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Determination of Phenology, Seed Germination and Development of *Hura crepitans* using Chemical Scarifications

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Abstract: The phenology, seed germination, seedling development and evaluation were carried out on the seeds of *Hura cepitans.* The phenological data describes *Hura crepitans* seeds as 0.94 g in weight, 2.3x2.2x.48 cm in size; 3.6 cm^3 mean volume, of 78% moisture level. The capsule of length 8 cm contains 7-16 seeds. The seeds are circular in shape, smooth, glabrous and glossy in texture with a capsule depth of 2.5 cm and a brownish testa. The plant flowers and fruits from the end of October to the end of June. To break dormancy, investigations on the stimulatory effect of chemical scarifications were analyzed. Methanol pre-treatment recorded the highest of 70% germination. Comparatively, some of the pretreatments showed better germination energy and vigour than the control. Such pretreatments are good for germination and nursery establishment of the species.

Key words: *Hura crepitans,* phenology, seed germination, seedling development, chemical scarification

INTRODUCTION

Germination studies are fundamental to any plant multiplication scheme. Moreso where such plant does not do well by vegetative propagation methods (Eze and Orole, 1987). Such studies are primanty carried out to obtain information on the field, planting value of seeds and comparable values for different seed lots (ISTA, 1996) *Hura orepitans* (sand box) is of the family Euphorbiaceae. It produces purple flowers (spike) and fruits are large, flattened and fluted making it distinct. The mature tree grows up to 16 m high with a wide spreading crown branching down (Keay, 1989).

Seed germination and development cannot be isolated from the process of dormancy as it is a crucial factor determining the survival and hence continuity of any seed bearing plant species. The process itself is influenced by the parents and embryo in relation to the prevailing environmental conditions. Simpson (1990) and Hendrick and Taylorson (1972) reported that treating seeds with chemicals, which are not growth regulators could promote metabolic activity and induce germination.

Crocker (1906) first reported the use of acid to weaken the seed coat of hard seeds to improve the seed coat permeability to water (Crocker and Davies, 1914; Idu and Omonhinmin, 2000, 2001; Idu and Omoruyi, 2002; Idu *et al*., 2002). In the present study, phenological, observations, seed germination, seedling development and evaluation were carried out on the seeds of *Hura crepitans.*

MATERIALS AND METHODS

Seed source: Seeds of *Hura crepitans* for this study were collected from Benin City, Edo State, Nigeria during the month of March 2004. Ripe pods were collected and seeds were stored at ambient temperature in kilner jars, before commencement of study in April 2004.

Seed test: Seed germination tests were carried out, following the techniques outlined by Idu and Omonhinmin (2000, 2001).

Seed were surface sterilized with 0.1% mercuric chloride solution for 1 min and rinsed thereafter with several charges of distilled water. Seeds were soaked afterward in solutions of concentrated sulphuric acid, hydrochloride acid, nitric acid, boric acid, acetic acid as well as ethanol, benzene, xylene, methanol for 5, 15 and 25 min, respectively.

The treated seeds were washed thoroughly after the various time lapses. Set of ten seeds with five replicates per treatment was allowed, to imbibe water on Whatman No. 1 filter papers, saturated with distilled water in 9 cm diameter Petri-dishes at room temperature (28°C). A set of

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untreated seeds served as control. The experimental setup was placed under continuous florescent light at bench level.

Emergence of 2 mm of the radicle was used as criterion of germination. Results were grouped into vigour categories based on speed of germination, germination energy (Maguire, 1962), vigour index (Abdul-Baki and Anderson, 1973), germination value (Czabator, 1962) abnormal seedlings (Idu and Ogidiolu, 2002), high vigour and low vigour (Idu and Omonhinmin, 2001).

Comparison of treatment mean height was performed using the Least Significant Difference (LSD) multiple range test. Standard Error and critical difference at 5% were statistically evaluated for the various germination parameters.

RESULTS AND DISCUSSION

The phenology, seed germination, seedling development and evaluation were carried out on the seeds of *Hura cepitans*. The phenological data (Table 1) describes *Hura crepitans* seeds as 0.94 g in weight, 2.3×2.2×48 cm in size; 3.6 cm^3 mean volume, of 78% moisture level. The capsule of length 8 cm contains 7-16 seeds. The seeds are circular in shape, smooth glabrous and glossy in texture with a capsule depth of 2.5 cm and a brownish testa. The plant flowers and fruits from the end of October to the end of June. High cumulative germination of germinated seeds 85% for 25 min, 60% for 5 min treatments were recorded for Boric acid and Hydrochloric acid, respectively. Germination energy of 75% was recorded for 5 min (Boric acid) (Table 2).

