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Short Communication

Standardization of Seed Storage Techniques to Minimize Loss of Vigour and Viability in Jatropha (*Jatropha curcas* L.)

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Jatropha (*Jatropha curcas* L.) is one of the important oil seed crop belonging to the family Euphorbiaceae. The oil content of seed is 35 to 40 per cent of seed weight and 50 to 60 per cent of the kernel. A number of Tree Based Oil Seed (TBOS) crops are identified as an alternative source for diesel, of which Jatropha is one of the important bio-fuel crops suitable for growing in waste lands. Jatropha oil is an environmentally safe, cost effective renewable source of non conventional energy and promising substitute for diesel, kerosene and other fuel oils [1]. To reduce pressure on demand of petroleum products, as an eco-friendly bio diesel, employment generation, reducing air pollution and to improve the living standards of rural community, cultivation of Jatropha in a large scale assumes greater importance. Jatropha can be grown in tropical and sub tropical climatic conditions and its potential have not been fully exploited. The efforts taken to popularize the cultivation of this crop are far from satisfactory. Since Jatropha is mainly propagated through seeds, the area for quality seed production has to be concentrated. A good quality seed is a pre requisite to obtain a healthy plant and its production is a specialized job requiring skill, care and training. Lack of knowledge on seed storage requires standardization of storage techniques is very essential to improve storability and viability of the seeds. Hence, the present study was carried out with the objective to maintain the seed vigour and viability on storage.

Jatropha seeds harvested during June 2003 obtained from the Institute of Forest Genetics and Tree Breeding (IFGTB) Coimbatore, India formed the basic material for the study. The experiment was carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore for one year (July 2003 to June 2004). The seeds were graded using 12 mm sieve and dried to uniform moisture content of eight per cent. The seeds were treated with carbendazim at the rate of 2g kg^{-1} of seeds (T_2), halogen mixture at the rate of 3g kg^{-1} of seeds (T_3) and carbendazim with halogen mixture (1+1.5g kg^{-1}, respectively) (T_4) and packed in cloth bag (C_1), polylined cloth bag (C_2) and High Density Poly Ethylene inter woven bag (HDPE) (C_2) were stored under ambient conditions (mean temp. 27±1°C, RH 66±2%) along with control (T_1). The observations were recorded on germination (%), moisture content (%), oil content, electrical conductivity and enzyme activities initially and at bimonthly intervals upto 12 months to assess the quality of the stored seeds.

Immediately after treatment, germination test was carried out in sand medium in quadruplicate using 100 seeds for each treatment with four sub replicates of 25 seeds [2] in a germination room maintained at a temperature of 25 ± 1°C and relative humidity of 96 ± 2 per cent with diffused light (approx. 10 h) during the day. Final count on normal seedlings was recorded on fourteenth day and germination per cent was computed. The seedling dry weights were determined using normal seedlings after drying at 80°C for 36h. and

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mean of dry weight arrived and expressed as g seedlings^{-10}. Moisture [2] and oil content [3] were calculated and expressed in per cent.

The electrical conductivity test was measured by soaking 25 seeds in 50 ml of deionized water for 16h. [4]. Peroxidase activity [5] and dehydrogenase activity [6] were assessed using embryos from seeds preconditioned with moist blotters for 16h. All the analyses were made in duplicate. The data were subjected to an Analysis of Variance and treatment differences tested for significance [7].

In the present study, the moisture content of the seed increased (8.00 to 8.35 %) with advancement in storage period (Table 1) and it was highest in seeds stored in cloth bag (8.38 %) compared to those stored in polylined cloth bag and High Density Poly Ethylene interwoven bag (8.05 %). Among the treatments, the combination of carbendazim with halogen mixture (1+1.5 g kg^{-1}, respectively) registered the lowest moisture content (8.11 %) followed by Halogen mixture (chlorine based) at the rate of 3 g kg^{-1} (8.13 %), irrespective of the containers and periods of storage, which could be due to absorption of atmospheric moisture by the seeds and the attainment of equilibrium status with differential moisture content of the atmosphere at faster rate in cloth bag but at lower rate with polylined cloth bag and High Density Poly Ethylene interwoven bag due to their characteristic prevention of moisture entry into the container [8].

