG1974, RG1980, RG2029, RG1929, RG1941, RG1967, RG1982, RG2013, RG1969, RG1942, RG2046, RG2030, RG1957, RG1973, RG1930, RG1948 |
| III | RG1963, RG2003, RG1964, RG2011, RG1970, RG1997, RG1996, RG1962, RG1968, RG1971, RG1978, RG1987, RG1923, RG1958, RG1940 |
| IV | RG1965, RG1949, RG1966, RG1953, RG1955, RG1959, RG1984, RG1927, RG1975, RG2001, RG2041, RG1928, RG1934, RG1931 |
| V | RG1946, RG2032, RG1935, RG2019, RG2031, RG2043, RG1924, RG2012, RG1956, RG2042, RG2014 |
| VI | RG1932, RG1972, RG1954, RG2047, RG1961, RG1992, RG2018, RG2034, RG2015, RG1993, RG2036, RG2017, RG2049, RG2035, RG2037, RG2040, RG2010, RG1925, RG2008 |

**Table 2. Intra- and inter-cluster distance in 89 accession of castor**

| | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| I | **2.9** | 4.3 | 4.1 | 3.5 | 4.8 | 4.5 |
| II | | **4.8** | 4.3 | 4.4 | 4.7 | 5.2 |
| III | | | **3.6** | 3.9 | 3.9 | 4.4 |
| IV | | | | **2.6** | 2.9 | 3.0 |
| VI | | | | | **2.1** | 2.7 |
| V | | | | | | **2.3** |

The cluster mean values for different traits showed wide variability (Table 3). Cluster VI has the highest value for total number of spikes/plant and Cluster I had the highest value for total primary spike length and length of primary spike covered by capsules. Accessions possessing highest seed weight were grouped in cluster II. Therefore, crossing among these three groups

**Table 3. Intra-cluster mean values for different characters in castor**

| | Plant height (cm) | Number of nodes | Total length of primary spike (cm) | Length of primary spike covered by capsules (cm) | Days to 50% flowering | Days to 50% maturity | 100-seed weight | Total spikes/ plant |
|---|---|---|---|---|---|---|---|---|
| I | 144 | 21 | 39 | 28 | 96 | 135 | 23 | 4 |
| II | 173 | 23 | 31 | 19 | 107 | 147 | 25 | 3 |
| III | 130 | 22 | 27 | 17 | 111 | 154 | 22 | 5 |
| IV | 113 | 18 | 31 | 19 | 77 | 116 | 24 | 4 |
| V | 100 | 16 | 23 | 14 | 83 | 117 | 17 | 5 |
| VI | 86 | 16 | 29 | 16 | 73 | 111 | 18 | 8 |

would produce recombinants having desirable high yield traits. The wilt resistant accessions were grouped in five clusters (I, II, III, IV and VI). Leaf miner resistant accessions were grouped in two different clusters (II and VI) and jassid resistant accessions were found in II, IV and V clusters. The diverse clustering of resistant sources indicates that the resistant sources are quite diverse in their performance. Cluster II is the most potential one; as it was comprised of wilt, jassid and leaf miner resistant sources. Crossing with cluster II would produce diverse recombinants with resistance to diseases/insect pests.

The isolation of genetically diverse genotypes and grouping of less diverse ones, and identification of disease and insect resistant sources in the present study would greatly help castor breeders, to select the promising base material to generate desirable recombinants for high yield and disease and insect resistance.

## References


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