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PRE-SOWING TREATMENTS FOR ENHANCED SEEDLING EMERGENCE OF PINK SHOWER (*Cassia nodosa* Buch. –Ham. Ex Roxb.) SEEDS IN NURSERY

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Abstract
Pink shower (*Cassia nodosa*: Fabaceae family) is a flowering shade tree used in landscape garden and park planting. Seeds of *C.nodosa* experience dormancy which delays germination and early seedling establishment, and there is limited information addressing pre-sowing treatment of the species. The experiment investigated effects of some pre-sowing treatments(soaking for 3, 6 and 12 hours; two water temperature regimes – 60° and 80°C) on Seedling Emergence (SE) of *C. nodosa*.A3 x 2 factorial experiment in completely randomised design with five replications was used. Treatments were applied on both mechanically scarified and non-scarified seeds. Daily and total SE counts were taken for 84 Days After Sowing (DAS). Data were analysed by use of simple statistics and ANOVA at $p<0.05$. Results showed that days to first SE ranged from 4.4 to 5.8 DAS in scarified seeds, and 5.2 to 8.6 DAS in non-scarified seeds. The scarified seeds given various pre-sowing treatment combinations progressed beyond 50% SE at 84 DAS. Scarified seeds pre-soaked in 60°C water for 3 hours gave relatively highest cumulative SE (76%±8.9), while least SE (32%±11.0) was obtained from non-scarified seeds pre-soaked in 80°C hot water for 3 hours. In conclusion, the combination of mechanical scarification of seeds and soaking in 60°C water for 3 hours enhanced seedling emergence of *Cassia nodosa.*

Keywords: *Cassia nodosa*, emergence, germination, pre-sowing treatments, and scarification

Introduction

Pink shower (*Cassia nodosa* Buch.–Ham. Ex Roxb.) belongs to the sub-family *Caesalpinioideae* of *Fabaceae* (Mathew and Karikari, 1990; LPWG, 2017); it is an ornamental shade tree with great aesthetic and utility values. Pink shower and its close relation, Golden shower (*Cassia fistula*), are renowned for their ability to adapt to hostile environments. Their efficiency with regards to the recreational value in gardening, landscaping and bio-aesthetic scheduling is very high. The tree is known to favour open sunny location (Al-Menale *et al*., 2010). The pink shower tree can reach 15m in height. It has a short gnarled trunk, and fine spreading crown. From March and well into July, the flowers appear in groups along the cowry branches, each cluster borne on a short stalk. The flower stems are red, and grow in whorls. Its buds and flowers are mostly deep pink, and some parts fading white. The pink shower is a native of Malaysia, Burma and parts of Northern India (Al-Menale, 2008).

Seeds provide the most natural resources of plant reproduction, conservation of genetic materials, transportation and plant breeding programmes. Seed germination is the growth of an embryonic plant contained within a seed, resulting in the formation of the seedling. The most common example of germination is the formation of seedling from seed of an angiosperm or gymnosperm. Seeds are propagules or dispersal agents of plants (Hartmann *et al.,* 2007). All fully developed seeds contain an embryo, and in most plant species, some stored food reserves, wrapped in a seed coat. Most seeds go through a period of dormancy, where there is no active growth. During this time, the seed can be safely transported to a new location and/or survive adverse climate conditions until circumstances are favourable for growth. However, seed dormancy can become serious challenge in crop production, when prompt and uniform growth is desired.

Difficulty in germination is often observed with seeds of *Fabaceae* (*Leguminosae*), *Malvaceae*, *Cannaceae*, *Rhamnaceae* and *Tiliaceae* (Hong and Ellis, 1996); whereas, germination failure due to recalcitrance is

common with oil seeds, including that of Pink shower, African oil bean, Velvet tamarind, etc. (Ogbu and Awodoyin, 2017). Unless the impervious seed coat is overcome, such seed could be taken as dead seed, when it fails to germinate. Seeds of *C.nodosa* experience dormancy, which delays germination, and early seedling establishment. There is also paucity of information addressing pre-sowing treatment of the species using inexpensive, yet effective soaking in water, and mechanical scarification techniques. Al-Menale *et al*. (2010) had earlier reported effects of different pre-sowing treatments of *C. nodosa* seeds using acid scarification, and growth regulator (gibberellic acid) with marginal improvement in germination. Therefore, this research had the objective to investigate effects of some pre-sowing treatments (namely soaking durations in water and temperature regimes of water) on seedling emergence of *C. nodosa* in nursery.

Materials and Method

Location of the experimental site

This experiment was conducted at the Screen house nursery of Federal College of Agriculture (FCA), Ishiagu, Ebonyi State, Nigeria. Ishiagu lies within the South-East derived savanna ecological zone of Nigeria. It is located on latitude 05° 52′N, longitude 07° 35′E and altitude 57m above sea level.

