Journal of Agriculture and Environment Vol. 7 No. 2, Dec. 2011: 171-181
ISSN 1595465X

INFLUENCE OF PRE-GERMINATION TREATMENTS AND SEED SOURCE ON GERMINATION AND EARLY GROWTH OF *Dialium guineense* (Willd)

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ABSTRACT

The study aimed at identifying the best pre-germination treatment that would produce fast and more uniform germination of *Dialium guineense* seeds obtained from different sources. Seeds obtained from Benin, Awka and Ore in Southern Nigeria were subjected to different pre-germination treatments, namely: Sulphuric acid for 10 minutes, soaking in hot water at 100 °C until it cooled, overnight soaking in tepid water and control (untreated). The results revealed that seeds treated with sulphuric acid produced the highest germination rates of 82, 68 and 52% for seeds from Benin, Awka and Ore, respectively, while hot water treatment produced 15, 20 and 28% germination in same order. Overnight soaking in tepid water gave 15, 16 and 17% germination while control (untreated) gave 13, 12 and 10% for seeds from Benin, Awka and Ore, respectively. Seeds treated with sulphuric acid had mean seedling height of 12.30cm, 12.66cm and 12.00cm with mean collar diameter of 1.10cm, 0.91cm and 1.15cm and leaf number of 7, 7 and 7 for Benin, Awka and Ore respectively. Seeds treated with hot water produced mean seedling height value of 11.20cm, 10.90cm and 11.50cm with mean collar diameters of 0.87cm, 0.95cm, 0.94cm. Mean leaf numbers were 4, 6, and 6 for Benin, Awka and Ore seeds, respectively. Seeds soaked in water overnight had mean seedling heights of 11.80cm, 11.10cm and 11.80cm; collar diameter of 0.91cm, 0.95cn and 0.99cm; leaf number of 5, 7 and 6 for seeds from Benin, Awka and Ore, respectively. Control treatment had mean seedling heights of 9.30cm, 10cm and 10.06cm; collar diameter of 0.93cm, 0.90cm, and 0.95cm; leaf number of 5, 5, and 6 for Benin, Awka and Ore seeds, respectively. Source did not significantly affect the germination potential of the seeds but early growth responses significantly varied with source and treatments. Sulphuric acid has been recommended for large scale planters of *Dialium guineense* while hot water and overnight soaking in tepid water have been recommended for small scale planters. Further researches are needed in the area of early growth rate improvement of the species.

Key words: *Dialium guineense*; Pre-germination; Growth; Sulphuric acid.

INTRODUCTION

Nigeria is blessed with many indigenous fruit trees that form the base for rural livelihood enhancement. Majority of these are still being exploited from the wild with very few in plantations. Forest is fast disappearing, there is need to encourage domestication of existing gene resources so that people would continue to have the benefits of forest trees. Seed is an indispensable means of regeneration. Some of the forest fruit tree seeds are recalcitrant; others have seed coat dormancy (Aghatise and Egharevba, 1994) while others are faced with pest and disease problems which hinder their early and uniform germination, proper growth and silvicultural responses necessary for plantation establishment.

Dialium guineense (Willd) is a commonly consumed fruit tree species of Southern Nigeria in need of research towards domestication and conservation. The plant has not been fully integrated into the domestication programme because the species has seed dormancy problem and very slow early growth rate. Ways of breaking the dormancy problem is the focus of this investigation.

This tree is commonly known as the black velvet tamarind, belonging to the family of *Caesalpiniaceac*. It grows with a densely leafy crown but often shrubby and the bole is without buttresses. Its description is as given by Keay (1989). It is found in the rain forest zone and transition zones bordering the savanna. The more or less circular and flattened velvet black fruits are found between February – April. They are much consumed, being a good source of Vitamin C and the pulp can be processed into refreshing drink (Egharevba, 2008). During fruiting season, rural women engage in the harvesting and sale of its fruits, improving their economic power. It is a good agro-forestry species.

