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RESEARCH ARTICLE

EFFECT OF PRE-SOWING TREATMENTS AND NUT ORIENTATIONS ON EMERGENCE AND SEEDLING GROWTH OF SEEDS OF TEAK TREE (*Tectona grandis L F*)

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ABSTRACT

Studies were conducted to ascertain the effects of various pre-sowing treatments and nut orientation on emergence and seedling growth of seeds of Tectona grandis. Results showed that of the pre-sowing treatments, SDSA, TR, SHW, 30 minutes and TC followed by IN performed generally in terms of rate and percentage emergence as well as seedling vigour compared with the other treatments. SDSA however, manifested to do better in many aspects considered. Of the different nut orientations, BEU gave higher percentage emergence. It also emerged faster than other categories. BEU showed better seedling vigour and growth than seedling from nut planted in other orientations. These results which were obtained after statistical analysis of data using ANOVA and DNMRT showed that pre-treatments and positions of placement of nuts of Tectona grandis could enhance early emergence better performance of seedlings. This study revealed and also placed Tectona grandis alongside cashew – Anarcadium occidentale and shea butter - Vitellaria paradoxa in which nut orientation determine the rate and amount of emergence.

Key words: Nut, Treatment, Orientation, Seedling, Growth, Teak, *Tectona grandis L F*

INTRODUCTION

The teak tree (*Tectona grandis* Linn F) belongs to the family lamiaceae. Teak is native to south and south East Asia mainly India, Indonesia, Malaysia and Burma but it is naturalized and cultivated in many countries including those in Africa (Collin Tudge, 2005). Teak is a large deciduous forest tree that is dominant in mixed tropical forest. The success of large scale plantation is mainly due to its relatively fast growth, fire resistance, non browsability and high timber value (Tewari, 1992). FAO, 1999, has it that transition towards a greater utilization of plantation grown teak is not, however, being made without difficulty or controversy regarding possible soil deterioration and erosion in a pure teak plantations. Increase in the global net areas of teak plantations has been negligible since 1990 (FAO, 1995). The current high esteem accorded the species is predicated on several factors; teak is used extensively to make doors and windows frames, furniture and columns and beams in old type houses.

This is because it is very resistant to termite attacks. Mature teak fetches very good price (Collin Tudge, 2005). The leaves of teak wood trees are used in making ‘’Pellakai gatti’’ (jack fruit dumping) where batter is poured into a teak leaf and steamed particularly in a coastal district of Udupi in the Tulunadu region in south India. The leaves are also used in ‘’gudegs’’- a dish of young jack fruit made in central Java Indonesia. *T grandis* is also used as a food plant for the larvae of moths of the genus *endoclita* (Beach, 1914). Teak is used extensively in boat decks as it is extremely durable and requires very little maintenance. It is often an effective material for the construction of both indoor and outdoor furniture. Teak’s high oil content, strong tensile strength and tight grain makes it particularly suitable for outdoor furniture applications (Kadambi, 1972). Despite its usefulness, *T grandis* has remained largely undeveloped. Consequently, fruits and nuts are still collected from wild or semi-domesticated stands. Under such conditions, production cannot be planned and sustained exploitation will be difficult to carry out. To address this, nursery aspects of its production such as pre-sowing treatments of seeds and nut orientation need to be addressed in an attempt to enhance vigorous germination and early seedling growth and establishment. This study is therefore aimed at investigating the aspect of pre-sowing treatments and nut orientation on the emergence and seedling growth of seeds of *T grandis* in order to produce vigorous seedlings of high morphological and physiological grades that can guarantee even development after planting-out.

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MATERIALS AND METHODS

The study was conducted at the biological sciences garden, university of Agriculture, Makurdi. The study lasted from April, 2012 to November, 2012. Mature teak seeds were abtained from teak trees at the Tarukpe Forest Reserve, Yandev- Gboko local government area, Benue State in April, 2012.

Experiment 1

In this experiment, the seeds were subjected to various treatments to observe their effects on emergence and seedling growth. Thus, a group had their testa cracked (TC), another set had their testa removed (TR), another set were soaked in cold water (room temperature) for 24 hours (SCW). Another set were soaked in hot water for 30min (SHW). The last sets of nuts which served as control were left intact with no treatment applied in them. Another set were treated using dilute sulphuric acid (SDSA). These seeds were soaked in dilute sulphuric acid for 5min after which they were removed and washed. The nuts soaked in hot water were removed and placed under a shade to cool sufficiently before planting.

