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SEED GERMINATION ENHANCEMENT OF *Jatropha curcas* USING HYDRO PRIMING METHOD

Makinde A. I [a]*, Oni O.O[a], Okunade R.F and Oluwafemi M.O[b] Adesina, A.T[a]

[a]Department of Agriculture, Federal College of Agriculture, Ibadan, Nigeria.

[b]Department of Horticulture and Landscape design, Federal College of Agriculture, Akure, Nigeria

Correspondence to:

Aderemi Isaiah Makinde, Department of Agriculture, Federal College of Agriculture, P.M.B. 5029, Ibadan, Nigeria. Email: makindeaderemi30@gmail com, phone: +2348032438757

ABSTRACT

The study was carried to assess effect of hydro priming on the germination rate of *Jatropha curcas*. L. The study was carried out at the Horticultural Garden, Federal College of Agriculture, Moor Plantation Ibadan, Nigeria. The experiment was 2 x 4 factorial experiment in a complete randomized design in four replicates, cracked and uncracked seed were subjected to four different temperatures of distilled water prepared at 0^0C, 25^0C 40ºC and 80ºC. The seeds were socked for 16hrs in 500ml of distilled water. The growth and yield parameters were taken and recorded daily and weekly, while numbers of seedling emergence were recorded daily, seedling length and number of leaves per plant was recorded daily, seedling length and number of leave per plant was recorded weekly. The collected data were analyzed using Analysis of variance (ANOVA) and the significant means were separated using Duncan multiple range test (DMRT) at 5% level of probability. The result showed that scarification and priming temperature did not have significant effect on seedling emergence even though uncracked seeds had higher germination percent at 6, 7, 10 and 11 days after sowing (DAS), However the cracked seed at the peak of germination of *Jatropha* seeds at 12 DAS had higher germination of emerged seedlings than cracked seeds. Similarly seed primed at 25^0C significantly had higher seedling emergence than other priming temperature, while other temperature regimes had similar expression. Hence, cracking of *Jatropha curcas* seeds subjected to 25^0C priming could help to improve the germination of *Jatropha curcas.*

Keywords: emergence; germination enhancement; Jatropha; priming

INTRODUCTION

Jatropha curcas L., a drought tolerant perennial small tree, is autochthonous of Mexico and tropical America, and was then largely spread out in India, Africa and Southeast Asia (Achten *et al.,* 2010). Nowadays, *J. curcas* grows in tropical and subtropical regions in a wide range of climatic conditions from semiarid to humid (Achten *et al.*, 2010). In the last decades, *J. curcas* has become popular thanks to its wide capabilities and plethora of uses, including biodiesel production, which are the cause of an increasing of hectares of *J. curcas* yearly planted at global level (Kant and Wu, 2011). *J. curcas* seeds contain about 25 to 35% or more of oil (Verma and Verma, 2014), which can be extracted and used as lighting and cooking fuel, to manufacture soap medicine or biopesticide and, after further chemical treatments, to produce biodiesel, a renewable energy source alternative to conventional petrodiesel (Sushma, 2014).

Besides the economic value derived from *J. curcas* oil and its derived products, *J. curcas* strength as a crop derives from its potential adaptability to grow on low-nutrient soils and under arid and semi-arid conditions, avoiding *J. curcas* competition against food crops. Furthermore, the plant itself offers the ecological advantage to mitigate soil degradation and to restore marginal land or abandoned farmland (Reubens *et al.,* 2011). Nevertheless, the positive impacts that could be generated by the use of *J. curcas* in arid and semi-arid areas of developing countries, the high potential of this tree has not been reached so far and *J. curcas* is still a (semi-) wild undomesticated plant. Studies on vegetative (cutting) or generative (seed) propagation of *J. curcas*, representing a critical stage in the plant-life cycle, have been carried out so far (Moncaleano-Escandon *et al.*, 2013).