MATERIALS AND METHODS

The experiment was carried out at the Department of Forestry and Wildlife arboretum in the University of Benin, Benin City, Edo State of Nigeria. The GPS location of the arboretum is Latitude $5°37^{1}$N and Longitude $6° 24^{1}$E and on an altitude of 134m.

The vegetation of Benin City area is that of tropical lowland and rainforest, and the climatic condition has bimodal rainfall pattern with long and sometimes short period of uncertain rainfall and an annual mean of about 2300mm. The mean temperature is about 25.1°C (Egharevba *et al*., 2005).

Clean seeds were obtained from fresh fruits harvested from selected phenotypically superior mother trees in Awka, Benin City and Ore in Southern Nigeria. One hundred seeds were used for each treatment and source, each seed was sown into a medium sized polythene pot containing 1.2kg sieved top soil as the growing medium. The treatments were: soaking in concentrated sulphuric acid for 10 minutes, soaking in hot water at 100°C until water cools down, overnight soaking in tepid water and control (untreated). Each treatment was replicated four times. Sown seeds were given routine watering and weeding. The number of seeds germinating per treatment and source were recorded weekly and percentage germination was calculated. Growth parameters measured were seedling height, leaf number and collar diameter at the sixth week after sowing in order to allow germination commence at all treatments and sources. Growth measurements continued until the twenty-second week.

The Experiment was laid in the nursery in a Randomized Complete Block Design (RCBD), comprising four replications per treatment and treatment means of growth

parameters were compared using least significance difference at 0.05 probability level (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

All the pre-germination treatments gave different effects on the germination and early growth of *Dialium guineense* seeds. Concentrated sulphuric acid gave the best germination results irrespective of seed source. Germination started within two weeks and extended up to 14 weeks irrespective of treatment and source. The first six weeks was the most active germination time (Fig.1) for all the treatments and sources, after which there was decline to very scanty, irregular weekly values. Sulphuric acid was significantly different from all other treatments (Table 1) irrespective of source but the extent of difference between treatments due to source varied (Figs. 2, 3 and 4). Emergence and peak period of germination (time of maximum number of seed germination) was two weeks for Sulphuric acid and the high values obtained in the following four weeks culminated into the resultant lead recorded relative to other treatments.

Sulphuric acid attained 82, 68 and 52% germination in seeds from Benin city, Awka and Ore respectively. Somade and Obiaga (1992) reported high percentage germination of 63% for *Terminalia superba* when treated with 80% solution of concentrated Sulphuric acid for one hour.Seeds treated with hot water ranked second in performance. Germination percentage were 28, 20 and 15 for seeds from Ore, Awka and Benin-city respectively. Peak period of germination being attained at 6^{th}, 2^{nd} and 5^{th} week for Benin-city, Awka and Ore seeds, respectively. This relatively longer time to attain peak germination compared to Sulphuric acid is probably due to the effect of hot water on the embryo by initially slowing down the germinative enzymes and processes .Truong and Hans (2007) reported that high temperatures may affect either the initial process of water uptake by seed or biological processes that result in cell division. Temperatures between 60°C and 80°C were however reported by Aghatise and Egharevha (1994) to be effective in leguminous species.

