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Influence of Dry Heat Treatments (76°C) and Gibberellic Acid (GA_3) on Seed Germination and Seedling Growth of *Prosopis africana* (Guill and Perr Taub) and *Dialium guineensis* (Wild)

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Abstract: The seeds of *Prosopis africana* (Guill and Peer Taub) and *Dialium guineensis* (Wild) were investigated. The trees of these seeds were among many ones that are fast going into extinction due to reckless falling and annual bush burning with little regard for replanting. The seeds of this species have been found to be dormant while little regard for aforestation. The influence of dry heat treatments at 76°C and Gibberrellic acid (GA_3) on seed germination and seedling growth were investigated. The dry heat oven treatments (76°C) gave maximum percentage 50-60% in *P. africana* seeds when subjected to about 8 h treatments within 15th-24th day of sowing. While minimum germination percentage for this treatment was 10% under 4 h treatments within 15th-24th days of sowing. The control experiment was 0% throughout. *D. guineensis* seeds at 76°C oven dry treatment was 40-45% as maximum within 15-24 days. The minimum germination was 5-10% under 15-24 days when treated for 4-8 h. The control showed no evidence of germination *D. guineensis*. The influence of these treatments were equally investigated on the seedling growth of this species. The treatment greatly enhanced the seed growth of *P. africana* especially the seedling height 30±2.0 cm and leaf number 15.0. But the seedling growth in *D. guineensis* plant were less enhanced. Seedling height 28±5.0 cm and 12.0 in leaf number. However, the treatments had significant effect ($p<0.05$) on the seedling development when compared with control. Seedling height in control was 6.0±0.0 cm and 4.2±1 for *P. africana* and *D. guineensis*, respectively. In control, the leaf area was 10±8.1 cm^2 and 10±2.0 cm^2 in *D. guineensis*. This showed that the investigation on seedling growths was better enhanced than control. The experimental design was the randomized block type. All data was subjected to Analysis of Variance (ANOVA). All laboratory experiments was in five replicates, while field experiment was in 3 replicates.

Key words: *Prosopis afracana*, *Dialium guineensis*, aforestation, germination gibberrellic acid

INTRODUCTION

Germination incorporates those events that commence with the uptake of water by the quiescent dry seed and terminate with the elongation of the embryonic axis (Bewley and Black, 1994). The visible sign that germination is complete is usually the penetration of the structure surrounding the embryo by the radicle, the results is often called visible germination. Subsequent events, including the mobilization of the major storage reserves, are associated with growth of the seedling (Bewley, 1997). Virtually all of the cellular and metabolic events that are thrown to occur before the completion of germination of non-dormant seeds also occur in imbibed dormant seeds, indeed, the metabolic activities of the latter are frequently only subtly different those of the former. Hence, a dormant seed may o\achieve virtually all of the metabolic steps required to complete germination, yet for unknown reason, the embryonic axis fails to elongate (Bewley, 1997).

Seed dormancy is regarded as the failure of intact viable seed to complete germination under favourable conditions (Bewley, 1997).

Attempt to enhance seed germination, previous research showed that there is usually a beef up with the arrangement of hormonal treatments (Fasidi *et al*., 2000).

Some scarification methods such as dry wet and wet treatments have been known to be effective on seed germination. However, the choice of dormancy breaking methods of seeds depend on seed coat thickness and susceptibility to oxidative damage (Rosner *et al*., 2002).

Prosopis africana is a perennial tree legume which belong to the class Magnoliopsida and family leguminasae. This specie is a small to large tree. It is the only native to Africa. The tree are mostly found in the savanna region, mostly in fallow land on various textural soils and on lateritic soils. The pods remain on the tree long after maturity. There are 2 varieties of pod of this species, one with narrow cylindrical pods (2.5 cm in diameter) and one with broader flattened pods (3 cm in width).

The wood is used for cabinet works and wheels wright work. It is mostly used for carpentry tools, turnery, planes etc. Charcoals for cooking for both commercial and domestic purpose are made from the tree.

