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Variation in Oil Content of Non- edible and Unexploited-Oil Seed Species of Tamil Nadu

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ABSTRACT

Identification of unexploited and non-edible oil seed species for biofuel production is highly essential to sustain the biodiesel production demand in our country. The present investigation was carried out at Forest College and Research Institute, Mettupalayam during 2014-2015. A total of nine unexploited species namely *Sterculia foetida, Abrus precatorius, Thespesia populnea, Dodonaea viscosa, Hevea brasiliensis, Entadarhe edii, Cleome viscosa, Leucaena leucocephala, Pongamia pinnata* (control) were collected from various sources to study the pod and seed traits *viz*. pod length, pod breadth, seed length, seed breadth, 100 seed weight and oil content. A wide variation was observed for all the traits studied. Average oil content was observed among nine species varied from 1.2% to 33.4%. The highest oil content was recorded in *Sterculia foetida* (33.40%) followed by *Pongamia pinnata*(30.60%) and *Thespesia populnea* (30.20%). So, these species could be commercially cultivated in the in wasteland to meet out the raw materials demand for biodiesel production.

INTRODUCTION

India, a fast growing economy facing the challenge of meeting a rapidly increasing demand for energy, ranks sixth in the world in terms of energy demand. Energy independence has to be our first and foremost priority (Abdul Kalam 2005) as it is a vital commodity and is commonly recognized that access to energy is closely linked with economic development.

India is targeting economic growth rate of 8-9 % incoming years and there will be a substantial increase in demand for oil to manage transportation and to meet various other energy needs (Kureel 2007). The growing consumption of energy has resulted in increasing dependency on fossil fuels. The consumption of crude oil was about 295.6 MT for the year 2012-13 but 80 % of this demand was met by imports (TERI 2012).

Thus, the energy security has become a key issue for the nation as a whole. The rise in fuel demand, on the one hand, and diminishing fossil fuel reserves, on the other hand, has led to a serious examination of alternative energy sources. Solar power, wind energy and bio-fuels are some of the alternatives to fossil fuel.

The Government of India (GoI) approved the National Policy on Biofuels on December 24, 2009. The policy proposes a target of 20 % blending of

biofuel both for bio-diesel and bio-ethanol by 2017. In India, more than 100 species of tree borne oilseeds (TBOs) have been identified as a source of fatty oils with estimated potential of 11.3 lakh tonnes. Plant species which can be processed to provide diesel fuel substitutes have captured the interest of scientists. The potential sources include *Jatropha curcas, Pongamia pinnata, Madhuca longifolia, Azadirachta indica, Calophyllum innophyllum and Simarouba glauca*.

Many unexploited species which contain oil that can be extracted and used as bio-diesel. They are Wild Almond Tree (*Sterculia foetida),* Rosary Pea *(Abrus precatorius)*, Portia *(Thespesia populnea)*, Hopbush *(Dodonaea viscosa),* Rubber Tree *(Hevea brasiliensis),* African Dream Herb *(Entadarhe edii),* Asian Spider Flower *(Cleome viscosa),*and White Lead Tree *(Leucaena leucocephala).* Among the many unexploited species, in the present study *Sterculia foetida, Abrus precatorius, Thespesia populnea, Dodonaea viscosa, Hevea brasiliensis, Entadarhe edii, Cleome viscose, Leucaena leucocephala* has been compared with *Pongamia pinnta* for oil content to find as the potential source for biodiesel and bio- ethanol production. For which oil content of these species is determined.

MATERIALS AND METHODS

The experimental material for the present study consisted of 9 different species for which the oil content is estimated. The current study was carried out in the Biotechnology laboratory at Forest College and Research Institute, Mettupalayam (Latitude-11°19'40.73''N, Longitude-076°56'09.05"E, Altitude- 300 MSL), Tamil Nadu Agricultural University.

The dried pods were collected from the plants and seeds were extracted, cleaned and dried in shade to reduce the moisture content. In order to find out the oil content of collected seeds .Experiment were carried out in the Bio-Technology laboratory of Forest College and Research Institute, Mettupalayam during the year 2014 to 2015.

Observation on seed traits

The observations was recorded from the seeds collected for the study. The seeds were graded as large and small based on visual observation. Minimum 100 seeds were taken from each category and the average was computed for the seed trait studies. The seed parameter studies were carried out with a random sample of seeds from each species with three replications. The characters studied and the techniques adopted to record observation are given below.