Experiment 2

This considered the effects of nut orientations on emergence and seedling vigour. The four nut orientations tested were as follows;

1. Scar downward (SD); the nuts were planted with scar areas facing downward.
2. Scar upwards (SU); the nuts were planted with the scar areas facing upwards.
3. Blunt end downwards (BED); the nuts were planted with the blunt end facing downwards.
4. Blunt end upwards (BEU); the nuts were planted with the blunt end facing upwards.

Experimental Layout and Management

The experimental design was a randomized complete block (RCBD) where the first experiment was replicated four times, the second had five replications. Each polyethene bags consisted of fifteen nuts. The polyethene bags were filled with garden soil rich in organic matters. Mulching was not done while weeding and watering were done according to needs.

Data Collection and Analysis

Effects of treatments were measured in terms of speed and amount of seedling emergence and seedling growth. Seedling emergence was monitored on the basis of which days to first and last emergence. Emergence was considered to have occurred once the plumule had emerged from the soil and attained a length of at least 1cm (Ibinkule, 1975). Seedling vigour was measured in terms of seedling height, leaf number and leaf area. Leaf area was obtained by tracing the areas of individual leaves on squared graph sheet (Radford, 1967, Hunt, 1978) at seven weeks after germination (WAG). All seedling characters were estimated at 7 weeks after planting (WAG) for both experiments. Three randomly selected plants in each polyethene bags were used for the estimates. Analysis of variance (ANOVA) was used on all data collected and Duncan mighty new multiple range test (DNMRT) was performed for mean separation. The data obtained from experiment 1 was subjected to percentages before ANAOVA.

RESULTS AND DISCUSSION

Results

Experiment 1

The result revealed that seed treatments and nut orientations could not significantly influence the germination and seedling growth of teak. At 56 DAG, the treatments were insignificantly different in terms of seedling emergence with the acidic treatment and those which had their testa removed performing better. SDSA and TR had the highest percentage emergence as well as those SHW; 30min. the only treatment that expressed percentage emergence above 50 were SDSA and TR (54.67%, and 52% respectively). Speed of emergence is presented on Table 4. The earliest germination occurred at 13 days after planting (DAP) for TR. This was followed by SDSA, TC, SHW, 30min and SCW respectively. Among all the treatments, days to seedling emergence ranged from 13 – 42 days. Table 3 summarizes the effect of pre-sowing treatment on seedling characters. TR gave best performance in terms of seedling height, Leaf number and leaf area. SHW, 30min and SDSA gave similar results (Figures 1 and 2).

Table 1: Effect of treatments on percentage emergence at seven (7) days interval

Days	TC	TR	SCW	SHW, 30min	SDSA	Control
14	5.33	9.33	2.67	4.00	9.33	2.67
21	12.00	16.00	6.67	9.33	17.33	5.33
28	20.00	20.00	12.00	16.00	22.67	12.00
35	22.67	24.00	21.33.	22.67	29.33	22.67
42	25.33	33.33	29.33	36.00	36.00	28.00
49	33.33	42.66	36.00	42.67	48.00	33.33
56	38.67	52.00	42.67	49.33	54.67	36.00
Mean	22.48	28.19	21.52	25.71	31.05	20.00

Note the following; TC= testa cracked, TR= testa removed, SCW= seeds soaked in cold water, SHW= seeds soaked in hot water, SDSA= seeds soaked in dilute sulphuric acid, SD= Scar downwards, SU= Scar upwards, BEU= Blunt ends upwards and BED = Blunt end downwards.

Table 2: Effect of nut orientation on percentage emergence at 7 days interval

Days	SD	SU	BED	BEU	Control
14	2.67	6.67	4.00	14.67	2.67
21	5.33	12.00	13.33	25.33	5.33
28	12.00	22.67	21.33	38.67	12.00
35	21.33	29.33	28.00	45.33	22.67
42	28.00	34.67	36.00	52.00	28.00
49	30.67	42.67	41.33	60.00	33.33
56	34.67	46.67	45.33	60.00	36.00
mean	19.24	27.81	27.05	42.29	20.00

Note the following; TC= testa cracked, TR= testa removed, SCW= seeds soaked in cold water, SHW= seeds soaked in hot water, SDSA= seeds soaked in dilute sulphuric acid, SD= Scar downwards, SU= Scar upwards, BEU= Blunt ends upwards and BED = Blunt end downwards.