Dialium guineensis is the commonest and most widespread Dialium in the tropics and savanna regions. The small black velvety fruits are very rich in Vit. C. The plant belongs to the class leguminosae. It extends from Senegal to Nigeria, also occurring in the Island of Sao Tome. The tree is about 20 m high, but often shrubby with a densely leafy crown. The bank is smooth, grey, slash reddish, yielding a little red gum, sapwood white and with distinct ripple marks. The leaves are with a common stalks each 5-13 cm long, sometimes finely hairy, with an odd terminal leaflet and usually 2 pairs of opposite or alternate leaflets, the lower pair being somewhat smaller. The leaflets are mostly 3.5-10 cm long by 2.5-5 cm broad, elliptic to broadly elliptic. Sometimes slightly obovate, blunt at the apex or abruptly and shortly accummate symmetrical and rounded or slightly cuneate at the base, leathery, glabrous above and with the midrib slightly sunken, sometimes finely hairy beneath, with 6-12 pairs of very thin lateral nerves up curving at a wide angle to the prominent midrib and looping away from the margin. The veins form and extremely fine close network, while the stalk of leaflets are stout and sometimes finely hairy up to 6 mm long (Keay, 1989).

There is little or no known evidence of propagation of *P. africana* and *D. guineensis* seeds. The information obtained showed that the farmers and the rural people find it difficult to propagate the plant through the seeds due to their hard seeds coats. With their hard seed coat, the seeds have been known to exhibit dormancy.

This research focused on how to enhance the seed germination of *P. africana* and *D. guineensis* via dry heat treatments and gibberellic acid. In order to raise seedlings for afforestation. Having observed their great economic importance in the socio-economic development of people in both rural and urban settlements.

MATERIALS AND METHODS

Seed procurement and processing: Pods of *P. africana* seeds were collected directly from the tree stands after fruit fall in December 2007 from the University of Ilorin, Ilorin (8.32^{N} and 4.34^{E}) Nigeria, seeds of *D. guineensis* were collected from Oke-Odo market, Abule-Egba, Lagos.

The fruits were dried under sun for 5 days, then cracked using gently strokes from a granite stone of moderate size. The damage seeds were hand-picked and discarded.

Viability studies: Viability test of seeds were carried out using the floating method of ISTA. Fresh seeds were separated into lots and surface sterilized with 0.1% mercuric chloride solution for 25 seconds and rinsed with several changes of distilled water. Ten seeds were planted in each of 9 cm Petri dishes lined with sterile filter paper and moistened with sterile distilled water. All germination trials were done at room temperature of 30±20°C. Five replicate of the set up were made in this and subsequent experiments.

Dormancy studies

Dry heat presowing treatments: Seed lots were exposed to temperature regimes of 76°C for the period of 2-10 h. The oven used was already preset to the temperature value in each case. The seeds were allowed to cool and planted for germination. Seeds were also presowed in distilled water for 24 h after which the seeds were prepared for germination in 9 cm petri dishes. Untreated seeds served as control in all cases. The experimental design used was the randomized block type. Data were subjected to analysis of variance and means compared by Least Significant Difference (LSD^{t}).

Preparation of gibberellic acid: Some small sample of gibberellic acid was obtained in International Institute of Tropical Agriculture (IITA), Ibadan, Oyo State. About 0.01 g of the sample was dissolved in 50 mL of distilled water to give 200 ppm (stock solution). 0.25, 0.50, 0.75, 1.00 and 1.25 volumes of the stock solution were added with distilled water to make up to 50 mL. Each of these gives 1-5 ppm concentration of GA_3, respectively.

Effect of dry heat presowing treatments and gibberellic acid on seedling growth: Seedlings raised from the above treatments were studied for 3 months under green-house condition. Some growth parameters such as seedling height, stem girth, leaf number, leaf area, stalk length were observed and monitored during this period.

RESULTS

Table 1 showed the viability percentages for *P. africana* 100% and *D. guineensis* 100%, respectively.