The germinability of the seeds declined with ageing from 80 to 59 per cent (12 month) irrespective of treatments and containers (Table 1), which could be attributed to the depletion of food reserves, decline in synthetic activity that occurred within the seed as reported by Heydecker [9]. Among the containers, High Density Poly Ethylene inter woven bag proved its superiority in the maintenance of higher germination (62 %) followed by polylined cloth bag (60 %). Among the pre-storage seed treatments, halogen + carbendazim mixture preserved higher germination (75 %) with lesser deterioration rate than the untreated seeds (65 %). This is mainly due to stabilization of double bonds in unsaturated fatty acid and reduction of lipid peoxidation as suggested by Basu [10]. The drymatter production (2.327g seedling^{-10}) was higher in seedlings obtained from the seeds treated with halogen + carbendazim mixture than those from the control seeds (Table 2).

The electrical conductance of the seed leachate is considered as a good indicator of deterioration and is likely to be caused due to the breakdown of the lipoprotein membrane structure [11]. In the present study, electrical conductivity of seed leachate increased gradually over period of storage (0.908 to 1.152 dSm^{-1}) irrespective of seed treatments and containers due to loss of membrane integrity [12] and the increase was slow with halogen + carbendazim treatment (0.982 dSm^{-1}) and High Density Poly Ethylene inter woven bags (0.966 dSm^{-1}) (Table 2).

The oil content, the biochemical factor of deterioration, decreased with increase in storage period (Fig. 1). While the decrease was less in seeds treated with carbendazim + halogen mixture (32.48 %) and stored in High Density Poly Ethylene inter woven bags (32.43 %). Dehydrogenase, the enzyme responsible for viability of seeds and the causes for the staining of seed in TZ test, reduced their activity during storage with the advancement in storage period, irrespective of treatments and containers due to the inability of the seed tissues to reduce tetrazolium salt to insoluble formazan. Among the treatments, carbendazim + halogen mixture recorded the highest value of 0.633 compared to control which recorded the lowest value of 0.602 irrespective of the containers and periods (Fig. 2). The seeds stored in High Density Poly Ethylene inter woven bag recorded the highest value of 0.628 compared to cloth bag which recorded the lowest value of 0.606, irrespective of the treatments and periods. The dehydrogenase activity (OD) decreased with increase in storage periods (0.675 to 0.558). This was revealed by Balamurugan [13] in sunflower. Abdul-Baki and Anderson [14] coined the loss of energy during germination as the reason for reduced activity of the dehydrogenase enzymes in storage. Peroxidase is another enzyme responsible for seed quality maintenance as it act as a protectant against accumulation of peroxides and caused the decomposition of hydrogen peroxide into water and oxygen [15]. In this study, the

Table 1. Periods of storage, packaging containers and treatments on seed moisture content (%) and germination (%) in Jatropha seeds