Table 3: Mean value of effects of pre-sowing treatments on seedling vigour at 7 weeks after germination (wag).

Seed (nut) treatment	Seedling height	Number of leaves	Leaf area (cm^2)
Control	7.81	8.00	3.63
TC	8.61	8.00	3.85
TR	9.02	9.67	4.28
SCW	8.57	7.00	3.70
SHW,30min	5.71	5.00	2.75
SDSA	5.80	5.00	2.78
Nut orientations			
SD	8.66	8.00	4.27
SU	8.45	8.00	4.18
BED	8.40	8.00	4.00
BEU	9.22	10.00	4.77

Note the following; TC= testa cracked, TR= testa removed, SCW= seeds soaked in cold water, SHW= seeds soaked in hot water, SDSA= seeds soaked in dilute sulphuric acid, SD= Scar downwards, SU= Scar upwards, BEU= Blunt ends upwards and BED = Blunt end downwards.

Table 4: Effects of treatments on days to emergence.

Nut treatment	First emergence	Last emergence
IN(Control)	15	35
TC	15	37
TR	13	35
SCW	17	42
SHW,30 min	21	38
SDSA	13	36
Nut orientations		
SD	14	35
SU	14	39
BED	16	38
BEU	12	36

Note the following; TC= testa cracked, TR= testa removed, SCW= seeds soaked in cold water, SHW= seeds soaked in hot water, SDSA= seeds soaked in dilute sulphuric acid, SD= Scar downwards, SU= Scar upwards, BEU= Blunt ends upwards and BED = Blunt end downwards.

Experiment 2

This result also revealed a statistically insignificant treatment on germination. This is shown on Table 2. At 49 and 56 days, BEU gave 60% germination. This is slightly insignificantly followed by BED and SU which gave 45.33% and 46.67% respectively. BEU maintained highest percentage emergence at all interval, reaching its peak at 49 DAG. The performances of other treatments were similar but different from those of BEU. Seedlings from other treatments which had equal number of leaves (eight leaves each) had the heights of SD, BED and SU significantly different from each other.

DISCUSSION

In this study, the problem of breaking seed dormancy was investigated in different ways. Higher percentage emergence from SDSA, TR and SHW could be attributed to their effect on seed coat. Cracking or softening of the seed coat must have prompted quick sprouting of the pseudo- radical as a result of freer movement of water in the protoplasm thereby hastening the germination process (Figures 1 and 2). The presence of lower percentage emergence shown by others could be due to strong testa which posses barrier to air and water movement (Ugese *et al*., 2005). Response of seeds to pre- germination or sowing treatments depends on how closely such treatments resemble the ecological characteristics of the natural habitat of the species in question (Robert, 1972 and Williemsen, 1975).

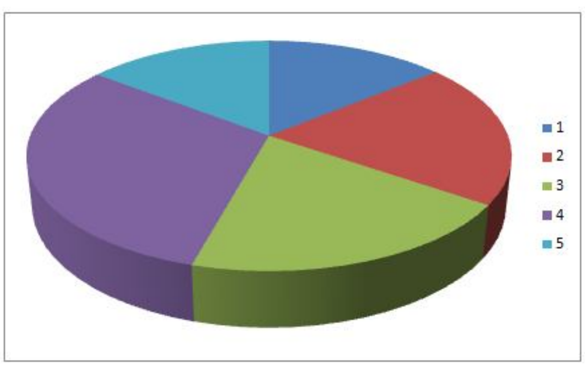

Figure1: The effect of nut orientation on percentage emergence at 7 days interval.

Note the following; 1= SD, 2= SU, 3= BED, 4= BEU and 5= IN(Control).