Dry heat presowing treatments: The dry heat (oven) treatments at 76°C for 8 h showed maximum germination

Table 1: Viability test

Tree species	Viability (%)
P. africana	100
D. guineensis	100

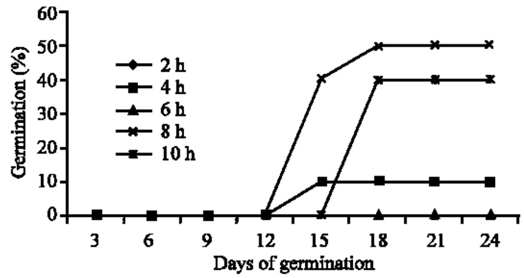

Fig. 1: Effect of dry heat treatments (at 76°C) on germination of *P. africana* seeds

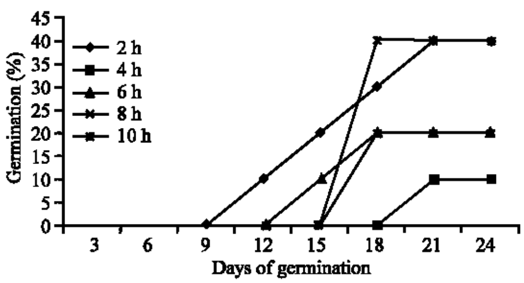

Fig. 2: Effect of dry heat treatment (at 76°C) on germination of *D. quineesis* seeds

of 50-60% in 15-24 days after sowing. While treatment for 4 h showed minimum percentage germination of 10% in *P. africana* (Fig. 1). Presowing treatments for 10 h at the same regime of temperature of 76% in *P. africana* seeds also showed 40-50% germination under 15-24 days (Fig. 1). However, there was no evidence of germination in seed treated for 6 h (Fig. 1). Control showed no evidence of germination (Fig. 2) showed that *D. guineensis* seed, when subjected to 76°C temperature regimes gave maximum germination percentage of 40-45% under 10 h of treatments within 18-24 days. Minimum germination percentage of 0-10% was observed for seeds under 4 h treatments. About 0-20% germination was observed for seeds under 6-8 h treatments within 15-24 days (Fig. 2). Treatment of *D. guineensis* seeds under 2 h shoot up from 0-45% when observed for 12-24 days (Fig. 2). There was no traces of germination with control experiment.

Effect of Gibberellic Acid (GA_3): Figure 3 showed that the seed of *P. africana* had highest percentage germination (50-60%) at 3 ppm concentrations within 16-20 days of sowing. Followed by 2 ppm concentration

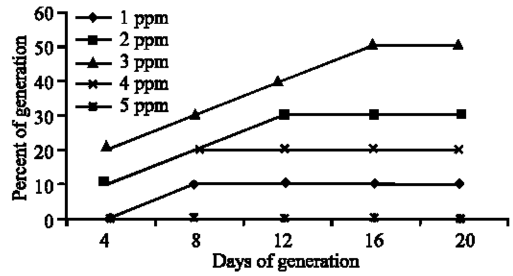

Fig. 3: Effect of Gibberellic Acid (GA_3) on germination of *P. africana* seeds

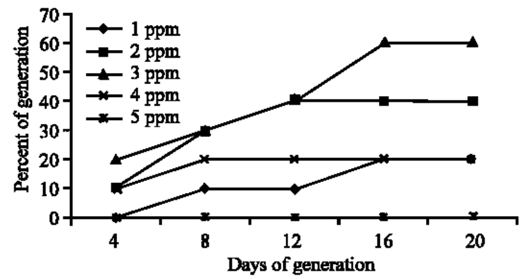

Fig. 4: Effect of Gibberellic Acid (GA_3) on germination of *D. quineesis* seeds

that gave 25-30% termination within 12-20 days of sowing. There was a sharp decrease in percentage germination when subjected to 1 ppm and 4ppm which ranges from 10-20% germination whereas 5 ppm had no significant effect on germination percentage of the seeds (Fig. 3). Control experiment showed no evidence of germination. Figure 4 revealed the effect of treatment of *D. guineensis* seeds on gibberellic acid prepared at different levels of concentration 3 ppm had the highest percentage germination with seeds of *D. guineensis* by showing up to 60-70% germination (Fig. 4). Followed by 2 ppm concentrations, 40% germination was observed within 12-20 days of sowing (Fig. 4).