Treatments (T)/ containers (C)		Periods of storage in months (P)									
		Moisture content (%)					Germination (%)				
		P_0	P_4	P_8	P_{12}	Mean	P_0	P_4	P_8	P_{12}	Mean
T_1	C_1	8.00	8.40	8.80	9.10	8.57	80(63.45)	65(53.74)	55(47.87)	50(45.00)	62(51.95)
	C_2	8.00	8.00	8.10	8.20	8.07	80(63.45)	71(57.42)	60(50.77)	55(47.87)	67(54.94)
	C_3	8.00	8.00	8.13	8.22	8.08	80(63.45)	72(58.06)	61(51.36)	56(48.44)	67(54.94)
	Mean	**8.00**	**8.13**	**8.34**	**8.51**	**8.24**	**80(63.45)**	**69(56.41)**	**59(50.00)**	**54(47.10)**	**65(54.18)**
T_2	C_1	8.00	8.25	8.55	8.90	8.41	80(63.45)	70(56.80)	61(51.36)	55(47.87)	67(54.94)
	C_2	8.00	8.00	8.08	8.13	8.05	80(63.45)	76(60.71)	66(54.33)	60(50.77)	71(57.42)
	C_3	8.00	8.00	8.06	8.10	8.04	80(63.45)	78(62.04)	68(55.56)	61(51.36)	72(58.06)
	Mean	**8.00**	**8.08**	**8.23**	**8.38**	**8.17**	**80(63.45)**	**75(59.85)**	**65(53.75)**	**59(50.00)**	**70(56.80)**
T_3	C_1	8.00	8.20	8.40	8.60	8.30	80(63.45)	71(57.42)	66(54.33)	56(48.44)	68(55.65)
	C_2	8.00	8.00	8.07	8.11	8.05	80(63.45)	77(61.35)	71(57.42)	61(51.36)	72(58.06)
	C_3	8.00	8.00	8.05	8.09	8.04	80(63.45)	78(62.04)	74(59.35)	62(51.95)	74(59.35)
	Mean	**8.00**	**8.06**	**8.17**	**8.27**	**8.13**	**80(63.45)**	**75(59.85)**	**70(56.80)**	**60(50.77)**	**71(57.90)**
T_4	C_1	8.00	8.15	8.35	8.55	8.25	80(63.45)	77(61.35)	71(57.42)	60(50.77)	72(58.06)
	C_2	8.00	8.00	8.06	8.10	8.04	80(63.45)	80(63.45)	76(60.71)	65(53.94)	75(60.38)
	C_3	8.00	8.00	8.05	8.08	8.03	80(63.45)	80(63.45)	77(61.35)	67(54.96)	76(60.71)
	Mean	**8.00**	**8.05**	**8.15**	**8.24**	**8.11**	**80(63.45)**	**79(62.98)**	**75(59.85)**	**64(52.95)**	**75(59.90)**
	C1	8.00	8.25	8.53	8.79	8.38	80(63.45)	71(57.42)	63(52.75)	55(48.02)	67(54.96)
	C_2	8.00	8.00	8.08	8.14	8.05	80(63.45)	76(60.71)	68(55.56)	60(50.77)	71(57.90)
	C_3	8.00	8.00	8.07	8.12	8.05	80(63.45)	77(61.35)	70(56.80)	62(51.95)	72(58.06)
	Mean	**8.00**	**8.08**	**8.22**	**8.35**		**80(63.45)**	**75(59.85)**	**67(54.94)**	**59(50.00)**	

	T	C	P	TC	CP	TP	TCP	T	C	P	TC	CP	TP	TCP
SEd	0.020	0.017	0.026	0.034	0.046	NS	NS	0.4703	0.4073	0.6222	NS	1.0777	1.2444	NS
CD (P = 0.05)	0.040	0.034	0.052	0.068	0.090			0.9285	0.8042	1.2283		2.1276	2.4567	

Table 2. Periods of storage, packaging containers and treatments on dry matter production and electrical conductivity in Jatropha seeds