Seed treated with sulphuric acid and acetic acid recorded low germination percentages and energies. Nitric acid recorded 0% germination. Germination speed of 8.37 for boric acid (15 min) and 6.27 for hydrochloric acid (25 min) were quite high for both. The highest vigour index was recorded for sulphuric acid (Table 3). Idu (1994) recorded 60% germination for *Bixa orellana* seed treated with 36% hydrochloric acid for 5 min. Further, research by Idu and Omonhinmin (2001) reported 62% germination for *Tamarindus indica* using acid under continous light condition.

Seed coat dormancy eliminated by acid scarification is linked to the corrosive removal of the waxy seed coat thereby directly increasing the water uptake of the seeds, permeability to gases and change in sensitivity to light or temperature and/or probably of inhibitors (Noel and Van Stalen, 1976).

Benzene and methanol recorded high cumulative percentage germination of 65% (15 min) for benzene and

Table 1: Phenological data of Hura crepitans

A	B	C	D	E	F	G	H	I	J	K	L	M
Beginning and end of rainy season	December to June	8	7-16	18-21	0.94	2.3×2.2×0.48	3.6	78	Brown	Circular	Smooth glabrous and glossy	2.5

Flowering period = A: Fruiting period = B: Capsule length (cm) = C: No. of seed per capsule = D: Seed length (mm) X±SE = E: Mean wt. of one seed (g) = F: Seed size (cm) = G: Mean vol. of one seed cm^3 = H: Moisture level of one seed (%) = I: Seed colour = J: Seed shape = K: Seed texture = L: Capsule depth (cm) = M

Table 2: Percentage germination and germination energy

	Germination (%)				Germination energy (%)				High vigour				Low vigour			
Pretreatment (min)	Boric acid	H_2SO_4	HCl	Acetic acid	Boric acid	H_2SO_4	HCl	Acetic acid	Boric acid	H_2SO_4	HCl	Acetic acid	Boric acid	H_2SO_4	HCl	Acetic acid
5	75	40	60	10	75	15	40	10	22	17	30	5	15	20	30	5
15	75	10	35	5	30	10	25	5	15	0	2	0	15	5	17	2
25	85	5	5	5	60	5	15	5	12	0	0	0	30	2	5	2
Control	30				20				10				27			
SE±	3.33	10.93	15.89	1.67	13.23	2.89	10.40	01.67	2.96	5.67	9.68	1.67	5.0	5.57	7.22	1.00
CV (%)	7	103.00	83.00	43.00	42.00	50.00	60.00	43.00	31.00	173.00	157.00	173.00	43.00	107.00	72.00	58.00
CD at 5%	9.24	30.30	44.07	74.62	36.67	8.00	28.85	04.63	9.13	17.47	29.85	5.14	15.14	17.17	22.26	3.08

Table 3: Germination speed, seed vigour and abnormal seedling percentage

	Speed of germination				Vigour index				Germination value				Abnormal seedling (%)			
Pretreatment (min)	Boric acid	H_2SO_4	HCl	Acetic acid	Boric acid	H_2SO_4	HCl	Acetic acid	Boric acid	H_2SO_4	HCl	Acetic acid	Boric acid	H_2SO_4	HCl	Acetic acid
5	3.65	3.52	6.50	0.50	1267.50	1420.30	1147.80	180.00	25.55	10.56	35.00	1.00	0.00	42.86	0.00	0.00
15	8.37	0.50	5.83	0.25	0937.50	97.50	420.00	55.00	50.22	1.00	29.15	0.25	20.00	0.00	42.86	0.00
25	6.27	0.25	0.33	0.25	1329.40	50.50	44.00	50.00	50.16	0.25	0.33	0.25	64.71	0.00	00.00	0.00
Control	6.5				16200.00				26				057.14			
SE±	1.37	1.05	1.95	1.58	121.64	448.97	323.98	42.52	8.21	3.32	10.70	0.25	19.13	14.28	14.28	0.00
CV (%)	39.00	128.00	80.00	150.00	18.00	149.00	104.00	78.00	34.00	146.00	86.00	87.00	117.00	173.00	173.00	0.00
CD at 5%	3.78	2.92	05.41	4.39	337.16	1244.48	898.05	117.87	22.78	9.19	29.69	0.69	53.02	39.61	39.61	0.00