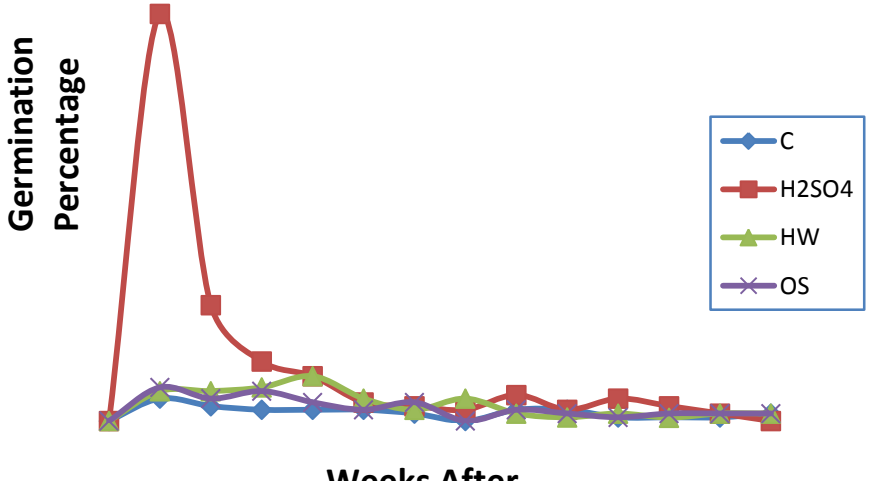

Fig 1: Mean Germination percentage of *Dialium guineense* seeds under various treatments

Table 1: Weekly germination percentage of *Dialium guineense* seeds in relation to treatment.

Trt	XTrt*	WAS (Weeks After Sowing)						
		1	2	3	4	5	6	7
C	0.76^{b}	0	2	1.33	1	1	1	0.67
H_2SO_4	4.81^{a}	0	36.33	10.33	5.33	4	1.67	1.33
HW	0.48^{b}	0	2.67	2.67	3	4	2	1
OS	1.14^{b}	0	3	2	2.67	1.67	1	1.67
	XWAS **	0^{e}	11^{a}	4.08^{b}	3^{cb}	2.67^{bcd}	1.42^{cde}	1.17^{cde}
	XTrt*	WAS (Weeks After Sowing)						
		8	9	10	11	12	13	14
C	0.76^{b}	0	1	1	0.33	0.33	0.33	0.67
H_2SO_4	4.81^{a}	1	2.33	1	2	1.33	0.67	0
HW	0.48^{b}	2	0.67	0.33	0.67	0.3	0.67	0.67
OS	1.14^{b}	0	1	0.67	0.33	0.67	0.67	0.67
	XWAS **	0.75^{cde}	1.25^{cde}	0.75^{cde}	0.83^{cde}	0.67^{cde}	0.58^{cde}	0.5^{cde}

NB: Means with same letters are not significantly different (P>0.05)
*- Vertical comparism only; ** - Horizontal comparism only

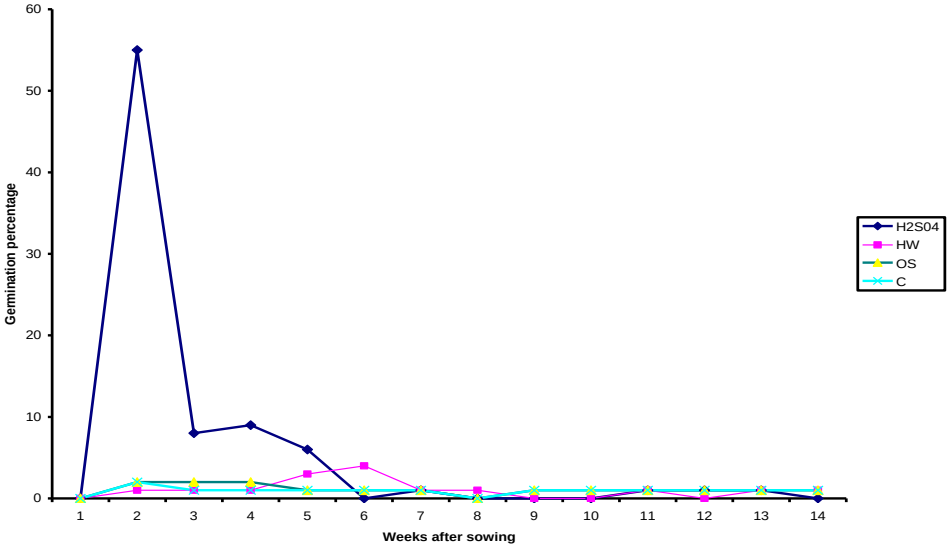

Fig. 2: Weekly germination percentage of *Dialium giuneense* seeds from Benin-city source

