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# *Khaya senegalensis* seeds polymorphism and dormancy breaking, Seeds collected from different localities in Sudan

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**Abstract** *Kayasenegalensis* (Desr) A. juss, locally known as Mahogany , is one of the most economically important forest tree species in Sudan .The seeds of this species have polymorphism phenomenon and dormancy mechanism. Therefore the objective of this study is to determine feasible and practical seed dormancy – breaking method as reflected uniform germination in order to select the method have high rate of germination for forestation and conservation purpose . .The study carried out on seeds that selected from three localities (Sinnar, Southern Kordofan and Southern Darfur States). Sudan. The germination was examined using three interval of water soaking (12hr, 18hrsand24hrs) and three different concenrration of Gibberellic acid (0.01con, 0.001con, and0.0001con) under controlled environmental conditions in germination chamber. Result revealed significance differences between the three localities on seed attributes, Seeds of Mahogany also showed large and small sizes which are deeply dormant .and presence of a combined dormancy (Chemical and endogenous). In conclusion soaking in $H_2O$ for 18 hrs and $GA_3$ (0.01 cons) for two hours are the best treatments to break seed dormancy.

*Key words: Khaya senegalensis, Dormancy, Gibberellic acid, polymorphism*

## 1. INTRODUCTION

Seed dormancy is state in which a mature viable seed failure to germinate under environmental conditions normally favorable to germination. (Hilhorst, 1995; Li and Foley, 1997). Plants have evolved several dormancy mechanisms to optimize the time of germination (Jones, 1999) and, by optimizing the distribution of germination over time (‘dispersal in time’), seed dormancy enhances survival (Li and Foley,1997; Foley, 2001). The intensity of dormancy in a given species exhibits high degrees of variation within populations (Andersson and Milberg, 1998;Meyer and Pendleton, 2000). Seed dormancy is a typical quantitative feature influenced environment interactions (Foley and Fennimore, 1998; Koornneef *etal.*, 2002). seed dormancy is classified to three main types depending on the location of dormancy in different seed parts i- exogenous or seed coat / per carp dormancy ii- indigenous or embryo dormancy : and iii- combined dormancy ,where both i and ii occur at the same time Schmidt (2000). Dormancy in nature is broken by external or environmental factors ( Doran *et al* 1983; kaul and Monohar 1985). Dormant seeds stimulated to germinate using treatments that imitate natural conditions or satisfy certain physiological requirements. (Bradbeer, 1988; Bonner etal.,1994;Nowag, 1998; Rahman et al., 2006). Several germination stimulators have been used to improve the seed germination, e.g., $GA_3$ (Dhankhar et al., 1996; Vijaya et al., 1996; Rahman et al., 2006; Soyler & Khawar, 2007),benzyladenin (Shafi et al., 1991) and polystimulins (Kırdar &Ertekin, 2001). Gibberellic acid ($GA_3$) is a naturally occurring hormone, which regulate the plants growth Commercially it can be found as a liquid, powder and tablet forms. The role of $GA_3$ in promoting seed germination has been described by several authors (e.g.,Lewak, 1985; Karssen, 1995). The promoting effect of $GA_3$treatment is often attributed to the mobilization of stored reserves (Bewley & Black, 1994; Soyler & Khawar, 2007)and acceleration of the disappearance of abscisic acid

khaya senegelensis (Desr )A. juss, locally known as Mahogany , is one of the most economically important forest tree species . The tree is very popular and used for high-class furniture, joinery, building and construction purposes. The species has also high traditional medicinal values and used as an ornamental tree for gardens and avenues.

Despite its importance the species is only limited incorporated in a forestation programmers. This is mainly because, like most tropical forest tree species, studies on silviculture of the species are incomplete, information on quality control standards for better procurement of its seeds is fragmented and improved technologies for seed handling that suit the condition in Africans developing countries are lacking Mahgoub (2002). EL Tahir (1999) claimed that mahogany seeds exist in two sizes. The large seed non-dormant and small is dormant seeds.) Mahgoub (2002) reiterated that effect of seeds polymorphism of Mahogany on germination was significant and that seed polymorphism is one of the obstacles to uniform

germination and successful plantation establishment. In the literal sense, polymorphism means having many forms (Harper1977)

The aim of this study to investigating the effects of seed pre-treatment techniques and seed polymorphism on uniform germination and successful establishment and determine feasible and practical seed dormancy – breaking method as reflected uniform germination.