High variability of seed germination has been recorded as influenced by the observed genotype (cultivar, seedling or population), time after harvest and storage conditions, environmental characteristics of plant growing, pre-sowing and after-sowing treatments (temperature and water potential of seed tissues and substrates) (Islam *et al.,* 2009; Pompelli *et al.,* 2010; Windauer *et al.*, 2012; Duong *et al.,* 2013; Moncaleano-Escandon *et al.,* 2013). Some authors report on a loss of seed viability and germinability after medium- and long-term storage (Duong *et al.,* 2013; Moncaleano-Escandon *et al.,* 2013), while others suppose that the presence of seed coat, may be the responsible of a physical dormancy, and furthermore generates the need to remove this inhibition by pre-sowing treatments (Baskin and Baskin, 1998; Islam *et al.,* 2009; Windauer *et al.,* 2012).

In order to enhance germination percentage, seeds have been subjected to pre-germination treatments before sowing, with the aim to break the seed coat, favour the embryo hydration and consequently increase the germination percentage as compared to untreated seeds. Among the studies on the effects of pre-sowing treatments of *J. curcas* seeds on different germination parameters, Islam *et al.* (2009) demonstrated that *J. curcas* seeds, moistened with water for 72 h before sowing, showed a significantly higher germination percentage than the untreated and directly sown control in all the twenty different genotypes tested in the experiment. Windauer *et al*. (2012) tested the effects of different temperatures (from 15 to 35°C) on *J. curcas* seed germination percentage. Consequently, there is a need to further establish better methods of reducing the low seed yield and low germination which are two important factors encountered by researchers.

The objectives of this study were:

- To identify the effect of hydro priming on the germination rate of *Jatropha curcas.* L.
- To access the effect of scarification on the germination rate of *Jatropha curcas*L

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Horticultural Garden, Federal College of Agriculture, Moor Plantation Ibadan, Nigeria which is in the Transitional vegetation zone of Nigeria on Latitude 07^{0} 23^{1}N, Longitude 03^{0} 50^{1}E.

Preparation of the treatments

Four different temperature of distilled water was prepared 0°c, 25°c 40°c and 80°c the seed was socked for 16hrs in 500ml of distilled water. Some of the seed sown were cracked with a stone but was done carefully to keep the embryo intact. Hydropriming was achieved using ten seeds (of similar size) of *Jatropha curcas* which were socked in each of the temperature regime for 16hrs and then air-dried back to the original moisture content.

Planting and cultural practices

Topsoil was sorted after which 5 kg of topsoil was weighed into polythene bags and watering was done till saturation. Ten seeds of Jatropha were sown into each polythene bag and watering was done. Water was added everyday till emergence and subsequently. The polythene bags were kept under the shade and weeding was carried out regularly.

Experimental design

The experiment was 2 by 4 factorial experiment in a Complete Randomized Design in four replicates. It comprises of cracked and uncracked seed subjected to four different temperatures of distilled water prepared at 0^0C, 25^0C 40ºC and 80ºC.

Data collection

- The following growth were taken and recorded daily and weekly.
- Number of seedling emergency was recorded daily
- Number of leave per plant was recorded weekly
- Seedling length was recorded weekly
- Speed of germination SOG was determined by dividing the number of first seedling emergence with day at emergence till final count which were added together to give SOG, according to AOSS (1983)
- Number of seed at final count \ days at final count
- Seedling growth rate (SGR) is the change in plant weighed divided by the period of such change.

Data analysis

The collected data were analyzed using analysis of variance (ANOVA) and the significant means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

Physical and chemical characteristics of the experimental soil.

The result of the physical and chemical characteristics of soil showed that the soil is moderately acidic with a pH of 5.67, available phosphorus and total nitrogen were low with values of 18.97mg/kg and 0.30g/kg respectively (Table 1). The organic carbon was very high with value of 25.9% and the exchangeable cations were high. The textural class of the soil was loamy sand with silt and clay.

Effect of scarification and priming on the seedling emergence of *Jatropha curcas.*

The result showed scarification and priming temperature did not have significant effect on seedling emergence (Table 2). Even though uncracked seeds had higher germination at 6, 7, 10 and 11 DAS, the cracked ones at the onset of seedling emergence at 5 DAS and at the peak of germination at 12DAS had higher emergence. Generally, germination was higher at priming temperature of 25 ^{0}C while lower values were recorded at higher temperature of 40 and 80^{o}C which was contrary to Mwang'Ingo *et al*. (2004) investigation of the effectiveness of various seed pre-sowing treatments in enhancing germination and early seedling growth of Jatropha where complete removal of the seed coat and soaking in hot water enhanced seed germination and promoted early seedling growth.