The length of pod from the base to the tip was measured using scale and expressed in cm. The breadth at the middle of pod was measured using scale and expressed in cm. The length of seed from the base to the tip was measured using vernier caliper and expressed in cm.

Table1. Collection and evaluation of unexploited species.

Sl.No	Common Name	Species	Place	Latitude	Longitude	Altitude (m)
1.	Wild Almond Tree	*Sterculia foetida*	Mettupalyam	11° 19'24.10 N "	76° 56'05.85 E "	321
2.	Rosary Pea	*Abrus precatorius*	Villupuram	11° 56'35.44 N "	79° 29'16.96 E "	51
3.	Portia Tree	*Thespesia populnea*	Mettupalyam	11° 19'27.16 N "	76° 56'06.25 E "	312
4.	Hop bush	*Dodonaea viscosa*	Mettupalyam	11° 19'32.03 N "	76° 56'27.01 E "	304
5.	Rubber Tree	*Hevea brasiliensis*	Nagercoil	08° 08'57.03 N "	77° 24'15.67 E "	24
6.	African Dream Herb	*Entadarhe edii*	Namakkal	11° 18'05.62 N "	78° 05'35.81 E "	215
7.	Asian Spider Flower	*Cleome viscosa*	Mettupalyam	11° 19'25.14 N "	76° 56'19.86 E "	316
8.	White Lead Tree	*Leucaena leucocephala*	Villupuram	11° 57'30.03 N "	78° 28'26.46 E "	48
9.	Indian Beech Tree	*Pongamia pinnata*	Coimbatore	11° 00'33.31N "	76° 56'03.16 E"	426

The breadth at the middle of seed was measured using vernier caliper and expressed in cm.

Determination of hundred seed weight was computed as per ISTA (1993). For this, 8 x 100 seeds were counted at random from the seed sample, weighed and recorded in gram

RESULTS AND DISCUSSION

The selected species were assessed to know the variation with respect to pod and seed parameters and are presented in (Table 2).

Pod length

Among the selected species pod length varied from (1.33 cm to 153.60 cm). The highest pod length recorded among the selected species was *Entadarhe edii* (153.60 cm)and the lowest pod length recorded was *Dodonaea viscosa* (1.33 cm) the average pod length recorded in the selected species was (21.49 cm).

Pod breadth

Among the selected species pod breadth varied from (0.57 cm to 10.00 cm).The highest pod breadth recorded among the selected species was *Entadarhe edii* (10.00 cm) and the lowest pod length recorded was *Cleome viscose* (0.57 cm) the average pod breadth recorded in the selected species was 2.91 cm (Table 2).

Seed length

Among the selected species seed length ranged from (0.33 cm to 4.80 cm). The highest seed length recorded among the selected species was *Entadarhe edii* (4.80 cm) and the lowest seed length recorded was *Cleome viscosa (*0.33 cm) the average seed length recorded in the selected species was 1.67 cm(Table 2).

Seed breadth

Among the selected species seed breadth varied from (0.10 cm to 4.00 cm). The highest seed breadth recorded among the selected species was *Entadarhe edii* (4.00 cm) and the lowest seed breadth recorded was *Cleome viscosa (*0.10 cm). The average seed breadth recorded in the selected species was 1.15 cm (Table 2).

Hundred seed weight

Hundred seed weight differed significantly among selected species. It ranged from (7.67 g to 1760.67 g). The highest hundred seed weight recorded among the selected species was *Entadarhe edii* (1706.67 g) and the lowest hundred seed weight recorded was *Cleome viscosa* (7.67 g).The average hundred seed weight recorded was 231.25 g. (Table 2).

Seed oil content

The seed oil content differed significantly among different species. The seed oil content ranged between 1.20 % to 33.40 %. The highest seed oil content recorded among the selected species was *Sterculia foetida* (33.40 %) and the lowest seed oil content recorded was *Abrus precatorius* (1.20 %). The average seed oil content recorded was 16.40 %.

