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Role of seed and kernel size, thickness and weight on oil content in *Jatropha curcas* L., - a study with Northeast India accessions

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ABSTRACT

Fruit of eighteen accessions of *Jatropha curcas* were collected from different places of Northeast India and seeds and kernel were measured by digimatic caliper. Weights of the seeds were measures by electronic balance and oil content was analyzed seeds with good condition. The study showed that there was a significant variation for the seed and kernel length width, thickness weight and oil content in *J. curcas*. Analysis showed that dry weight of seed and kernel length, breadth, thickness and weight has influence in oil content percentage of *Jatropha curcus.*

KEYWORDS *Jatropha curcas*, seed and kernel, oil content

INTRODUCTION

Jatropha curcas Linnaeus (Euphorbiaceae) is commonly known as Physic nut or Purging nut or JCL (*Jatropha Curcas* Linnaeus) and is a native of Mexico and tropical South America. It is now found almost in all the tropical and sub-tropical regions of the world (Holm et al 1979). *Jatropha curcus* was distributed by Portuguese ships via the Cape Verde Islands and Guinea Bissau to other countries in Africa and Asia (Heller, 1996). It is a shrub or small tree with yellowish rufescent latex. Leaves are deciduous, alternate, apical parts crowded, ovate, acute to acuminate, base cordate, 3 to 5-lobed, 6-40 cm long, 6-35 cm broad, petioles 2-8 cm long. Green flowers in cymes; sepals 5, yellowish, bell-shaped, broadly deltoid; male flowers many with 10 stamens, 5 united at the base only, 5 united into a column; female flowers borne singly with elliptic 3-celled, triovulate ovary with 3 spreading bifurcate stigmata. Capsules 2.5-4 cm long, split into 3 valves when drying; seeds oblong, black, 2 cm length and 1 cm breadth; the seed nearly elliptical and the oil existing mainly in the white kernel (Little et al 1974).

India is emerging very fast as a major force in the global economy. During the present phase of accelerated development, it is inevitable that energy consumption increases many folds as compared to the present per capita energy consumption which is very low in comparison to the other developed countries. In India gap between demand and supply of crude oil will exert a recurrent pressure on the import bills (Anonymous, 2006). In 2011-12 financial years itself India imported oil of Rs. 8, 60,000.00 crores (Anonymous, 2012). This alarming situation calls for emphasis on the use of non conventional energy sources in a big way. *Jatropha curcus* can be used as an alternative biodisel plant which grows well in semi arid and marginal sites and its seeds are rich in non edible oil.

High oil content of the seeds is an important crop characteristic, but if seed size, the number of seeds, or the number of fruits per tree is not accurately accounted for, oil yields per hectare are easily overestimated (Jongschaap et. al., 2007). In the ideal situation, accession with a high number of seeds with good seed and kernel characteristic per plant in combination to high oil content seed, it is justified to relate high oil yield. The seed of *J. curcas* has oil content as high as 35% with abundant oleic and linoleic acid. As a result, it is especially suitable for use as biofuel (King et al., 2009).

As a raw material for biofuel production, the biofuel yield is directly influenced by the seed oil yield of *J. curcas* which is influenced by the seed yield and its oil content, and the seed weight is one of the factors affecting the seed yield. Studies in India showed that there were significant differences in seed size, 100-seed weight and oil content between 24 accessions (Kaushik et al., 2007). However, few studies have been performed on the traits, oil content and correlation of a single seed and kernel in *J. curcas*. Therefore, studies of the seed weight and the oil content of *J. curcas* are of great significance in improving its seed oil production, with this background present study was undertaken with the objective to understand the role of seed and kernel size and thickness on oil content.

MATERIALS AND METHODS

The Department of Biotechnology, Government of India initiated a Jatropha networking programme throughout the country. The Energy and Resources Institute (TERI), Northeastern Regional Centre was also a partner of this programme in a project mode in the project "Demonstration and field trial of superior Jatropha clones in different agroclimatic zones of Northeastern states" and the present study is a part of this project work.

Collection of samples:

Jatropha fruits were collected during 2011 to 2012 from wild population based on the random selection process (which are more than six year old) from Kamrup Metro district of Assam and South and West Tripura district of Tripura. Fruits which turned black just after ripening and before suture formation were selected for harvest and from each accession two hundred fruits were harvested within a week time in the month of September to verify the data. Collected fruits were kept in mauslin cloth bag with proper tag. Place of collection, GPS data of the places of collection of 18 accessions were recorded in the data sheets (Table 1).