Four ppm and 1 ppm showed 20, 10% germination, respectively within 8-20 days of sowing Fig. 4. Highest concentration of 5 ppm showed 0% germination percentage. Control had showed no evidence of germination throughout the experimental period, 4-20 days of sowing.

Effect of presowing treatments of *P. africana* seeds for 24 h: The maximum germination percentage obtained in the seeds of *P. africana* when immersed in distilled water for 24 h showed 20% within 25-30 days of sowing (Fig. 5). Followed by 10% germination recorded within15-20 days. Within 5-10 days of owing,

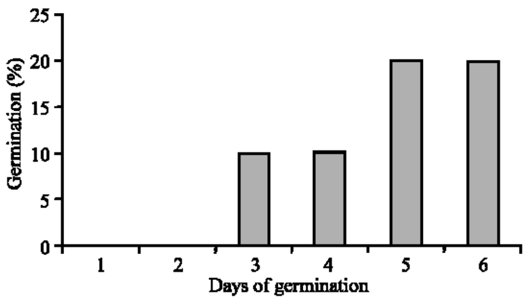

Fig. 5: Effect of soaking of sacrified seeds of *P. african* water for 24 h

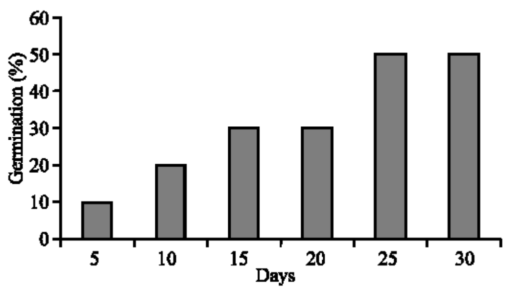

Fig. 6: Effect of soaking of scarifiled *D. guineensis* seedsin water for 24 h

there was no traces of germination in the seeds within 5-10 days (0%) including control.

Figure 6 exhibits the effect of presowing treatments on germination of *D. guineensis* seeds for 24 h. Maximum germination percentage was attained on the 25 and 30th day showing 50% germination. Followed by 15 and 20th day which gave up to 30% percentage germination rate. However, on the 10 and 5th days, germination percentage was 20 and 10%, respectively (Fig. 6). Whereas, percentage germination for the control was not evident.

The seedling height of *P. africana* was enhanced by dry heat presowing and Gibberellic acid treatments by showing 30±2.0 cm and 33±4.0 cm, respectively while that of *D. guineensis* was 28±5.0 and 22±1.0, respectively (Table 2). The leaf number was better enhanced in *P. africana* (15) when oven-dried at 76°C than in *D. guineensis* seedlings (12). The GA_3 treatment on seedling leaf number was less enhanced. The petiole length (cm) was better enhanced and highly significant ($p<0.05$) (Table 2). Also the leaf area in the seedling growth was enhanced by the treatments of GA_3 and dry heat treatments. 38±3.0 cm^2 and 25±6.0 cm^2, respectively. The growth of stalk length was almost the same in the two treatments and seedlings of *P. africana* and *D. guineensis* 1.1±0.2 cm, .21±0.0 cm, 2.0±0.4 cm, 1.5±2.0 cm, respectively (Table 2).