## 11. MATERIAL AND METHOD

Seeds used in the study collected from different provenances with the help of the National Tree Seed Center of the Forestry Research Centre**. (**Table 1)
Two experiments was conducted in the study Experiment 1 Investigation on some seed attributes: seed Weight, Number of seeds /kg
As described by ISTA rules (International Seed Testing Association) (Jovoll and Mahgoub, 1994). Experiment 2: Effect of seed polymorphism and pretreatment techniques on germ inability of Mahogany seed ,in this experiment three seed size classes large, medium and small were used and seven treatments were applied soaking in water for 12, 18 and 24hours, Soaking in gibberellic acid with 0.01,0.001 and 0.0001 cons For 2hrs and control without treatment. Twenty-five seeds of each size group from each provenance spread evenly on trays filled with pure sand, and covered with sand 0.5 cm depth; this then moistened with 25 ml of water. Treatments replicated four times in a split – plot experimental design. The main plots arranged in a randomized fashion and allocated to the size group of seeds.
The experiments conducted in the seed laboratory of National Tree Seed Center at Soba, Khartoum. It was conducted under controlled environmental condition (at 30 temperature and 12- hours light duration) in the germination chamber
Germination observed and germinating seeds counted at 7- day intervals for a period of 4 weeks. Germinated seeds removed after each count to avoid transfer microbial diseases by crowded seedlings. From records of germination, three different germination characteristics were determined: final germination percentage, weekly germination percentage, and germination rate for each provenance and each of the three – seed size classes. Results obtained statistically analyzed using the JMP advanced statistical package. Means compared using Tukey – Kramer method.

Table (1): seeds provenances information:

| Localitiesname &(code) | State | Latitude | Longitude | Annual rainfall (mm) |
|---|---|---|---|---|
| Um Abdalla (U) | Southern Kordafan | 11° 45N | 30° 55° E | 700 |
| Sinnar (S) | Sinnar | 13°75°N | 33°75°E | 600 |
| Zalinge (Z) | Southern Darfur | 13°00°N | 23°50° N | 800 |

## 111. RESULT

**Investigation on some d attributes-**

The results of weighted and counted seeds of the different provenances investigated in this study shown in

Table (2) Weight and count of seeds collected from different provenances

| Provenance | Wt. of 1000 seed (g) | No, of seed/kg |
|---|---|---|
| Sinnar | 129.74c* | 7708 |
| Um Abdalla | 160.58b | 6227 |
| Zalinge | 173.64a | 5759 |

P > 0.0001 C.V = 18 SE ± 2.6

The results show significant differences between the three provenances. Provenance Zalinge showed heaviest seeds with least number of seeds per Kg and Sinnar showed the vice-versa while Um Abdalla was mediocre for both traits

Table (3) Germination percentage according to pretreatment techniques applied in the study

| | Treatment | Mean (%) | |
|---|---|---|---|
| 1. | Control | 67.4 | c * |
| 2. | Soaking in $H_20$for 12hrs | 75.0 | ab |
| 3. | Soaking in $H_20$for 18hrs | 76.1 | a |
| 4. | Soaking in $H_20$for 24hrs | 72.4 | b |
| 5. | Soaking in GA, With 0,01 con | 79.6 | a |
| 6. | Soaking in GA, With 0,001 con | 75.3 | ab |
| 7. | Soaking in GA, With 0,0001 con | 67.3 | c |

P: >0.003 C.V= 42 SE ± 0.1

* Similar letters in the same column are not significantly different using Tukey-Kramartest.

Table (3) show germination responses to different pretreatment techniques as reflected by final germination percentages .The results show significant differences between treatments with soaking in $GA_3$,differentconc and $H_2O$ interval.

Table (4) effects of seed percentages techniques on germination of the three provenances of Mahogany

| Treatment | Sinnar | Um Abdalla | Zalinge |
|---|---|---|---|
| 1. Control | 70. 0b | 62.32 c | 74.32 a |
| 2. Soaking in $H_20$for 12hrs | 68. 0a | 68. 32 a | 66.00 b |
| 3. Soaking in $H_20$for 18hrs | 84. 3a | 71.68 c | 78.00 b |
| 4. Soaking in $H_20$for 24hrs | 68. 7a | 68.32 a | 55.68 b |
| 5. Soaking in GA, With 0,01 con | 82. 3a | 78.32 b | 74.68 c |
| 6. Soaking in GA, With 0,001 con | 73. 3a | 68.68 b | 72.32 a |
| 7. Soaking in GA, With 0,0001 con | 70. 7a | 63.32 b | 55.00 c |
| Probability | ≥0.0023 | ≥0.0092 | ≥0.0001 |
| STD | ± 19 | ± 20 | ± 25 |
| CV % | 26 | 27 | 37 |

* Similar letters in the same column are not significantly different using Tukey-Kramar test.