Process of seeds:

Seeds were extracted from the collected fruit without any

damage and shade dried for 24 hours. Deformed seeds were sorted out from the lot and well developed seeds were kept for further studies. From the selected seeds 50gm seeds were sent to TERI-Delhi for oil analysis and 100gm seeds were sent to National Bureau of Plant Genetic Resources (NBPGR), New Delhi to get indigenous collection (IC) number.

Analysis of seed and kernel data:
One hundred fifty (150) seeds were taken randomly from each accession for analysis of their size and thickness. The length, width and thickness of the seed and the kernel were measured by vernier caliper, and the weight of single seed and kernel were taken in electronic balance.

Compilation of data:
Length width, thickness and weight of seed as well as kernel, and the oil content data were entered in the excel sheet and data were analyze to draw the inference.

RESULTS

Total 2700 seeds under 18 accessions and 150 seeds from each accession were analyzed and their sizes and thickness were compared with oil analysis report received from TERI Delhi (Table 2). The seed length varied from 15.49 mm to 18.16 mm; seed breadth 10.05 mm to 11.03 mm; seed thickness 8.15 mm to 8.83 mm, seed weight 0.5942 g to 0.8478 g and kernel length from12.89 mm to 15.12 mm; kernel breadth 7.42 mm to 8.79 mm; kernel thickness 5.22 mm to 6.69 mm kernel weight 0.3553 g to 0. 5397g and oil % ranged from 31.333% to 41.722%. From the table 2 it is clear that the relation between the maximum seed length, breadth, thickness, weight and the kernel length, breadth and thickness was the highest in which oil content percentage was the highest and lowest in accessions where oil content percentage was lowest.

DISCUSSION

The seed of *J. curcas* is the major organ for the storage of synthesized oil. The yield of oil was directly influenced by the seed and kernel length, thickness, weight and oil content (Fig 1 and Fig 2). In this study, it was shown that there was significant phenotypic difference in the seed and kernel weight and oil content. Some studies also showed that there were significant differences in seed size, weight and oil content (Kaushik et al., 2007; Wu et al., 2012). Accordingly, the seed oil production of *J. curcas* can be greatly improved by the selection and breeding for high seed weight and high oil content accessions.

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Table 1: Locational details of Jatropha accessions collection

Sl no	Accession no	Locality	District	State	Latitude	Longitude	Altitude (ft.)
1	TERINE/ AS/04	Gobordhan	Kamrup Metro	Assam	N 26° 14′11.0″	E 91° 57′ 00.8″	695
2	TERINE/ AS/05	Janpar	Kamrup Metro	Assam	N 26° 13′11.3″	E 91° 57′ 00.8″	709
3	TERINE/ AS/16	Chandrapur	Kamrup Metro	Assam	N 26° 14′30.7″	E 91° 57′ 01.3″	436
4	TERINE/TR/24	Sital tilla	West Tripura	Tripura	N 23° 41′29.4″	E 91° 16′ 26.3″	191
5	TERINE/TR/25	Rumthang	West Tripura	Tripura	N 23°35′38.1″	E 91° 23′ 55.7″	323
6	TERINE/TR/26	Kaumaraghat	South Tripura	Tripura	N 23° 29′55.2″	E 91° 04′ 32.7″	254
7	TERINE/ AS/43	Bortilla	Kamrup Metro	Assam	N 26° 11′13.0″	E 91° 59′ 06.8″	152
8	TERINE/ AS/44	Borbari	Kamrup Metro	Assam	N 26° 18′17.0″	E 91° 52′ 12.8″	188
9	TERINE/ AS/46	Chachal	Kamrup Metro	Assam	N 26° 17′16.2″	E 91° 50′ 12.7″	161
10	TERINE/ AS/51	Moinakhureng	Kamrup Metro	Assam	N 26° 23′11.2″	E 91°88′ 15.8″	107
11	TERINE/ AS/52	Pamohi	Kamrup Metro	Assam	N 26° 29′18.6″	E 91°78′ 12.5″	103
12	TERINE/ AS/53	Deochatal	Kamrup Metro	Assam	N 26° 32′16.5″	E 91°88′ 18.1″	120
13	TERINE/ AS/54	Panikheiti railgate	Kamrup Metro	Assam	N 26° 10′24.3″	E 91°60′ 10.5″	406
14	TERINE/ AS/56	Panikheiti	Kamrup Metro	Assam	N 26° 17′22.6″	E 91°56′ 11.8″	194
15	TERINE/ AS/57	Chandrapur Tinali	Kamrup Metro	Assam	N 26° 16′29.8″	E 91°56′ 55.9″	187
16	TERINE/ AS/58	Tantimara	Kamrup Metro	Assam	N 26° 16′37.5″	E 91°56′ 41.4″	179
17	TERINE/ AS/59	Pragjoytishpur	Kamrup Metro	Assam	N 26° 19′37.9″	E 91°64′ 05.5″	489
18	TERINE/ AS/73	VIP Road	Kamrup Metro	Assam	N 26° 17′15.0″	E 91° 50′ 11.6″	160