Collection and characterization of plant species

The seeds of 9 different species *viz*., *Sterculia foetida, Abrus precatorius, Thespesia populnea, Dodonaea viscosa, Hevea brasiliensis, Entadarhe edii, Cleome viscosa, Leucaena leucocephala, Pongamia pinnata* were collected. The collected seeds were morpho-metrically characterized and oil content was estimated. Divakara et al. (2010) recorded significant variation in seed traits such as seed length, width, oil content hundred seed weight among 24 candidate plus trees of Pungam. Similarly, the seeds of 53 candidate plus trees of Pungam showed significant variation in seed length, seed width, 100 seed weight and oil content (Sahoo et al. 2011).Similarly the pungam seeds that were studied in the present investigation showed variation. Pod length (3.67 cm), pod breadth (2.40 cm), seed length (2.33 cm), seed breadth (1.37 cm), 100 seed weight (108.33 g) and oil content (30.60 %) was observed in the present study. In *Madhuca latifolia***,** distinct variation in respect of seed characters *viz*., seed length, seed breadth, seed length, seed breadth ratio and 100 seed weight was observed (George et al. 2003). Seed length varied between 3.92 cm and 2.16 cm, seed breadth from 0.94 cm to 1.35 cm, seed length: seed breadth ratio from 0.94 to 1.35 and

100 seed weight between 134.06 g and 262.04 g. similar variation for seed breadth and hundred seed weight was observed in this study.

Variability in seed physical parameters of *Jatropha curcas* was earlier recorded by Kumar et al. (2003). Significant variability for different seed physical attributes was observed among different *Jatropha curcas* sources (Sudhirkumar 2003; Mohapatra and Panda 2010; Das et al. 2010; Rao et al. 2008 and Ginwal et al. 2004; Reddy et al. 2007) in Pungam. In the present investigation, significant variation was recorded for seed oil content among the 9 different selected species. Seed oil content variation is more widely reported not only in annual crops but also in wide variety of tree borne oil seeds (Johansson et al. 1997; Kaura et al. 1998; O'Neill et al. 2003; Vollmann et al. 2007). The species with highest oil content could be commercially exploited.

Table 2. Evaluation of different species for pod and seed parameters and oil content

Species	Pod length (cm)	Pod breadth (cm)	Seed length (cm)	Seed breadth (cm)	100 Seed weight (g)	Oil content (%)
Sterculia foetida	4.07	3.57	2.50	1.00	92.33	33.40
Abrus precatorius	2.80	1.73	0.70	0.60	31.33	1.20
Thespesia populnea	3.10	2.10	0.80	0.50	16.33	30.20
Dodonaea viscosa	1.33	1.60	0.40	0.33	20.00	4.00
Hevea brasiliensis	3.60	2.07	2.50	2.00	25.00	22.20
Entadarhe edii	153.60	10.00	4.80	4.00	1760.67	9.60
Cleome viscosa	5.60	0.57	0.33	0.10	7.67	10.20
Leucaena leucocephala	15.67	2.17	0.73	0.52	19.67	6.20
Pongamia pinnata	3.67	2.40	2.33	1.37	108.33	30.60
Mean	21.49	2.91	1.67	1.15	231.25	16.40
S.Ed	1.05	0.33	0.14	0.20	2.99	2.18
CD (0.05)	2.23	0.70	0.30	0.44	6.33	4.63

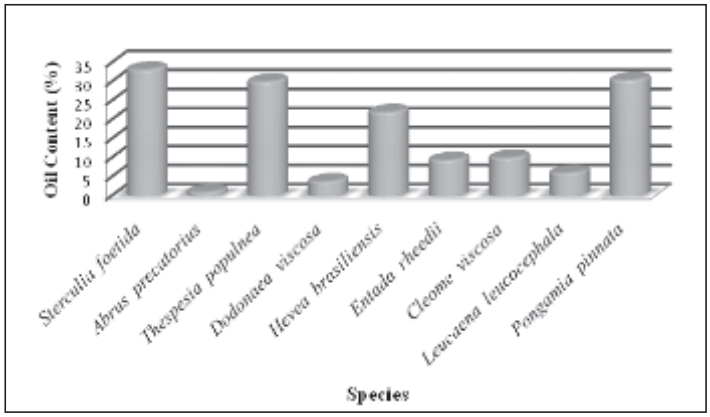

Fig. 1. Estimation of oil content in different species

CONCLUSION

From the current investigation result we conclude that there is wide variation in the oil content of all selected species and highest oil content recorded in *Sterculiafoetida*, with the future demand for biofuel. We can recommend this species as the potential source of non-edible unexploited oil seed species to meet out the energy demand.