Table 2: Effect of dry heat (76°C) treatments and GA_3 on seedling growth of *P. africana* and *D. guineensis*

Species	Seedling height (cm)	Stem girth (cm)	Leaf No.
	Dry heat treatments (76°C)		
P. africana	30±2.0	1.1±0.2	15.0
Control	10±4.5	2.1±0.0	12.0
D. guineensis	28±5.0	0.0±0.1	05
Control	10.0±0.0	0.1±0.2	
	Leaf area (cm^2)	Petiole length (cm)	
	25±6.0	3.4±4.0*	
	18±3.0	6±3±1.0**	
Control	6.2±1.4	2.1±1	
	Gibberellic treatments (GA_3)		
P. africana	33±4.0	2.0±0.4	6
Control	6.0±0.0	0.0±0.1	8
D. guineensis	22±1	1.5±2.0	3
Control	4.2±1	0.2±0.1	
	Leaf area (cm^2)	Petiole length (cm)	
P. africana	38±3.0*	3.0±2.0*	
Control	12.0±8.1		
D. guineensis	30±6.0**	4.2±1.0**	
Control	10±2.0	0.2±0.2	

Superscript are on par $p<0.5$, *-Significant, **-Higher significant

DISCUSSION

Hard seed coverings have been found to be impervious to water and gases. Proper enzymatic actions and proper mobilization of food materials for growth of the embryo of the seeds are hampered due to the impervious nature of their seed coats. As such, the seeds germinate readily after reducing the thickness of the seed coats by dry heat treatments at 76°C (oven treatments) and application of Gibberellic acids (GA_3) on the dormant seeds before germination could commence.

Gibberellic acid (GA_3) is one of the major plant hormones involved in the control processes of mobilization of food reserves from the endosperm or cotyledons, most especially enzymatic production (Black, 1972). Consequently, acceleration of the rate of germination by 1-5ppm concentrations in *P. africana* and *D. guineensis* seeds was due to the fact that there was unhindered entry of GA in the seed coat barrier, having been reduced and soften by dry heat (76°C) oven-dried treatments. The absorbed hormonal concentrations also compliments that of the internal levels of the hormone in the seeds. Gibberellic acid (GA_3) has been known by various plant researchers to affect various processes in germinability of the seed, for example, metabolism of amino acids and aminoles respiration, increase amylase content (Stuart and Cathey, 1961). This provides a possible explanation for the rapid germinability and peeling-off of hard testa observed in *P. africana* and *D. guineensis* seeds.

The effect of presowing treatments on the seeds germinability showed that those seeds are naturally dormant in nature. Their dormancy state was traced to be that of hardness of the seed coats. By subjecting the seeds into different presowed treatments helped to reduce the hardness of the seed coat, thereby allowed the influx of water to the embryo and promote embryo expansion, leading to the inhibition of the water. This also gave rise to the mobilization of food researches in the endosperm. Emergence of radicle showed was a vivid evidence of germination in the seeds. Other seeds that exhibits the same characteristics include: *Parkia biglobossa, Tamarindus indica, Albezia lebbeck, Prosopis facarta, Tithonia diversifolia, Afzelia Africana, Ceiba petendra, Ceceadpinia bunduc* etc.

The result showed that the seedlings were enhanced with the applications of the two treatments when compared with control experiment of the *P. africana* and *D. guineensis*. This showed that dry heat presowing treatments and GA_3 enhanced and induced better performance of the seedlings than the control (Table 2). Previous research showed that Gibberellic Acid (GA_3) enhanced leaf number and plant height in *A. lebbeck* and *P. biglobossa* while IAA enhanced plant height and dry weight. Kinetin and IBA enhanced leaf number (Ebofin 2003). Dybing and Lay (1982) found that application of growth regulators on plants improves the plant height and dry weight in *Hibiscus sabdarifa*. GA_3 also stimulated growth of leaf disks, by a combination of cell division and expansion (Jones, 1973). Omran *et al.* (1980) also discovered that soaking seeds of okra (*Abelmoschus esculentus* (Lin) Moench) in different concentrations of GA_3, IAA and IBA increased the plant height and dry matter content. There was enhancement of germinations of seeds by gibberellic acid (GA_3). The growth promoters are well known for stimulation of lettuce seed germination (Sankhla and Sankla, 1968).

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