Table (4) shows significant difference on final germination percentage between treatments. Sinnar provenance was significantly different from the other two provenances followed by Zalinge and Um Abdalla. Soaking in water for 18 has and soaking in $GA_3$, (conc. 0.01) is significantly different for all provenances against control

Table (5) Comparison of germination mean of treatment versus control for Seed size groups over all provenances

| Treatment | large | medium | Small |
|---|---|---|---|
| Control | 77.00a* | 73.00 b | 42.12c |
| Soaking in $H_20$for 12hrs | 81. 6ba | 84. 32 a | 50.68c |
| Soaking in $H_20$for 18 hrs | 94. 68 a | 88.00 b | 86.00bc |
| Soaking in $H_20$for 24hrs | 83. 68b | 86.00 a | 85.44 a |
| Soaking in GA,With 0.01 con | 86. 00 a | 77.68 a | 87.56 a |
| Soaking in GA, With 0,001 con | 87. 38 a | 82.68 a | 49.32 b |
| Soaking in GA,With 0,0001 con | 73. 68b | 87.68 a | 49.26 c |
| 0.0089 | STD ± 22.4353 | CV=27 | |

* Similar letters in the same raw are not significantly different using Tukey–Kramar test.

Table (5) shows high significant difference between treatments and control for all seeds sizes. .The large size and medium size give more or less similar results for all the treatment and the control. The small seed size had high significant different between the control and the spooking in water for 18 hrs and spooking in $GA_3$, with 0.01 but the rest of the treatment are not significantly different from the control. The germination mean percentage of the small sized of seed after treatment with soaking in water for 18 hrs and treatment with $GA_3$(conc. 0.01 ) become similar to germination of large size seed and not significantly different from the control of the large seed sized .

## 1V. DISCUSSION

Significant differences detected in seed weight between the three provenances. Provenance Zalinge ranked first followed by Um Abdalla then Sinnar respectively. Thus, the superiority of Zalinge provenance to produce heavy seed is evident .On the other hand the significant difference in seed weight between the provenances attributed to the effect in water condition available in each provenance (Zalinge 800 mm, Um Abdalla 700mm and Sinner 600mm). It is evident from these results that seed of drier areas (Sinnar) are lighter than seed of relatively wetter habitats (Um Abdalla and Zalinge). This results support earlier findings obtained by some workers. Several studies also reported high variability in seed weight with arrange of 10-24 gm per 100 seed while in the present study the range is 12.9 to -17.4gm per 100 seeds. This range attributed to the fact that seed included in present study belong to different geographic regions where difference in seed weight is expected in a changing environment like the tropics variability in seed germination between the different seed size Seed germination of large size may be the best one because the large size is not dormant EL Tahir(1999).

Seed germination response over all treatment levels showed high significant differences ($p \geq 0.05$). Mahogany seed soaked in $GA_3$ 0.01 conc and soaking in $H_20$ for 18 hrs gave the best germination response, whereas soaking in $GA_3$.0001 and control gave the lowest. The high response of seed to soaking in $GA_3$ confirms the presence of endogenous dormancy of the embryo. on the other hand the high response of seed to soaking in water for 18 hrs and the negative response to soaking in water for 24hrs confirms the presence of some coat inhibitors, which were leached out after soaking for 18h and absorbed by the seed when soaking for prolonged periods (24hrs) which sharply decrease germination. These two findings indicates the presence of a combined dormancy (chemical + endogenous) in mahogany seeds this the same as obtain by Mahgoub(2002)

## V.CONCLUSION

Seed of Mahogany were found to have two sizes large and small which is deeply dormant and. presence of a combined dormancy (Chemical + endogenous) in mahogany seed The best treatment to break the dormancy of small Mabogany seed was found soaking in $H_2O$ for 18 hrs and. $GA_3$ (0.01) con) for two hours. These suggest select soaking in$H_2O$ for aforestation program which reduce the effort and cost of planting this species.

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