SHORT COMMUNICATION

Variability Studies in Seed Morphology of Castor (*Ricinus communis* L.) Collected from North-eastern Region of India

Rita Gupta* and Shilpi Aggarwal

Division of Plant Exploration and Germplasm Collection, National Bureau of Plant Genetic Resources, New Delhi-110 012

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A total of 90 accessions of castor germplasm represented from north-eastern region of India were studied for seed morphological characteristics *viz.* seed length, seed breadth, caruncle size, mottling, seed surface texture, seed coat thickness and seed coat colour. Morphological variations were observed among different accessions for seed characters and significant correlation was recorded among seed morphological traits.

Key Words: Castor, Genetic diversity, Mottling, Seed Morphological Characters, Variability

Castor (*Ricinus communis* L., family Euphorbiaceae) is an important non-edible oilseed crop considered to be native of tropical Africa (Vavilov, 1951; Zeven and Zhukovsky, 1975) and now extensively cultivated in tropical and subtropical regions of world. The genus *Ricinus* is considered monotypic, with significant variation in plant habits, seed morphology and oil content (Kulkarni and Ramanamurthy, 1977; Li *et al*., 2008).

India is the world's largest producer of castor seed with 65 per cent contribution of total world production (http://www.crnindia.com/commodity/castor.html). The Indo-gangetic plains are one of the centres of variability of castor. The species is common throughout the country particularly in the drier areas but cultivated commercially for extraction of oil from seeds and rearing silk worm for production of silk in north-eastern region especially in Assam and Meghalaya (Sarmah, 2010). The species depicts wide variability in cultivated and wild germplasm in plant habit and seed characters from diverse habitats. Variability studies on this species have been carried out on germplasm collected from the Upper Gangetic plains and adjoining regions of the Indian subcontinent (Anjani *et al.,* 1993; Duhoon *et al*., 1996; Pandey and Radhamani, 2006).

The present study was undertaken on 90 accessions from different states of north-eastern region *viz*. Assam, Arunachal Pradesh, Meghalaya, Manipur and Nagaland assembled during 2004-2006 and available as representative vouchers in the National Herbarium of Cultivated Plants (NHCP), National Bureau of Plant Genetic Resources (NBPGR), New Delhi. A total of seven morphological traits (seed length, breadth, caruncle size, mottling, colour, seed coat thickness and seed surface) were studied. The seeds were categorized on the basis of length and breadth ratio. Seed length, breadth and caruncle size were measured with the help of digital vernier calipers. Other morphological characters *viz*., mottling, seed coat colour, and seed surface were assessed visually. To quantify the data coding was done for mottling (nil-0, less mottled-1, medium mottled-2 and maximum mottled-3); seed coat colour (creamish brown-1, light brown-2 and dark brown-3); seed surface (dull-1, medium shining-2 and maximum shining-3); seed shape (categorized and coded as elongated-1, rhomboidal-2 and oval-3). For measuring seed coat thickness, seed diameter with or without seed coat was measured using vernier calipers and difference in dimensions were recorded, categorized and coded. The analysis of variance among different accessions for seed length, seed breadth and caruncle was done using ANOVA with completely randomize design (CRD) in 5 replication of each seed lot. A two tailed Pearson Correlation Coefficient was calculated between different seed characters to understand interrelationship between them (MS Excel).

Analysis of variation revealed significant difference among all accessions for seed length, breadth and caruncle size (Fig. 1). According to Kulkarni and Ramanamurthy (1977), seed size of castor generally ranges between 7.05 mm x 5.30 mm and 20.95 mm x 13.50 mm. In the present study, seed size varied between 7.73 mm x 5.03 mm and 15.23 mm x 10.28 mm, indicating good variability

**Author for Correspondence: E-mail: ritagupta@nbpgr.ernet.in*

of castor seeds in the north-eastern region (Table 1). Seed length/breadth ratio showed range of variation from 0.43 to 0.81. Based on this ratio 90 accessions were categorized into three categories as small seeded type (0.43-0.55), medium seeded type (0.56-0.68) and large seeded type (0.69-0.81). Most of the castor seeds were small (49 accessions) followed by medium sized seeds (36 accessions) and the large seeded types were not common (5 accessions). According to Kulkarni and Ramanamurthy (1977), medium and small sized seeds are the two groups to which most of the cultivated varieties of the Indian castor belong. There are multiple factors in nature which are responsible for variation in seed size, of which small seeded types may be favoured in natural selection for wider adaptability and effective dispersal capacity (Rao *et al*., 2008). Small seeds of castor have also been recorded correlating to high oil content (Anjani and Jain, 2004; Pandey and Radhamani, 2006).