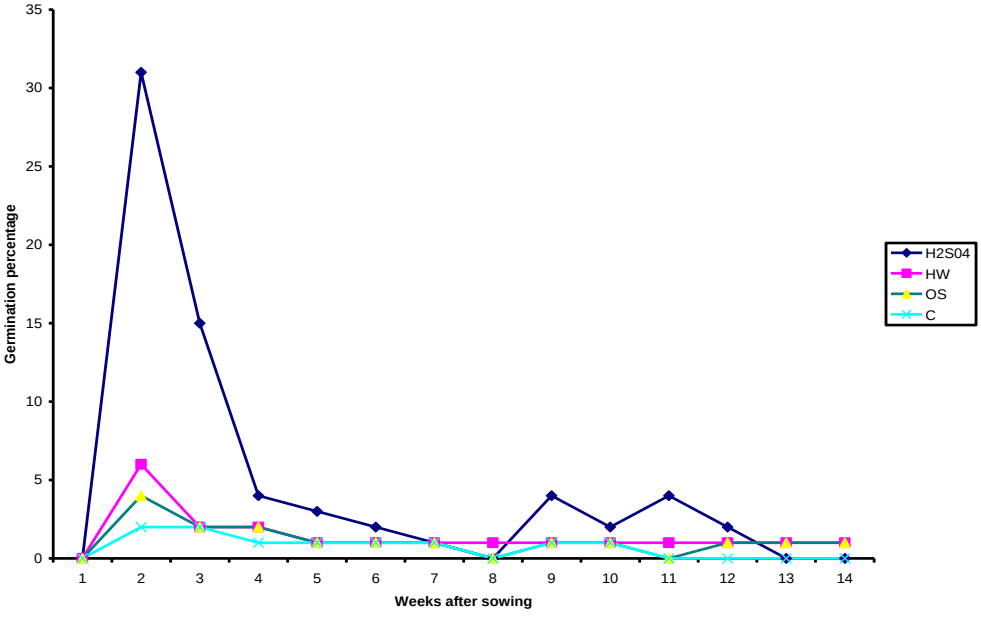

Fig. 3: Weekly germination percentage of *Dialium giuneense* seeds from Awka source

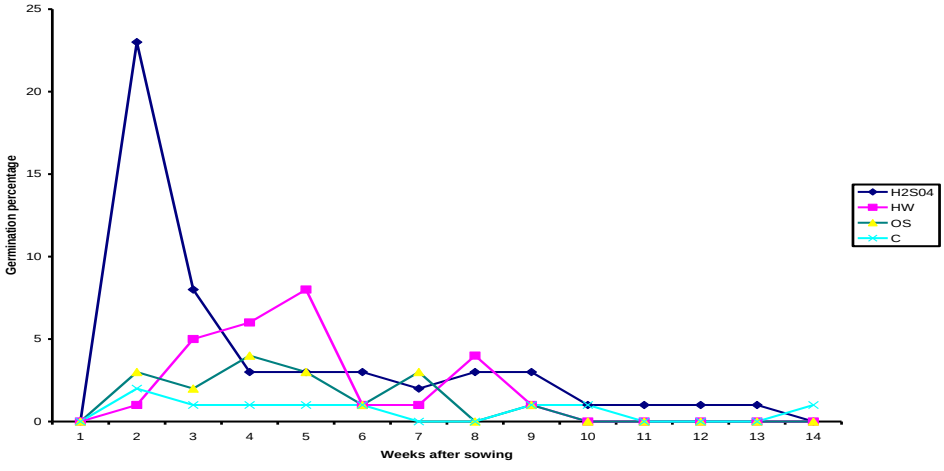

Fig. 4: Weekly germination percentage of *Dialium giuneense* seeds from Ore source

Overnight soaking in tepid water was third. Percentage germination values were 17, 16 and 15 for Ore, Awka and Benin City respectively. Peak period of germination was in the 2nd week for both Benin City and Ore, but 4th week for Ore. Robertson and Small (1977) were of the view that soaking seeds in water may reduce germination through oxygen deficiency.