Effect of scarification and priming temperature on the seedling growth of *Jatropha curcas*

Results in table 3 showed that cracked seeds significantly had thicker stem of (1.96 cm) than the uncracked (1.67 cm). Seedling length and number of leaves per plant were similar with cracked and uncracked seeds. With seed priming, it was observed that 0, 25, 40 and 80^{o}C showed no significant difference on seedling length, stem diameter and number of leaves/plants, indicating that priming temperature did not affect growth of jatropha seedlings even though highest seedling length and leaves values were from plants raised at 80 ^{o}C. Highest number of leaves/plant was also recorded at 80 ^{0}C while highest stem diameter was recorded at 0^{0}C. This result was at variance with the report of Islam *et al.* (2009) who demonstrated that *J. curcas* seeds soaked in water for 35^{0}C was not significantly higher in stem thickness than control due to the rupture of seed coat.

Effect of scarification and priming temperature on the seedling vigor indices of *Jatropha curcas*

From the results obtained, scarification did not significantly affect seedling vigour indices of jatropha even though germination percentage and seedling vigour index of cracked seeds were higher than the uncracked seeds (Table 4). Similarly, priming temperature did not significantly affect all the seedling vigour indices of jatropha but seedling vigour index was highest with priming temperature 80^0C. Meanwhile, germination percentage was significantly highest with the priming temperature of 25^0C. This report was similar to the work of Islam et al. (2009) who demonstrated that *J. curcas* seeds, soaked in water for at 25^0C before sowing, showed a non-significant but had higher germination percentage than the untreated and directly sown control in all the twenty different genotypes tested in the experiment.

Table 1: Physical and chemical properties of soil

Parameters	**Soil Test Value**
pH	5.67
Organic C (g/kg)	25.9
Total N (g/kg)	0.30
Avail. P (mg/kg)	18.97
Exchangeable cations (mol/kg)	
Ca	1.63
Mg	2.00
K	0.35
Na	1.02
Particle size distribution (g/kg)	
Sand	816
Silt	116

Clay	68
Textural class (USDA)	Loamy sand

Table 2: Effect of scarification and priming temperature ranges on the seedling emergence of *Jatropha curcas.*

Treatments	5	6	7	8	9	10	11	12
	Days after sowing, (DAS)							
Scarification(S)								
Cracked	1.25	1.63	1.69	1.69	1.69	1.63	1.56	1.56
Uncracked	0.88	1.69	1.88	1.69	1.69	1.69	1.69	1.50
	Ns	ns	Ns	ns	ns	ns	ns	ns
Priming(P) Temperature range (^{0}C)								
0	0.50	1.50	1.63	1.63	1.63	1.50	1.50	1.13
25	1.75	2.38	2.38	2.38	2.38	2.38	2.38	2.38
40	1.00	1.63	1.75	1.38	1.38	1.38	1.38	1.38
80	1.00	1.13	1.38	1.38	1.38	1.38	1.25	1.25
	Ns	ns	Ns	ns	ns	ns	ns	ns
S*P	Ns	ns	Ns	ns	ns	ns	ns	ns

ns – not significant

Table 3: **Effect of scarification and priming temperature range on the seedling growth of *Jatropha curcas* at 12 DAS**

Treatments	**Seedling length(cm)**	**Stem diameter(cm)**	**No. of leaves/plant**
Scarification (S)			
Cracked	12.94	1.96a	3.04
Uncracked	11.66	1.67b	2.57
	Ns		ns
Priming(P)			
Temperature range (^{0}C)			
0	11.71	1.90	2.53
25	12.56	1.84	2.94
40	11.54	1.85	2.59
80	13.38	1.69	3.18
	Ns		
S*P	Ns	ns	ns

DAS- days after sowing ns- not significant.

Means with same letter (s) in a column are not significantly different at 5% level of probability according to Duncan multiple range test.