All accessions, categorized as large, medium and small types of seeds showed a well developed caruncle. Caruncle size also varied from 0.33- 2.33 mm, but in some genotypes the caruncle was very flat and could not be measured. Castor bean seeds contain caruncle which are fleshy structures and have different shapes (http://www.hybridcastorseeds.in/blog/). Caruncle shape also showed morphological variation i.e., flat (17 accessions), small (18 accessions), elevated (23 accessions) and irregular shape (28 accessions). Elevated or irregular shapes of caruncle were most common among the studied lot.

Table 1. Variation in seed size with different variables

Parameter	Range	LSD
Seed length (mm)	7.73 – 15.23	0.039
Seed breadth (mm)	5.03 – 10.28	0.026
Caruncle size (mm)	0.33 – 2.33	0.081
Seed breadth/length ratio	0.43 – 0.81	–

LSD at 0.5

As reported by Kulkarni and Ramanamurthy (1977) caruncle is always present in Indian varieties and helps in absorbing moisture during castor seed germination.

Enormous variability was observed in seeds of castor which showed wide range of mottling i.e. less mottled (39 acc.), medium mottled (39 accessions), maximum mottled (7 accessions) and without mottling (5 accessions) (Table 2). Seed coat colour also exhibited different colours: dark brown was most common (62 accessions) followed by light brown (27 accessions) and creamish brown (one accession). Seed coat thickness was divided into three categories. Most of the castor seed possess thick seed coat (64 accessions) as compared to less and medium seed coat (18 accessions each). Surface of mature castor seeds showed variation from less shining to maximum shining seed coat. 41 accessions had less shining seed coat and in contrast maximum shining seed coat was observed only in 18 accessions. Study of seed structure variability is important for identification of different genotypes in any germplasm which also plays a major role in classification of different *Ricinus* genotypes (Varier *et al*., 1999).

Table 2. Variation in seed morphological characters of castor seeds

S. No.	Seed morphological traits	Categories	Number of accessions
1	Mottling	Nil	5
		Less mottled	39
		Medium mottled	39
		Maximum mottled	7
2	Seed coat colour	Creamish brown	1
		Light brown	27
		Dark Brown	62
3	Seed coat thickness	Less	18
		Medium	18
		Maximum	64
4	Seed surface	Less shining	41
		Medium shining	31
		Maximum shining	18
5	Seed shape	Elongated	10
		Rhomboidal	45
		Oval	35
6	Caruncle size	Flat	17
		Small	18
		Elevated	23
		Irregular	28

Seed shape showed large morphological variations. These shapes were elongated (10 accessions), rhomboidal (45 accessions) and oval (35 accessions). Rhomboidal shape was most commonly occurring among accessions and elongated shape was less common.

Correlation coefficient revealed relationship between various seed traits. Among the morphological characters, positive and negative correlations were observed (Table 3). Seed length and breadth were significantly

Table 3. Correlation between different seed characters of castor

Characters	Breadth	Length	Caruncle	Mottling	Seed coat colour	Seed coat thickness	Seed surface	Seed shape
Length	0.767**	1.000	-	-	-	-	-	-
Caruncle	0.138	0.077	1.000	-	-	-	-	-
Mottling	0.248*	0.411**	0.228*	1.000	-	-	-	-
Seed coat colour	0.152	0.113	0.111	0.272**	1.000	-	-	-
Seed coat thickness	-0.411**	-0.471**	-0.071	-0.286**	0.014	1.000	-	-
Seed surface	-0.099	0.012	0.001	0.368**	0.195	0.210*	1.000	
Seed shape	-0.239*	-0.218*	-0.038	-0.009	0.110	0.159	-0.024	1.000
Caruncle shape	0.007	0.025	0.731**	0.137	0.070	0.030	-0.093	-0.027

**Correlation is significant at the 0.01 level; *correlation is significant at the 0.05 level.

positively correlated with each other (P >0.01). Positive correlation of seed length with seed breadth and thickness was also reported by Kaushik *et al*., (2007) in *Jatropha curcas*. Seed surface also showed positive correlation with sed mottling and seed coat thickness but seed shape showed significant negative correlation with seed length and breadth. Caruncle size and caruncle shape are highly correlated with each other. Seed coat colour also showed positive correlation with mottling.

The present study undertaken on morphological variation in castor seeds showed maximum representation of dark brown, small sized, hard seed coated, rhomboidal shaped, less mottled seeds with elevated and irregular caruncle in the north-eastern region. Previous studies conducted on the indigenous variability in castor seed morphology from western Himalayan region (Himachal Pradesh, Jammu & Kashmir) by Pandey and Radhamani (2006) and from trans-gangetic plains (Punjab and Haryana) by Duhoon *et al*. (1996) also showed higher representation of small sized seeds mostly the wild types. This species has been prominently growing as a wild/ weedy type all over India across different regions of the country. Further studies on germplasm from north-eastern region would add more information on diversity pattern in seed.

Fig. 1. Variabilty in seed morphological characters of castor germplasm

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