Control (untreated) was the last in performance. Seeds attained emergence and peak germination in the 2nd week irrespective of seed source. Germination percentages were 13, 12 and 10 for Benin City, Awka and Ore respectively. Overall weekly germination percentage values did not show any significant difference with seed source (Table 2).

Van Howerbeke and Comer (1985) working on the effect of treatment and seed source on Eastern red cedar seeds in USA found that seeds treated with acid germinated nearly three times faster than seeds of other treatments, but source did not give significant difference. Similarly, Badejo *et al*. (2010) working on early growth of *Jatropha carcus* in Nigeria observed numerical but not statistically different germination percentages of 62, 58 and 56 with seeds from Rivers, Delta and Imo States. It is probable therefore that seed dormancy trait is more linked to genetic status of species and not easily affected by environmental factors as it is an additive variation captured only through sexual reproduction (Falconer 1989). Germination is a function of embryo and the heritable traits within the nucleus (Jurado, 1997).

Growth: The early growth rate of *Dialium guineense* was very slow. Twenty-two weeks of growth only produced 12.6cm seedling height with sulphuric acid which was the best treatment; there being slow but steady weekly increments.

Height: Seedlings from sulphuric treatment attained heights of 12.66cm, 12.33cm and 12.0cm in Awka, Benin City and Ore respectively. Hot water treated seeds attained 11.50cm, 11.20cm and 10.90cm in Ore, Benin City and Awka respectively. Overnight soaking in tepid water produced seedlings of 11.8cm in both Bein City and Ore while Awka had 11.10cm. Control (untreated) seedlings attained heights of 10.06cm in Ore, 10.00cm in

Awka and 9.30cm in Benin City. All treatments exhibited similar height growth trends irrespective of seed source (Fig. 5, 6, 7). There was statistical difference in the mean height values between seed sources in their response to treatments (Table 3).

Collar diameter: Seeds treated with acid attained collar diameter of 1.15cm, 1.10cm and 0.91cm for Ore, Benin-city and Awka respectively. Soaking in tepid water gave 0.95cm for Awka and Ore and 0.91cm in Benin City. Hot water produced seedling collar diameter of 0.95cm, 0.94cm and 0.87cm in Awka, Ore and Benin-city respectively. Control (untreated) seeds attained 0.95cm in Ore and Benin-city and 0.90cm for Awka respectively. Mean collar diameter values significantly varied between sources and treatments (Table 3).

Table 2: Overall weekly germination percent of *Dialium guineense* seeds relative to source and treatment.

	Location			
Treatments	AWKA	BENIN	ORE	*Mean treatment
C (control)	0.7	0.93	0.64	0.76^{b}
H_2SO_4	4.86	5.86	3.71	4.81^{a}
HW	1.43	1.07	1.93	1.48^{b}
OS	1.14	1.07	1.21	1.14^{b}
** Mean Location	2.04^{a}	2.23^{a}	1.87^{a}	

NB: Means with same letters are not significantly different at (P>0.05) *Vertical comparism only; **Horizontal comparism only;

Table 3: Effect of different seed treatment methods on early growth parameters of *Dialium guineense*