Table 4: Effect of scarification and priming temperature on the seedling vigor indices of *Jatropha curcas* at 12 DAS

Treatments	Germination percentage	Seedling vigour index	Speed of germination
Scarification(S)			
Cracked	15.63	307.44	2.13
Uncracked	15.00	249.81	2.34
	Ns	ns	ns
Priming (P) Temperature range(^{0}C)			
0	11.25b	209.13	2.13
25	23.75a	329.00	2.74
40	13.75b	217.25	1.88
80	12.50b	359.13	2.18
		ns	ns
S*P	Ns	ns	ns

DAS- days after sowing ns- not significant.

CONCLUSION AND RECOMMENDATION

Conclusion

The result obtained in this study showed that pre-germination treatments significantly enhanced the germination process of *Jatropha curcas* seeds. As the seeds coat of *Jatropha curcas* is hard, it takes more time to germinate well, therefore, with effective pre-sowing treatment, germination can be enhanced using scarification (seed cracking) and priming temperature of 25^{0}C.

Recommendation

Since cracking of the hard seed coat of jatropha significantly improve germination with comparable results with room temperature of 25^{0}C. Therefore, seed cracking can be a way of improving the germination of jatropha, subject to further trials.

REFERENCES

Achten W.J.M., Nielsen L.R,, Aerts R., Lengkeek A.G., Kjær E.D., Trabucco A., Hansen J.K., Maes W.H., Graudal L., Akinnifesi F.K.and Muys B. (2010). Towards domestication of Jatropha curcas. *Biofuels* 1:91-107.

Baskin C.C, Baskin J.M (1998). Seeds: ecology, biogeography, and evolution of dormancy and germination. Academic Press, San Diego, California, USA

Duong T.H, Shen J.L, Luangviriyasaeng V, Ha H.Vand Pinyopusarerk K (2013). Storage behaviour of Jatropha curcas seeds. *Trop. For. Sci*. 22:193-199

Islam AKMA, Anuar N, Yaakob Z. (2009). Effect of genotypes and pre-sowing treatments on seed germination behaviour of Jatropha. *Asian Jatropha Plant Science*. 8(6):433-439.

Kant, P., and Wu, S. (2011). The extraordinary collapse of Jatropha as a global biofuel. *Environ. Sci. Technol*. 45:7114-7115

Moncaleano-Escandon, J., Silva, B.C.F., Silva, S.R.S., Granja, J.A.A., Alves, M.C.J.L.and Pompelli, M.F. (2013). Germination responses of Jatropha curcas L. seeds to storage and aging. *Ind. Crops Prod*. 44:684-690.

Mwang'Ingo, P.L., Z. Teklehaimanot, S.M. Maliondo and H.P. Msanga, (2004). Storage and pre-sowing treatment of recalcitrant seeds of Africa sandalwood (*Osyris lanceolata*). *Seed Science and. Technology*, 32: 547-560.

Pompelli, M.F., Barata-Luis, R., Vitorino, H.S., Goncalves, E.R., Rolim, E.V., Santos, M.G., Almeida-Cortez, J.S., Ferreira, V.M., Lemos, E.E. and Endres, S. (2010). Photosynthesis, photoprotection and antioxidant activity of purging nut under drought deficit and recovery. *Biomass and Bioenergy*. 34, 1207-1215.

Reubens, B., Achten, W.M.J, Maes, W.H., Danjon, F., Aerts, R., Poesen, J., Muys, B. (2011). More than biofuel? Jatropha curcas root system symmetry and potential for soil erosion control. *J. Arid Enviroment*. 75:201-205

Sushma, B. (2014). Analysis of oil content of Jatropha curcas seeds under storage conditions. *J. Enviromental Biology,* 35:571-575.

Verma, K.C., Verma S.K. (2014). Biophysicochemical evaluation of wild hilly biotypes of Jatropha curcas for biodiesel production and micropropagation study of elite plant parts. *Applied Biochemistry Biotechnology* 175(1):549-59.

Windauer LB, Martinez J, Rapoport D, Wassner D, Benech-Arnold R (2012). Germination responses to temperature and water potential in Jatropha curcas seeds: a hydrotime model explains the difference between dormancy expression and dormancy induction at different incubation temperatures. *Anatomy of Bottny* 109:265-273