Treatments (T)/ containers (C)		Periods of storage in months (P)									
		Dry matter production (g seedlings^{-10})					Electrical conductivity (dsm^{-1})				
		P_0	P_4	P_8	P_{12}	Mean	P_0	P_4	P_8	P_{12}	Mean
T_1	C_1	2.458	2.151	2.056	1.931	2.151	0.908	1.115	1.356	1.581	1.235
	C_2	2.458	2.201	2.116	2.021	2.202	0.908	0.990	1.085	1.145	1.032
	C_3	2.458	2.215	2.127	2.036	2.210	0.908	0.975	1.065	1.125	1.019
	Mean	**2.458**	**2.189**	**2.100**	**1.996**	**2.188**	**0.908**	**1.027**	**1.169**	**1.283**	**1.095**
T_2	C_1	2.458	2.311	2.215	2.110	2.271	0.908	1.055	1.253	1.345	1.142
	C_2	2.458	2.346	2.237	2.132	2.293	0.908	0.955	0.985	1.035	0.968
	C_3	2.458	2.357	2.242	2.141	2.298	0.908	0.940	0.970	1.025	0.959
	Mean	**2.458**	**2.336**	**2.231**	**2.128**	**2.287**	**0.908**	**0.983**	**1.069**	**1.135**	**1.023**
T_3	C_1	2.458	2.325	2.218	2.128	2.279	0.908	1.035	1.157	1.335	1.118
	C_2	2.458	2.351	2.247	2.147	2.299	0.908	0.945	0.975	1.025	0.961
	C_3	2.458	2.362	2.256	2.252	2.322	0.908	0.940	0.967	1.015	0.955
	Mean	**2.458**	**2.346**	**2.240**	**2.176**	**2.300**	**0.908**	**0.973**	**1.033**	**1.125**	**1.012**
T_4	C_1	2.458	2.344 –	2.256	2.156	2.303	0.908	1.005	1.135	1.255	1.077
	C_2	2.458	2.386	2.291	2.203	2.335	0.908	0.925	0.945	0.971	0.938
	C_3	2.458	2.395	2.301	2.211	2.343	0.908	0.920	0.940	0.965	0.932
	Mean	**2.458**	**2.375**	**2.283**	**2.190**	**2.327**	**0.908**	**0.950**	**1.006**	**1.064**	**0.982**
	C_1	2.458	2.283	2.186	2.082	2.251	0.908	1.053	1.225	1.379	1.143
	C_2	2.458	2.321	2.223	2.126	2.282	0.908	0.954	0.997	1.044	0.974
	C_3	2.458	2.331	2.232	2.160	2.293	0.908	0.944	0.985	1.033	0.966
	Mean	**2.458**	**2.312**	**2.214**	**2.122**		**0.908**	**0.983**	**1.069**	**1.152**	

	T	C	P	TC	CP	TP	TCP	T	C	P	TC	CP	TP	TCP
SEd	0.0036	0.0032	0.0048	0.0064	0.0085	0.0097	NS	0.0033	0.0028	0.0044	0.0057	0.0076	0.0088	0.0152
CD (P = 0.05)	0.0073	0.0063	0.0096	0.0126	0.0167	0.0191		0.0066	0.0057	0.0087	0.0114	0.0150	0.0174	0.0301

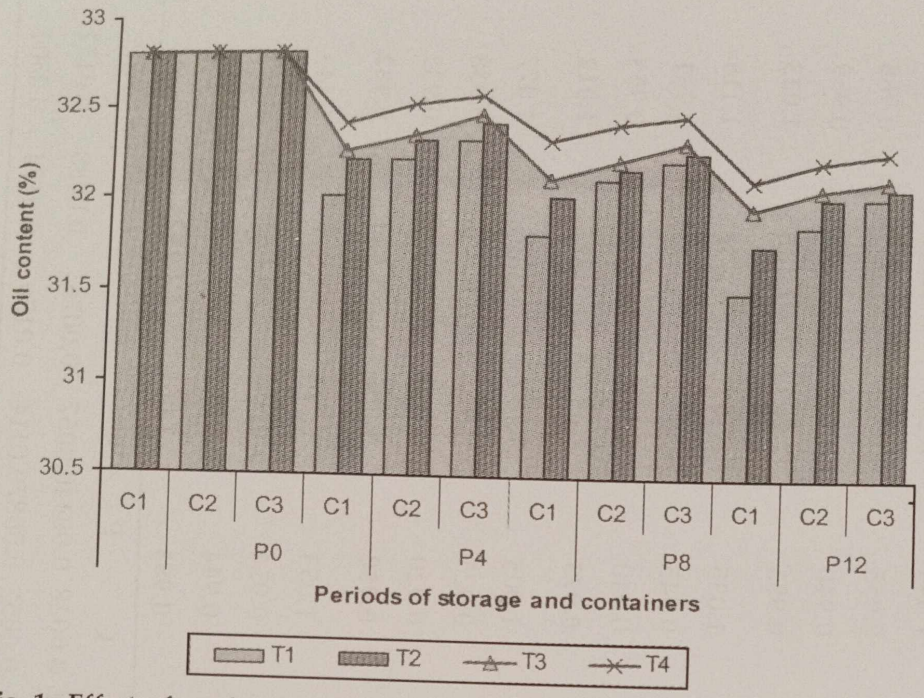

Fig. 1. Effect of seed treatments and containers on oil content in jatropha. P-Periods of storage; C_1-Cloth bag; C_2-Polylined cloth bag; C_3-High density poly ethylene inter woven bag (HDPE); T_1-Control; T_2-Carbendazim @ 2g kg^{-1}; T_3-Halogen mixture @ 3 g kg^{-1}; T_4-Carbendazim + halogen mixture (1+1.5g kg^{-1}, respectively)