Parameter	Location	H_2SO_4	Hot water	Soaked	Control
Height (cm)	Benin	9.07^{a}	8.52^{a}	9.52^{a}	8.10^{a}
	Awka	9.23^{a}	8.55^{a}	8.48^{b}	7.32^{b}
	Ore	9.62^{b}	8.82^{b}	9.52^{a}	8.15^{a}
LSD = 0.25					
Collar diameter (cm)	Benin	0.66^{a}	0.65^{a}	0.72^{a}	0.73^{a}
	Awka	0.72^{b}	0.72^{b}	0.74^{a}	0.71^{a}
	Ore	0.81^{c}	0.74^{b}	0.77^{a}	0.74^{b}
LSD = 0.06					
Leaf number	Benin	5.60^{a}	4.31^{a}	4.48^{a}	5.04^{a}
	Awka	5.64^{a}	5.64^{a}	5.3^{a}	5.33^{a}
	Ore	5.54^{a}	4.96^{a}	5.33^{a}	4.20^{b}
LSD = 1.1					

* Means with same letters are not significantly different at (P>0.05)

Leaf number: Seedlings from sulphuric acid treatment had the highest number of leaves, all sources having 7 leaves. Hot water treatment produced 6 leaves in Awka and Ore and 5 leaves in Benin-city respectively. Overnight soaking in tepid water produced 7, 6, and 5 leaves in Ore, Awka and Benin-city respectively. Control (untreated) seeds produced

seedlings with 6, 5 and 5 leaves in Akwa, Benin-city and Ore respectively. Mean value analysis indicated no significant difference between sources for sulphuric acid, hot water and soaking treatments, but control treatment showed source differences (Table 3). It is probable that within species differences response to treatments result from adaptations to different environmental conditions occurring at such geographic locations. This is an indication that growth of species is a trait that is related to environment. Jurado (1997) in his study of species germination in relation to seed mass, dispersal syndromes and plant attributes across N.E Mexico observed that germinability was independent of growth form.

