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Influence of Size Polymorphism on Seed and Seedling Quality of *Jatropha curcas*

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Studies were carried out to evaluate the influence of size polymorphism on seed and seedling quality characteristics of *Jatropha curcas* at laboratory and at nursery both with fresh and stored seeds. The results revealed that bigger sized seed weighing more100 seed weight recorded better germination and seedling vigour both at laboratory and at nursery. The graded seeds, stored under ambient conditions for a period of six months also expressed similar results. In all instances medium and smaller sized seeds followed the bigger sized seeds in the quality performance and the seed size exerted a positive association with seed quality characters.

Key words: Jatropha, seed grading, seed quality.

Several studies on tree species (Sivasamy, 1991; Masilamani, 1996; Manonmani *et al.,* 1996) identified grading as an integral part of post harvest operations to enhance the planting value of the seed lots. Grading, that entitled to remove the empty, immature, broken and insect damaged seeds (Bonner and Switzer, 1971) is done mainly based on size, weight and colour of the seed. Among them size grading is widely accepted as the basic processing technique for maximizing quality characters of the seed (Gupta *et al.,* 1983). *Jatropha* is one of emerging biodiesel crop of the globe and studies on basic grading are much limited in this species. Hence studies were made in *Jatropha curcas* with seeds collected from five year old plantation of Thondamuthur seed source of Coimbatore district of Tamilnadu.

Materials and Methods

Bulk fruits collected from the seed source at Thondamuthur (Coimbatore), were extracted for seeds manually and graded as big, medium and small based on visual appearance. Fruits were evaluated for the seed recovery on weight basis based on total weight to the seed recovered in each of the grade and the results were expressed as percentage**.** The seeds of each grade were evaluated for the physical seed quality characters *viz.,* seed length (cm) and seed breadth (cm) and the oil content (%) as per AOAC, (1960). Under the germination room conditions as per ISTA (1999) each of seed grades along with ungraded seeds were evaluated for the seed quality characters *viz.,* 100 seed weight (g) and germination (%)as per ISTA (1999) and for the seedling quality characters *viz.* root length (cm), shoot length (cm), hypocotyl length (cm) and dry matter production 10 seedlings^{-1} (g). Vigour index values were also computed adopting the following formulae, as these values are the totality expressions seed quality characters (Abdul-Baki and Anderson, 1973).

Vigour index 1 = Germination (%) x Total seedling length (cm)

Vigour index 2 = Germination (%) x root length (cm)

Vigour index 3 = Germination (%) x Dry matter production 10 seedling $^{-1}$ (mg)

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The seeds were stored under ambient conditions of Mettupalayam (76° 57 E, 11°8 N 320 MSL) for a period of six months and were observed for seed quality characters as mentioned above for the fresh seeds. Graded seeds both as fresh and after storage were also evaluated for their performance at nursery in terms of seedling percent (%) root length (cm), shoot length (cm), hypocotyl length (cm), dry matter production 10 seedlings^{-1} (g), vigour index (Abdul-Baki and Anderson, 1973), stem collar diameter (cm), number of leaves seedling^{-1} and number of roots seedling^{-1} along with bulk. The data gathered were statistically scrutinized as per Panse and Sukhathme (1999) for F test of significance for understanding the level of significance among the size grades for seed and seedling quality characters.

Results and Discussion

Size grading of *Jatropha* seeds with different sizes based on visual appearance revealed that the seed recovery of big, medium and small sized seeds were in the order of 27, 51 and 22 per cent (Table 1and 2 respectively). The evaluated seed quality characters *viz.* 100 seed weight, germination, root length, shoot length, hypocotyl length, dry matter production and vigour index values (1,2,3) of the bigger sized seeds, respectively recorded 13.4, 6.0, 1.0, 2.3,