REFERENCE

A.O.A.C. 1975. Official methods of analysis. Association of Official Agricultural Chemists, Washington, 12th edition. Pp. 488-492.

Abdul Kalam, APJ 2005 Independence Day address to the nation on 15 August.

Anonymous 2003 Report of the Committee on

Development of Biofuel, Planning Commission, Government of India, New Delhi. 164 p.

Das S, Misra R, Mahapatra, AK, Gantayat, BP and Pattnaik RK 2010 Genetic variability, character association and path analysis in *Jatropha curcas. World Applied Sciences Journal* 8 (11): 1304-1308

Divakara BN, Alur AS and Tripathi S 2010 Genetic variability and relationship of pod and seed traits in *Pongamia pinnata* (L.) Pierre. Apotential agroforestry tree. *International J. of Plant Production* 4(2): 129-14.

George Jenne M, Dasthgiri Prathiban K and Judesudhagar 2003 Variability studies in seed and seedling attributes in Mahauva (*Madhuca latifolia*). *Indian Forester*, 129 (4): 509-516.

Ginwal HS, Phartyal SS, Rawat PS and Srivastava RL 2005 Seed source variation in morphology, germination and seedling growth *of Jatropha curcas* Linn, in Central India. *Silvae Genetica* 54(2): 76-80.

ISTA. 1993. International rules for seed testing. Seed Sci. & Technol., 21: 1- 288.

Johansson AK, Kuusisto PH, Laakso PH, Derome KK, Sepponen PJ, Katajisto JK and Kallio HP 1997 Geographical variations in seed oils from Rubus chamaemorus and *Empetrum nigrum*. *Phytochemistry*. 44: 1421–1427.

Kaura SK, Gupta SK and Choudhary TB 1998 Morphological and oil content variation in seeds *of Azadirachta indica* from Northern and Western parts of India. *Plant Food for Human Nutrition*. 52(4): 293-298.

Kumar S, Parimallam R, Arjunan MC and Vijayachandran SN 2003 Variation in *Jatropha curcas* seed characteristics and germination. Proceeding of the national workshop on Jatropha and other perennial oilseed species. Pune, India, p. 63-66.

Kureel RS 2007 Prospect and potential of *Jatropha curcas* for biodiesel production. In: Biodiesel – Towards Energy Independence. Bratma Singh, Swaminathan, R. and Ponraj, V. (Eds.), Rashtrapathi Bhawan, New Delhi. p. 374.

Mohapatra S and Panda, PK 2010 Genetic variability on growth, phonological and seed characteristics of *Jatropha curcas* L. *Notulae Scientia Biologicae* 2(2): 127-132.

O'Neill CM, Gill S, Hobbs D, Morgan C and Bancroft I 2003 Natural variation for seed oil composition in *Arabidopsis thaliana. Phytochemistry*. 64:1077–1090.

Rao GR, Korwar, GR. Shanker AK. and Ramakrishna YS 2008 Genetic associations, variability and diversity in seed characters, growth, reproductive phenology and yield in *Jatropha curcas* (L.) accessions. *Trees Struct. Funct* 22(5): 697–709.

Reddy Vasanth KN, Kumar PH, Siddraju CM, Gunga RP, Madiwalar SL and Patil SK2007. Seed source variation for seed and seedling traits in Pongamia pinnata (L.) Pierre; An important biofuel yielding tree species. *My For.*, 43(1):61-68.

Sahoo DP, GR, Rout S, Das S, Aparajita and MahapatraAK 2011 Genetypic Variability and Correlation Studies in Pod and seed characteristics of *Pongamia pinnata* (L.) Pierre in Orissa, India. *International J. For Research* 10: 1-6

SudhirKumar 2003 Effect of seed size on germination and seedling traits of *Jatropha curcas.* National Workshop on Jatropha Other Perennial oil seed species, 5th to 8th Aug.2003, Bharathiya Agro-Industries Federation of India(BAIF), Pune.pp 5-7.

TERI 2012 TERI Energy Data Directory & Yearbook (TEDDY):2012.

Vollmann J, Moritz T, Kargl C, Baumgartner S, Wagentrist H 2007 Agronomic evaluation of camelina genotypes selected for seed quality characteristics. *Ind. Crops Prod*. (in Press, corrected proof, available online).

Witze A 2007 That's oil, folks. Nature, 445, 14–17.