Description of experiment

Cassia nodosa seeds were sourced from a nursery centre at Umuahia, Abia State, South-East Nigeria. The experiment was a two-factor trial: soaking period (3, 6 and 12 hours) and soaking water temperature regimes (60° and 80° C), following Al-Meanale *et al*. (2010) and Ogbu and Otah (2017).Thus, the experiment was a 3 x 2 factorial experiment in completely randomised design. Each treatment was applied on both mechanically scarified and non-scarified seeds. One hundred and fifty (150) seeds were mechanically scarified using sandpaper, and another 150 seeds left non-scarified. Five seeds each from the scarified group were picked at random and soaked in water at 60° C for three, six and twelve hours. Same number of seeds were selected and soaked at 80° C for same soaking durations. The non-scarified seeds were also given same pre-soaking in 60° C warm water, and 80° C hot water for same three soaking durations (3, 6 and 12 hours). Thus, there were six treatments each for scarified and non-scarified seeds experiment. The growth medium, a mixture of saw-dust and river sand (1:1; v/v), was prepared and filled into polythene bags. Thereafter, seeds from each treatment were sown separately in each polythene bag. Each treatment was replicated five times, giving a total of 30 experimental units.

Data collection and analysis

Seedling emergence counts were recorded daily for 12 weeks after sowing (WAS). Plumule protrusion from the soil surface was marked as evidence of seedling emergence for the two experiments. From the daily seedling emergence count, other parameters including day to first seedling emergence, total emergence percent and cumulative percent emergence were determined. The data generated were subjected to statistical analysis of variance (ANOVA) to determine if any treatment exerted a significant effect on any of the variables measured. Treatment means were separated using Fisher's LSD at 5% probability level. Descriptive statistics were also used where appropriate.

Results and Discussion

Cumulative percent seedling emergence of Cassia nodosa at 84 days after sowing (DAS)

Table 1shows the cumulative seedling emergence of *C. nodosa* scarified and non-scarified seeds subjected to different pre-sowing soaking duration (3, 6 and 12 hours) and temperature regimes (60°C and 80°C). There was evidence of germination and subsequent seedling emergence at 14 DAS in all the treatments. From the results in Table 1, it was obvious that the scarified seeds soaked in warm and hot water for the various durations performed better than the non-scarified seeds. Without scarification, none of the treatments except soaking in 60°C warm water for 3 hours (T1), achieved up to 50% germination and seedling emergence at 84 DAS. However, all the *C. nodosa* seeds that received scarification, and soaked for varying durations (3, 6 and 12 hours) in warm and hot water had more than 60% seedling emergence at 14 DAS, and thus gave a more massive and uniform germination. This result corroborated the findings of Ogbu and Awodoyin (2017) in similar study on African oil bean (*P. macrophylla*: Fabaceae), in which combination of mechanical scarification by nicking and soaking in water for 6-12 hours produced more than 80% germination.

Table 1: Cumulative seedling emergence (%) of scarified and non-scarified seeds of *Cassia nodosa* pre-soaked in water at various temperature regimes (60 and 80°C) across 84 DAS

	Scarified seeds						Non-scarified seeds					
Days to first seedling emergence	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**
0 – 14	68	60	64	60	64	76	36	32	20	24	40	30
15 – 28	76	60	68	64	68	76	52	48	36	24	40	32
29– 42	76	60	68	64	68	76	52	48	36	24	40	32
43 - 56	76	60	68	64	68	76	52	48	36	24	40	32
57 – 70	76	64	72	64	76	76	56	48	36	36	44	32
71 – 84	76	64	72	64	76	76	56	48	36	36	44	32

NOTE: T_1= 3 hours soaking in 60°C water; T_2 = 6 hours soaking in 60°C water; T_3 = `12 hours soaking in 60°C water; T_4 = 3 hours soaking in 80°C water; T_5 = 6 hours soaking in 80°C water; T_6 = 12 hours soaking in 80°C water; DAS= days after sowing

Day to first seedling emergence

Day to first seedling emergence of *C. nodosa* was evidently influenced by the combined action of pre-soaking durations and water temperature regimes ($p<0.05$). Earliest seedling emergence (at 4.4 DAS) was recorded among scarified seeds pre-soaked for 12 hours in warm water at 60°C, whereas, non-scarified seeds soaked for 6 hours in hot water at 80°C had earliest seedling emergence of 5.2 DAS (Table 2).The various levels of single factor soaking duration treatments did show significant effects on days to first germination of test plant seeds.