Table 1. Influence of seed size on seed and seedling quality characters

Seed Size /Characters	Big	Medium	Small	Bulk	SEd	CD (P=0.05)
Seed Characters						
Recovery (%)	27.6	50.8	21.6	-	**0.772**	**1.633**
Seed length (cm)	1.86	1.84	1.58	1.81	**0.032**	**0.065**
Seed breadth (cm)	1.26	1.26	1 .15	1.16	**0.023**	**0.056**
Oil (%)	36. 6	36.8	31.6	35.6	**0.911**	**1.932**
Seed quality characters						
100 seed weight (g)	84.4	76.7	49.6	74.4	**0.908**	**1.925**
Germination (%)	77	63	52	71	**(0.892)**	**(1.902)**
	(60.33)	(52.67)	(43.33)	(57.00)		
Root length (cm)	11.3	12.6	8.2	11.2	**0.576**	**1.212**
Shoot Length (cm)	35.4	33.2	28.3	34.6	**0.722**	**1.531**
Hypocotyl Length (cm)	26.8	19.8	21.5	25.6	**3.162**	**NS**
Dry matter production 10 seedling^{-1} (g)	4.26	3.97	3.68	4.19	**0.072**	**0.164**
Vigour index (1)	3577	2902	2253	3252	**76.02**	**161.1**
Vigour index (2)	864	798	504	795	**33.31**	**70.62**
Vigour index (3)	326	252	227	297	**4.983**	**10.56**
Storability(after 6 months of storage)						
Germination (%)	72	62	45	57	**(0.525)**	**(1.106)**
	(57.63)	(51.66)	(41.64)	(49.57)		
Root Length (cm)	12.4	9.5	7.4	8.7	**0.398**	**0.823**
Shoot Length (cm)	32.0	29.0	26.4	32.4	**1.032**	**2.184**
Hypocotyl Length (cm)	39.1	25.2	24.9	29.7	**0.728**	**1.527**
Dry matter production 10 seedling^{-1} (g)	4.32	3.62	3.44	3.69	**0.142**	**0.302**
Vigour index (1)	3205	2403	1520	2345	**70.41**	**149.2**
Vigour index (2)	896	593	332	498	**32.32**	**68.52**
Vigour index (3)	312	226	155	210	**8.532**	**18.08**

** Figures in parentheses are arc sine transformed values*

Table 2. Influence of seed size on nursery performance

Seed Size /Characters	Nursery duration (months)	Big	Medium	Small	Bulk	SEd	CD (P=0.05)
Nursery Performance (fresh seeds)							
Seedling percent (%)	1	81 (63.75)	66 (54.25)	60 (49.75)	63 (54.75)	**(0.732)**	**(1.554)**
	3	74 (56.75)	64 (52.5)	49 (43.75)	61 (52.5)	**(0.632)**	**(1.354)**
Root length (cm)	1	19.0	15.9	12.4	15.2	**0.391**	**0.825**
	3	34.0	30.0	26.0	25.2	**4.304**	**9.120**
Shoot length (cm)	1	43.2	35.7	28.1	32.8	**0.502**	**1.061**
	3	47.1	41.8	36.2	43.4	**0.736**	**1.563**
Hypocotyl length (cm)	1	23.1	19.9	19.8	18.2	**1.474**	**3.124**
	3	24.3	22.4	13.4	21.1	**0.491**	**1.037**
Dry matter production	1	18.22	17.34	14.52	16.66	**0.262**	**0.548**
10 seedling^{-1} (g)	3	28.92	22.60	16.82	22.68	**0.944**	**1.984**
Vigour Index (1)	1	5050	2423	1511	3007	**335.2**	**710.6**
	3	5940	3035	2447	4190	**460.7**	**976.8**
Stem collar diameter	1	1.22	1.16	0.80	0.97	**9.124**	**0.024**
seedling^{-1} (cm)	3	1.75	1.69	1.05	1.72	**0.054**	**0.063**
Number of Leaves	1	8.3	6.1	4.6	6.3	**0.184**	**0.385**
seedling^{-1}	3	11.8	10.3	7.3	8.4	**1.224**	**2.591**
Number of roots	1	6	5	5	5	**0.184**	**0.381**
seedling^{-1}	3	6	5	5	5	**0.225**	**0.472**
Nursery Performance (after 6 months of storage)							
Seedling percent (%)	1	77 (61.75)	63 (52.5)	61 (52.12)	61 (49.5)	**(2.217)**	**(4.701)**
Root length (cm)	1	20.3	15.2	9.1	15.1	**0.305**	**0.653**
Shoot length (cm)	1	40	33.1	25.2	31	**0.422**	**0.873**
Hypocotyl length (cm)	1	21.9	17.5	11.2	17.1	**0.324**	**0.684**
Dry matter production							
10 seedling^{-1} (g)	1	14.04	12.50	9.28	12.72	**0.283**	**0.594**
Vigour index (1)	1	4643	3043	2092	2812	**211.3**	**385.6**
Stem collar diameter (cm)	1	1.15	1.11	0.67	1.04	**0.021**	**0.042**
Number of leaves							
seedlings $^{-1}$	1	7.9	6.0	4.0	6.0	**0.174**	**0.373**
Number of roots							
seedlings $^{-1}$	1	6	5	5	5	**0.164**	**0.271**