Table 2: Seed and Kernel data

Sl no	Accession no	IC no	Seed				Kernel				Oil (%)
			Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)	Length (mm)	Breadth (mm)	Thickness (mm)	Weight (g)	
1	TERINE/AS/04	565670	15.49	10.05	8.15	0.5942	12.89	7.42	5.22	0.3353	31.333
2	TERINE/AS/05	565671	16.79	10.11	8.25	0.6013	13.51	7.44	5.37	0.3433	33.202
3	TERINE/AS/16	565674	17.37	10.28	8.45	0.7055	13.72	7.62	5.79	0.3706	36.799
4	TERINE/TR/24	565541	17.41	10.33	8.53	0.7322	14.17	7.82	5.81	0.4786	37.130
5	TERINE/TR/25	565542	17.43	10.36	8.55	0.7691	14.23	7.85	5.82	0.4787	37.258
6	TERINE/TR/26	565543	17.22	10.21	8.36	0.6367	13.69	7.51	5.77	0.3678	35.659
7	TERINE/AS/43	569324	17.68	10.47	8.61	0.8015	14.68	8.05	6.23	0.5029	39.431
8	TERINE/AS/44	569325	17.65	10.43	8.60	0.7923	14.65	7.97	6.16	0.4991	38.717
9	TERINE/AS/46	569327	17.11	10.14	8.31	0.6254	13.38	7.46	5.50	0.3500	34.366
10	TERINE/AS/51	569331	17.35	10.25	8.42	0.6589	13.70	7.52	5.79	0.3702	36.570
11	TERINE/AS/52	569332	17.40	10.30	8.49	0.7130	14.13	7.73	5.80	0.3935	37.047
12	TERINE/AS/53	569333	17.51	10.39	8.57	0.7793	14.55	7.91	5.90	0.4958	37.878
13	TERINE/AS/54	569334	18.14	11.18	8.81	0.8393	14.94	8.47	6.78	0.5342	41.722
14	TERINE/AS/56	569336	17.72	10.53	8.64	0.8117	14.72	8.13	6.37	0.5167	39.668
15	TERINE/AS/57	569337	17.84	10.64	8.65	0.8181	14.90	8.31	6.44	0.5192	40.420
16	TERINE/AS/58	569338	18.16	11.03	8.83	0.8478	15.12	8.79	6.69	0.5397	41.762
17	TERINE/AS/59	569339	17.96	10.73	8.66	0.8295	14.93	8.44	6.62	0.5293	41.061
18	TERINE/AS/73	586024	17.15	10.18	8.33	0.6290	13.64	7.50	5.74	0.3576	34.430

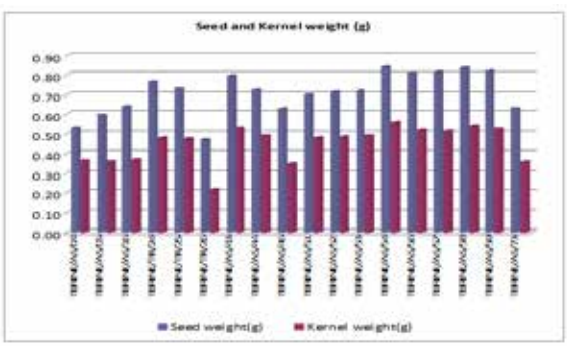

Fig 1: Seed and kernel dry weight against each accession

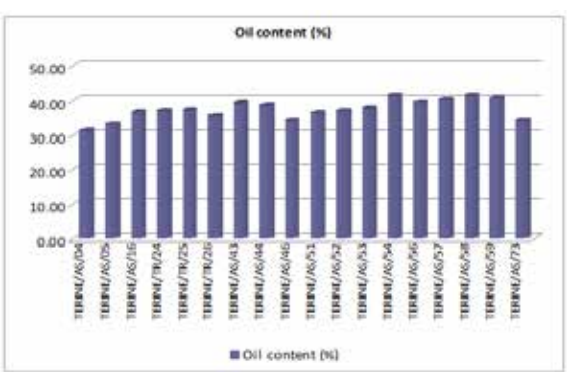

Fig 2: Oil content (%) against each accession

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