activity of this enzyme, decreased from 0.381 to 0.261 with increase in storage period (12 months) (Fig. 2). Thus, it is evident from the study, that the seed treatment and storage containers play an important role in the maintenance of seed viability and vigour during storage. The results revealed that the seeds treated with carbendazim + halogen mixture and stored in High Density Poly Ethylene interwoven bag maintained maximum vigour and viability of seeds in storage and the germinability of these seeds were 67 per cent after 12 months of storage while it was 50 per cent with untreated seeds stored in cloth bag.

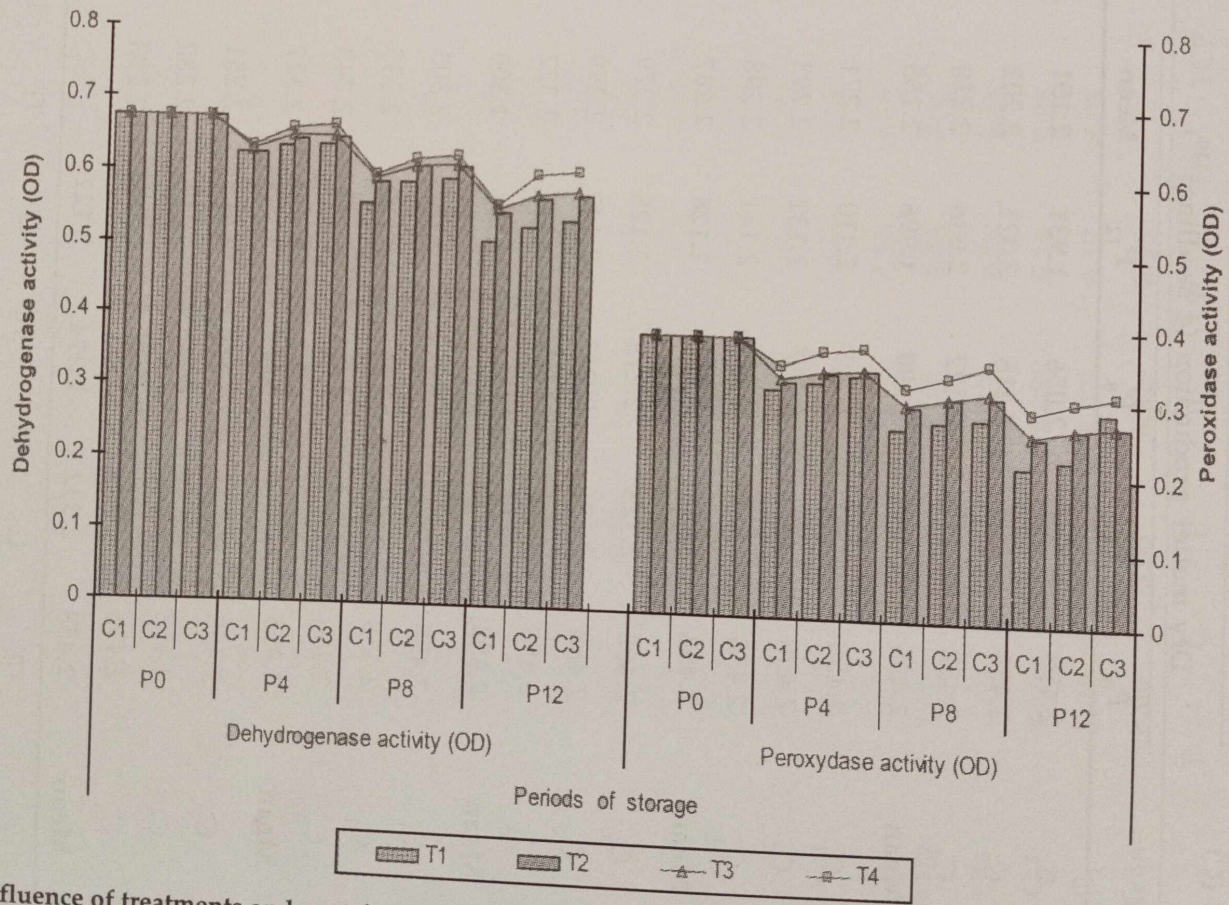

Fig. 2. Influence of treatments and containers on enzyme activities in jatropha seeds. P-Periods of storage; C_1-Cloth bag; C_2-Polylined cloth bag; C_3-High density poly ethylene inter woven bag (HDPE); T_1-Control; T_2-Carbendazim @ 2g kg^{-1}; T_3-Halogen mixture @ 3 g kg^{-1}; T_4-Carbendazim + halogen mixture (1+1.5g kg^{-1}, respectively)

REFERENCES

1. RAVERKAR, K.P., Y. SINGH, A.B. PANDE & S.P. NANI (2003). Tree Based oil seed (TBOS) species in rural development and energy sector: Perspective, scope and strategies National Work shop Jatropha and other perennial oil seed species, pp. 15. BAIF, Development Research Foundation, Warje, Pune 411 0291.

2. ISTA (1999). International Rules for Seed Testing. *Seed Sci. and Technol., Supplement Rules*, **27**: 25-30.

3. AOCS (1945). Rules of the National Cotton Seed Products Association Official Methods. AS-3-38 and Aa **4-38**: 114-119.

4. PRESLEY, J.T. (1958). Relationship of protoplast permeability of cotton seed viability and predisposition of seedling disease. *Pl. Dis. Reptr.*, **42**(7): 582.