* *Figures in parentheses are arc sine transformed values*

4.7 , 1.7, 9.9, 8.7 and 9.8 per cent higher values than bulk seeds, while the size grades *viz.* big, medium and small in general exerted a positive association with seed quality characters. Similar results were also reported by Hoppe (1991) in *Melia azadiracta* and by Malarkodi *et al.* (1999) in Punnai. The positive association of growth of seedlings from larger to smaller size seed is explained not only by the quantum of accumulated reserve of nutritional matter in them (Ashby, 1936) but also by their higher chemical composition. Katsuka (1964) opined that translocation of reserve from endosperm to embryo proceeds differently in large and small seeds and the better-filled, larger seeds of *Pinus thunbergii* transformed more nitrogen from the endosperm to the embryo after sowing than the small seeds. Arjunan *et al.* (1994) and Manonmani *et al*. (1996) in Pungam and Kathiravan (2004) in *Jatropha* and Ponnuswamy (1993) in neem also reported that seed size and seed quality characteristics are positively related to each other.

Not only the initial seed quality characters but also the seed stored for six months at ambient condition, exerted positive association between seed size and seed quality characters explaining the extension of initial vigour up to storage and at planting as revealed by Srimathi *et al.,* (2002) in *Cassia fistula,* but Manonmani *et al.* (1996) in Pungam reported that seed size had no bearing in seed quality characters under storage

It was explained that the advantage conferred by large seed was due its ability to emerge from greater depth and through the deep litter vegetation (Gross and Werner, 1982). In the present study, the graded seeds germinated in nursery to evaluate their performance under nursery both as fresh seeds and as stored seeds expressed the superiority of bigger seeds followed by medium sized seeds for their better performance which was also opined similarly by Manonmani *et al.* (1996) working with pungam. They also advocated a linear relationship between seed size and quality attributes in *Pongamia pinnata* as obtained in the present study where both the initial seed quality characters and the performance of stored seeds were higher in bigger seeds and were followed by medium sized seeds.

The performance of bigger and medium sized seeds collectively at laboratory and nursery were 15 and one per cent (averaged to 8%) higher than bulk seed in terms of seed germination with the combined seed recovery of 68 per cent. Hence based on recovery and seed quality characters selection of big and medium sized seeds neglecting smaller sized seed could be recommended for selection of quality seeds in association with seed recovery from a bulk as it would be economical in marketing more quantity of quality seed. Thus, the present study emphasized the need for size grading of seeds and the use of larger and medium sized seeds for production of quality seedling. However on stringent selection of propagative material for raising seed production area, the bigger sized seeds alone could be used for effective plantation.

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