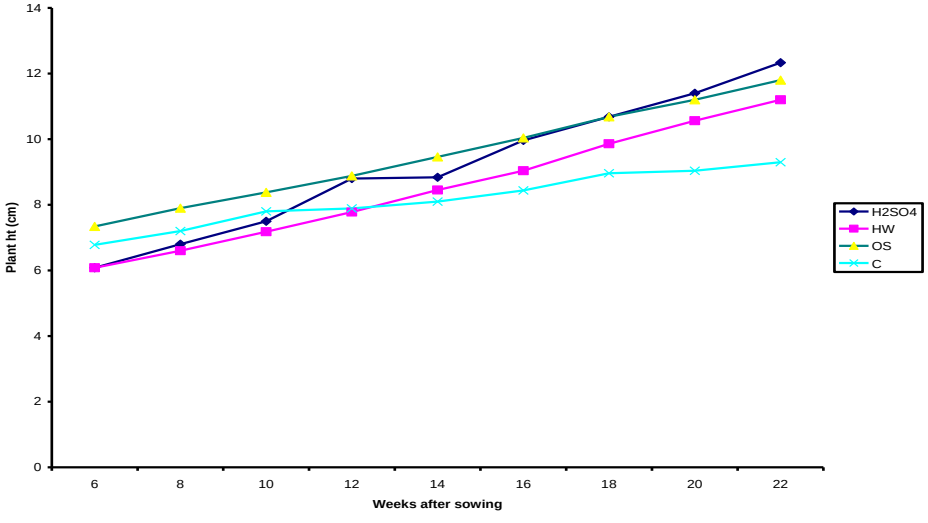

Fig. 5: Plant height of *Dialium guineense* seedlings for Benin-city source

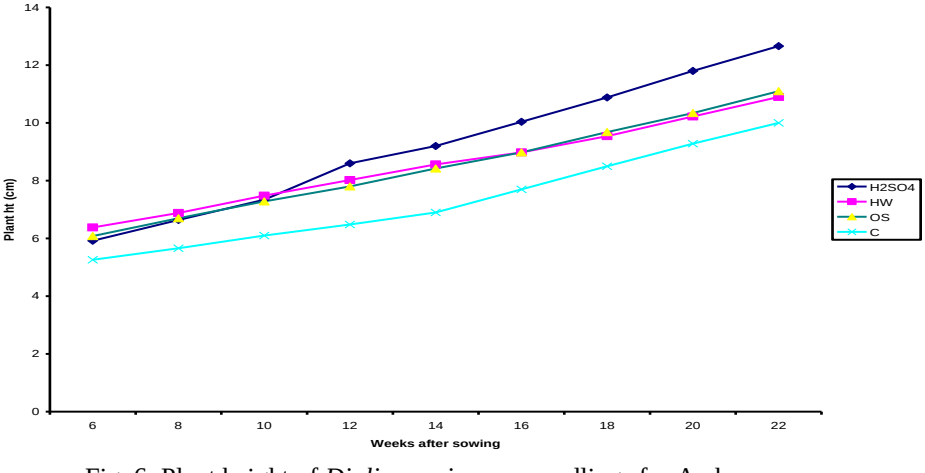

Fig. 6: Plant height of *Dialium guineense* seedlings for Awka source

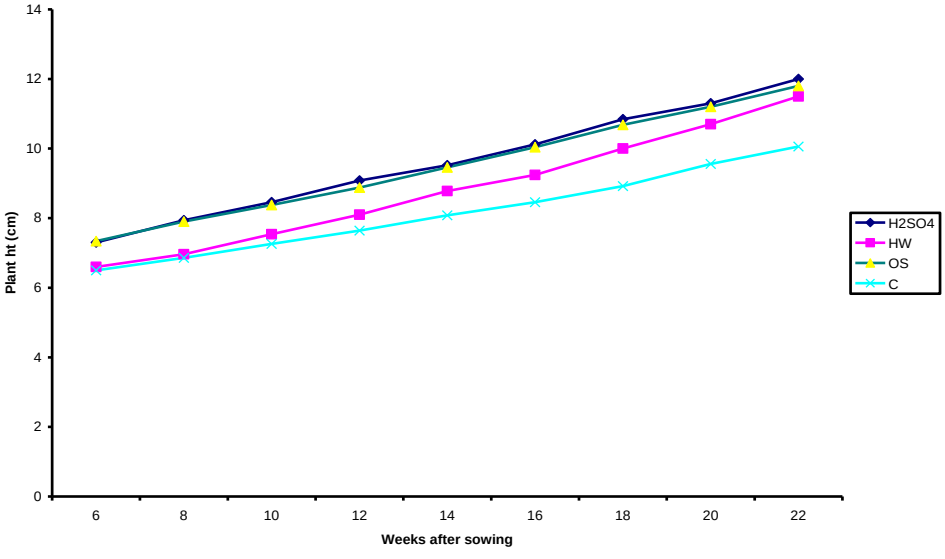

Fig. 7: Plant height of *Dialium guineense* seedlings for Ore source.

CONCLUSION

This investigation has revealed that method of seed treatment greatly affects the time of seed germination (emergence), peak period of germination, percentage germination and early growth of *Dialium guineense*. But there was no significant difference in seed germination potential with respect to seed source. Early growth response varied between treatments and seed source, though not along any specific and clear cut lines.

The most effective method of seed treatment (sulphuric acid) gave the best result in all sources, followed by hot water, overnight soaking in tepid water and control in that order. Overall, the locational differences between the sites investigated have not been sufficient to effect great biological changes in respect of seed germination of *Dialium guineense* hence there was no significant result with seed source.

Source of seed is more likely to be important only in respect of the extent to which a particular treatment would affect early growth parameters after seeds have germinated. There is therefore an indication that seed dormancy trait and germination potential are closely linked to genetic status while growth could be modified by locational factors. Sulphuric acid treatment has been recommended for large scale growers of *Dialium guineense* while hot water and soaking overnight in tepid water are recommended for small scale planters.

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