Table 2: Effect of pre-sowing treatments on days to first seedling emergence, and total seedling emergence (%) of *Cassia nodosa* seeds at 84 DAS

	Days to first seedling emergence		Total seedling emergence (%)	
Treatments	**Scarified seeds**	**Non-scarified seeds**	**Scarified seeds**	**Non-scarified seeds**
3 hours at 60°C warm water	5.8±1.8	8.2±3.4	76±8.9	56±16.7
6 hours at 60°C warm water	5.0±1.0	6.0±1.9	64±16.7	48±22.3
12 hours at 60°C warm water	4.4±0.5	8.4±6.1	72±17.9	36±16.7
3 hours at 80°C hot water	4.6±1.3	6.2±1.6	64±8.9	32±17.9
6 hours at 80°C hot water	5.0±1.2	5.2±1.3	76±8.9	44±16.7
12 hours at 80°C hot water	5.4±3.1	8.6±6.0	76±32.9	32±11.0
LSD $_{(0.05)}$	0.84	1.67	8.15	9.23
Soaking duration				
3 hours	5.2±0.8	7.2±1.4	70±8.5	44±14.1
6 hours	5.0±0.0	5.6±0.6	70±8.5	46±2.8
12 hours	4.9±0.7	8.1±0.1	74±2.2	34±2.8
LSD $_{(0.05)}$	0.96	1.02	3.76	1.83
Water temperatures				
60°C	5.1±0.7	7.5±1.3	71.0±6.1	47±10.1
80°C	5.0±0.4	6.7±1.7	72.0±6.9	36±6.1
LSD $_{(0.05)}$	ns	0.60	0.85	6.53

ns = non-significant; Values are mean ± SD (n = 25); ** = Significant at 5%

Total seedling emergence of *Cassia nodosa*

Total seedling emergence was highest (76±8.9%) in scarified seeds pre-soaked in warm water (60°C) for at least 3 hours, and least (32±17.9) in non-scarified seeds pre-soaked in hot water (80°C) for 3 hours duration ($p<0.05$). Moreover, single factors (soaking duration and water temperature) and their interaction effects had significant improvement on total seedling emergence ($p<0.05$). The soaking duration exerted more positive influence on enhancing germination and subsequent seedling emergence of *C. nodosa* than water temperature (Table 2). Non-scarified seeds given combined treatment of 3 hours soaking in 60°C water were the only treatment that barely reached fifty percent seedling emergence (56±16.7%) at 84 DAS, unlike the scarified seeds that mostly exceeded 70% seedling emergence within the same period. It is apparent from the results that viable seeds of *C. nodosa* without scarification experienced drag in seedling emergence, which lend credence to the need for some sort of pre-sowing treatments. The present observation corroborated report of Al-Menale *et al*. (2010)on poor germination of *C. nodosa* seeds, and other *Cassia* species without pre-treatment techniques (Ramamoorthy *et al.,* 2005).

Seeds of *C. nodosa* being typically characterized by thin impervious seed coat, will need pre-treatment techniques like pre-sowing soaking in water to guarantee early massive seedling emergence since such practice facilitates the infiltration of moisture and oxygen in the kernel that triggers the germination process (Hartmann *et al*., 2007; Ogbu and Otah, 2017). The duration of pre-soaking treatment in water coupled with temperature regime of pre-soak water seemed to play positive role in affecting rate of seedling emergence as longest soaking period of 12 hours favoured higher total seedling emergence than other periods of three and six hours for scarified seeds. However, for non-scarified seeds of *C. nodosa*, the inverse was the case as longer duration of pre-soaking in water appeared to decrease total seedling emergence relative to other periods of three and six hours pre-soaking. Similar observations have been reported with other plant species including *Maesobotrya barteri* (family *Euphorbiaceae*), and *Pentaclethra macrophylla* (family *Fabaceae*) (Omokhua *et al.,* 2015; Ogbu and Awodoyin, 2017). With reference to reports on temperature regime of water for pre-soaking, Aliero (2004), Omokhua *et al.* (2015), and Ogbu and Otah (2017) indicated raised water temperature treatment as another way to pre-treat seeds in order to enhance germination rate, and seedling emergence. With higher temperatures, germination (%) was very high (about 80-100%) in *P. macrophylla* seeds (Ehiagbonare and Onyibe, 2008).

Interaction effect of the two factors (soaking duration and water temperature) also positively and significantly ($p<0.05$) improved total seedling emergence of *C. nodosa*. Both water and temperature are critical factors in germination, and subsequent seedling growth. Water provides solvent for dissolution of stored biochemical

solutes and medium for their mobilization to destinations where they are needed (Hartmann *et al*., 2007; Chadha, 2009). While temperature is known to affect the rate of biochemical processes, it also affects the state of solutes, solvents and the enthalpy of the biological system (Jain, 2010). This fact may explain the reason behind some positive impacts of raised temperature regimes and soaking in water on germination and seedling emergence of *C. nodosa*.

Conclusion

The use of scarified seeds and pre-sowing treatment of soaking *C. nodosa* seeds in warm water at 60°C for a 3 hour duration seems a good treatment of choice for farmers as it gives relatively most uniform and highest seedling emergence (76%) at 84 DAS. Therefore, the application of mechanical scarification, with pre-sowing in warm water for at least 3 hours is safe and relatively affordable dormancy breaking approach in comparison to other chemical methods, like the use of concentrated acids or phytohormones, which are rather expensive for low income nursery.

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