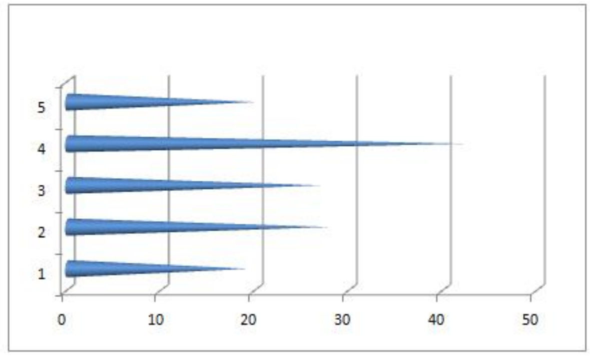

Figure 2: The effect of pre-sowing treatment on nut orientation at 7 days interval.

Note the following; 1= SD, 2= SU, 3= BED, 4= BEU and 5= IN (Control).

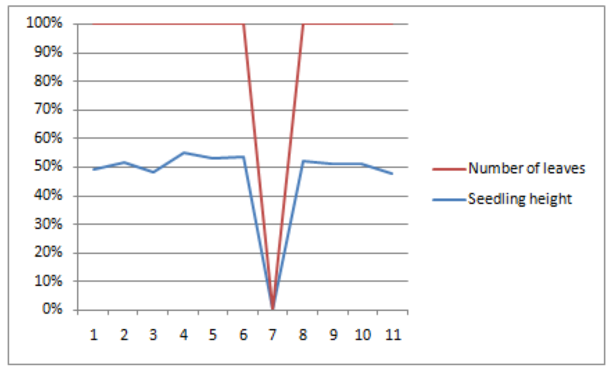

Figure 3: Seedling height and number of leaves in percentages

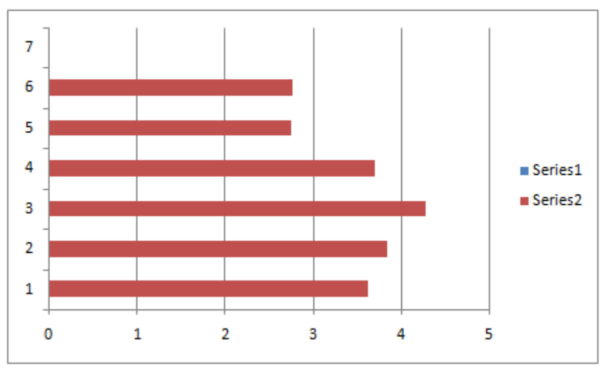

Figure 4: Leaf area per treatment.

The higher emergence rate of seed soaked in hot water indicates the non-aversion of teak seed to high temperatures. This study indicates that the testa imposed some level of dormancy on the seeds. Dormancy may also be caused by the presence of germination inhibitors in the fetty mesocarp and also hormone imbalance in seeds. These factors cause poor germination of seeds (Masilamani, 1996). Applications of chemicals have been found to bring about the germination of dormant teak seeds (Bradbeer, 1968) Figure 5. Alternate soaking and drying gave fairly good results. Besides, the exogenous application of water causes cracks in the helium along the ring of the seed coat which results in the release of the coat resistance enhancing water absorption. Normally, humid condition is conducive for rooting and oxygen uptake (Ching, 1994). Temperature and relative humidity have high interaction effect on germination of teak seeds (Masilamani, 1997). These reports are consistent with the present findings.

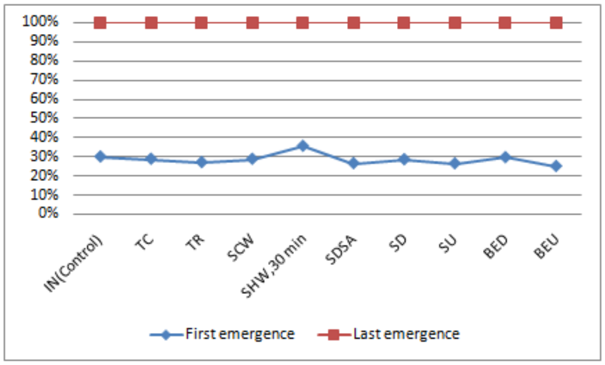

Figure 5: The effect of treatment on emergence

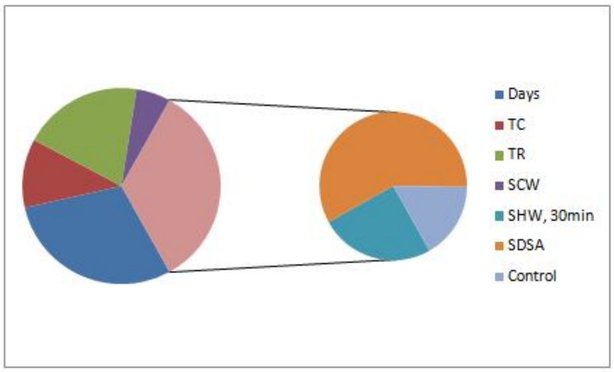

Figure 6: The effect of treatment on percentage emergence at 7 days interval.