Table 4: Percentage germination and germination energy

Pretreatment	Germination (%)		Germination energy (%)		High vigour		Low vigour	
(min)	Benzene	Methanol	Benzene	Methanol	Benzene	Methanol	Benzene	Methanol
5	55	70	15	50	15	20	12	15
15	65	55	40	45	12	10	20	17
25	35	20	20	10	07	02	10	07
Control	80		20		10		27	
Nicking	35		35		0		17	
SE±	8.82	14.81	7.64	12.58	2.33	5.21	3.06	3.06
CV (%)	30.00	658.30	53.00	62.00	36.00	85.00	38.0	41.00
CD at 5%	27.19	045.67	23.54	38.80	8.09	18.04	10.59	10.59

Table 5: Germination speed, germination vigour and percentage abnormal seedling

Pretreatment	Speed of germination		Vigour index		Germination value		Abnormal seedling (%)	
(min)	Benzene	Methanol	Benzene	Methanol	Benzene	Methanol	Benzene	Methanol
5	5.28	8.83	1055.45	1477	15.84	44.15	36.36	7.14
15	4.90	5.50	1162.20	1012	29.4	33.00	23.08	9.09
25	1.62	2.83	630.00	322.6	3.24	05.66	14.29	0.00
Control	6.50		1620.00		26.00		57.14	
Nicking	3.17		0390.95		9.51		57.14	
SE±	1.16	1.74	162.56	335.34	7.55	11.43	6.42	2.76
CV (%)	51.00	53.00	30.00	62.00	81.00	72.00	45.00	88.00
CD at 5%	3.38	5.07	473.57	976.93	22.00	33.31	18.68	8.06

Table 6: Ranked mean of alcohol pretreatment

Pre-treatment (Acid)*	Ranked mean*	LSD (H)+mean*	Pre-treatment (Alcohol)**	Ranked mean**	LSD(H)+mean**
HCl 25 min	8.8a	11.88	Control	12.25a	15.67
H_2SO_4 15 min	9.75ab	12.83	Methanol 25 min	16.13b	19.55
Acetic acid 25 min	10b	13.08	Benzene 15 min	17.88b	21.30
H_2SO_4 25 min	10.1b	13.18	Benzene 25 min	18bc	21.42
Acetic 15 min	11bc	14.08	Methanol 15 min	18.4bc	21.82
HCl 15 min	12c	15.08	Benzene 5 min	19.19d	22.61
Control	12.25c	15.33	Methanol 5 min	21.13e	-
Boric acid 15 min	12.5c	15.58			
Boric acid 25 min	15.64d	18.72			
Boric acid 5 min	16.3d	19.38			
Acetic acid 5 min	18e	21.08			
HCl 5 min	19.13e	22.21			
H_2SO_4 5 min	20.29f	----			

*F = Ratio = 4.49, **F = Ratio = 1.81, Mean followed by the same letter(s) are not significantly different at 5% (LSD)