5. MALIK, C.P. & M.B. SINGH (1980). In: Plant enzymology and Histo enzymology. Kalyani Publishers, New Delhi, pp. 53.

6. KITTOCK, D.L. & A.G. LAW (1968). Relationship of seedling vigour to respiration and tetrazolium chloride reduction by germinating wheat seeds. *Agron. J.*, **60**: 286-289.

7. GOMEZ, K.A. & A.A. GOMEZ (1984). *Statistical Procedures for Agricultural Research*. John Willey and Sons, New York.

8. SKU, C. & J.C. TARA (1991). Relative influence of different storage containers on germinability of sunflower seeds, stored under ambient conditions. *New Agriculturist*, **1**(2): 129-132.

9. HEYDECKER, W. (1972). Vigour. In: *Viability of seeds* (ed. E.H. Roberts), Chapman and Hall, London, pp. 209-252.

10. BASU, R.N. (1994). An appraisal of research on wet and dry physiological seed treatments and their applicability with special reference to tropical and sub-tropical countries. *Seed Sci. & Technol.*, **22**: 107-126.

11. MATHEWS, S. & W.T. BRADNOCK (1968). Relationship between exudation and field emergence in peas and French beans. *Hort. Res.*, **8**: 89-93.

12. DOIJODE, S.D. (1985). Genetic differences for longevity of seeds in muskmelon. *Prog. Hort.*, **17**(4): 321-324.

13. BALAMURUGAN, P. (1993). Seed production techniques in BSH 1 and quality assessment in parental lines and hybrid of sunflower (*Helianthus annus* L.). Ph.D. Thesis, Tamil Nadu Agricultural University, Coimbatore.

14. ABDUL-BAKI, A.A. & J.D. ANDERSON (1972). Physiological and biochemical deterioration of seeds. In: *Seed biology* (ed. T.T. Kozlowski), Academic Press, New York, pp. 283-315.

15. WOODSTOCK, L.W. (1973). Physiological and Biochemical tests for seed vigour. *Seed Sci. & Technol.*, **1**: 127-157.