Seeds planted with blunt end facing upwards as displayed in the Tables and Figures had statistically higher emergence than those planted with the scar area facing down wards which is the more natural position shows that contrary to Jackson's belief, this position could due principally to the shape of the nut and may have no other advantage to confer. Differences in seedling emergence may have been a function of the depth from which the shoot emerged. In line with Ugese *et al*., 2005, work on *Vitellaria paradoxa*, in BEU radical may have to go straight into the soil without attempting to coil around the seed unlike SD where the attempted coiling is necessary and may result to emergence delays. The better performance of BEU seedlings may be attributed to its earlier emergence occasioned by the more shallow depth of shoot emergence. The result of this study therefore has placed T*ectona grandis* alongside species such as cashew (Argles, 1976, Nagabushanum, 1981), *Cola acuminate* (Ibinkule, 1975) and avocado (Manjo, 1975; Rice *et al.*, 1986) and *Vitellaria paradoxa (*Ugese *et al*., 2005) in which nut orientation determines the rate and amount of emergence

Summary

The result of this study indicates that SDSA and TR treatment of matured seeds of teak improves the germination percentage of the seeds. Acid treatment for five minutes gave higher average percentage germination of 31.05% compared to the average percentage germination of untreated seeds of 20%. SDSA treatment at 29.33%, 36% and 48% respectively with higher percentage germination found using diluted acid. Percentage emergence, emergence speed and seedling growth under experiment 1 where generally in favour of SDSA and TR treatment. Of these treatments, SCW seem most ideal since testa cracking or removal required effort and skill in order not to damage the embryo. The treatments on nut orientations revealed that BEU had average germination percentage of 42.29% 20%. The treatments revealed 60% for both 49 and 56 days after germination (DAG). BEU has the highest percentage emergence rate, emergence speed and other seedling characteristics. BED has 45.33% percentage germination rate and 46.67% for SU. The un-germinated (but still viable) seeds will still maintain viability and germinate in the following year (s) when conditions are favourable. Such germination behavior is due to dormancy. The real causes of teak seed dormancy could be attributed to three major factors viz; seed structure, seed maturity and seed biochemistry (Kaosa-ard, 1986).

Conclusion

The study has revealed that exposure of teak seeds to acids seems to render the teak seed coats pervious to water by softening of the teak seed coverings and consequent disintegration of the 'caps" of the layers of the coat. The permeability of the teak seed coat to water as a result of softened seed covering by the hot water treatment resulted in compound observed to be leached from the seed which presumably, may contain germination inhibitors that might be present in the seeds and the leaching may be, as such considered to be a contribution to dormancy-breaking process. In addition, the permeability and availability of water promoted the process of hydrolysis of reserved food materials which may have ultimately enhanced germination of seed process due to faster translocation of food. Whatever might be the process involved, it is apparent that acid soaking, water soaking, cracking and nut orientations applied improves germination of seeds. Thus, procedures applied could be effectively used as seed dormancy breaking process (procedures) in teak.

Recommendations

Teak is one of the most valuable timbers in the world on the account of its outstanding properties. The heartwood is dark golden-brown, sometimes with dark markings. The grain is generally straight but may be occasionally Figured. Texture is moderately coarse and uneven due to the presence of growth rings. This plant is of great value the human beings and therefore more information is needed for better teak production. It is therefore recommended that further studies be carried out on the following;

- Growing seeds under conditions that stimulate their natural environment such as mulching or growing under shade.
- The possibility of using diluted sulphuric acid for more periods as seed dormancy breaking process.
- In the nut orientation experiment, BEU is better in the major aspects considered and is accordingly recommended.

- The effect of hot water treatment on the growth and seedling vigour of the resulting seedling should also be tested on different variations.

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