Table 7: Ranked mean of hormone pretreatments

Pre-treatment (Coumarin)*	Ranked mean*	LSD (H) +mean*	Pre-treatment (Thiourea)**	Ranked mean**	LSD (H) +mean**	Pre-treatment (GA_3)***	Ranked mean***	LSD (H) +mean**
Control	12.25a	17.15	Control	12.25a	15.31	Control	12.25a	14.97
10 mg L^{-1} 5 min	14.03a	18.93	0.1 mg L^{-1} 5 min	14.89ab	17.95	0.001 mg L^{-1} 5 min	12.83a	15.55
0.01 mg L^{-1} 5 min	14.3a	19.20	0.1 mg L^{-1} 15 min	15.48c	18.54	0.1 mg L^{-1} 25 min	14.28b	17.00
0.1 mg L^{-1} 25 min	16.68ab	21.58	0.01 mg L^{-1} 5 min	15.56c	18.62	10 mg L^{-1} 5 min	14.72b	17.64
1 mg L^{-1} 15 min	17.87ab	22.77	10 mg L^{-1} 5 min	16.40c	19.46	10 mg L^{-1} 25 min	16.46c	19.18
10 mg L^{-1} 15 min	18.1b	23.09	0.001 mg L^{-1} 25 min	16/75c	19.81	0.001 mg L^{-1} 15 min	16.70c	19.42
0.01 mg L^{-1} 15 min	18.2b	23.10	1 mg L^{-1} 25 min	17.44d	20.50	0.01 mg L^{-1} 25 min	16.97	19.69
10 mg L^{-1} 25 min	18.33b	23.23	1 mg L^{-1} 15 min	17.53d	20.59	0.01 mg L^{-1} 15 min	17.00d	19.72
1 mg L^{-1} 25 min	19.25c	23.55	10 mg L^{-1} 15 min	17.55d	20.61	0.001 mg L^{-1} 25 min	17.37d	20.09
1 mg L^{-1} 5 min	19.60c	24.50	10 mg L^{-1} 25 min	17.75d	20.81	10 mg L^{-1} 15 min	17.79d	20.51
0.00/ mg L^{-1} 5 min	19.88c	24.78	0.001 mg L^{-1} 15 min	17.96d	21.02	0.1 mg L^{-1} 15 min	17.96d	20.68
0.1 mg L^{-1} 5 min	19.88c	24.78	1 mg L^{-1} 5 min	18.32e	21.38	0.01 mg L^{-1} 5 min	18.34de	21.06
0.001 mg L^{-1} 15 min	20.23d	--	0.01 mg L^{-1} 25 min	18.70e	21.76	1 mg L^{-1} 15 min	18.50de	21.22
0.001 mg L^{-1} 25 min	20.53d	--	0.1 mg L^{-1} 25 min	20.54f	23.60	1 mg L^{-1} 25 min	19.50e	--
0.01 mg L^{-1} 25 min	20.74d	--	0.01 mg L^{-1} 5 min	21.02f	24.08	1 mg L^{-1} 5 min	19.97e	--
0.1 mg L^{-1} 15 min	20.89d	--	0.001 mg L^{-1} 5 min	23.00f	--	0.1 mg L^{-1} 5 min	20.05e	

*F = Ratio = 0.73, **F = Ratio = 3.33, ***F = Ratio = 2.71, Mean followed by the same letter(s) are not significantly different at 5% (LSD)

70% (5 min) for methanol (Table 4). Higher germination vigour (8.83) at 5 min treatment was recorded for methanol. Similarly, higher vigour index was recorded for methanol pretreatment (Table 5).

Ethanol and xylene showed 0% germination. The stimulatory role of alcohol solvents on seeds might be due to the interaction with cellular membrane of the seeds or the chemical erosion of the outer waxy layer of the seed

coat (Taylorson, 1982). Hence alcohol solvent though less corrosive than acids, showed good abrasive properties.

Boric acid pretreatment (25 min) recorded high percentage of abnormal seedling, an index of poor establishment in the nursery of boric acid pretreated seedlings. Alcohol pre-treatments were not significantly different. However, those of the acid scarification were significant (Table 5).

Analysis of variance for a complete randomized design was carried out on the height data for seedlings raised from various acid, alcohol and hormonal pre-treated seeds, to test for the effect of the pre-treatments. The acid and alcohol were associated with an F-ratio of 4.49 and 1.81, respectively, while the hormone pre-treatments of coumarin had 0.73, 3.33 and 2.71, respectively, suggesting treatments difference at 5% level of significance for acid, thiourea and GA_3. Comparison of mean heights, performed using the Least Significance Difference (LSD) multiple range test (Table 6 and 7), showed that sulphuric acid and methanol treated seeds for 5 min and those treated with coumarin at 0.001 mg L^{-1} for 15 min 0.001 mg L^{-1} for 25 min and 0.01 mg L^{-1} for 25 min 0.1 mg L^{-1} for 15 min, thiourea at 0.001 mg L^{-1} for 5 min and GA_3 at 1 mg for 25 min 1 mg L^{-1} for 5 min and 0.1 mg L^{-1} for 5 min produced seedlings of higher vigour than other pre-treatments in their category.

CONCLUSIONS

Conclusively, scarification with methanol is promising. Its use in seed germination and seedling development of *H. crepitans* especially at a tolerable timing of 5 min would be ideal.

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