Effect of Hot Water on the Germination Rate of *Cassia siamea* L. Seeds

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Received: 23rd September 2016 Accepted: 5th May 2017

Abstract
An experiment was carried out to determine the effects of hot water treatment on the germination rate, germinabulity and rottenness on seeds of Cassia siamea L. The seeds were evaluated for rate of germination after a pre-treatment with hot-water at (100^{0}C) for the following durations: no heat treatment (control), 12, 24, 36, 48 and 60 min. designated as T0, T1,T2,T3,T4 and T5 respectively. The highest percentage germinability (100) was in T1and the lowest (17) in T0, percentage rottenness was highest and lowest in T0 (25) and T5 (0), respectively.T1 and T5 gave the highest while T 2, 3 and 4 gave the lowest (25) germination rate. Lastly, viability percentage was highest (100) in T 1 and T5 and lowest (80) in T0. In conclusion, seed dormancy is mainly attributed to seed coat as commonly found in most forage legumes and can be broken by treatment with hot water to break the dormancy but not for too long to the extent of adversely affecting the viability of the seed. From this study, pre-treatment of seeds with hot water for 12 mins. and 60 mins are recommended for high germination rate.

Keywords: Cassia, germinabilty, h-wateotr, pre-treatments.

Effet de L'eau Chaude Sur Le Taux de Germination Sur La Graine de *Cassia siamea* L.

Résumé
Une expérience a été réalisée pour déterminer les effets du traitement de l'eau chaude sur le taux de germination, la germination et la pourriture sur les graines de Cassia siamea L. Les graines ont été évaluées pour le taux de germination après un prétraitement avec l'eau chaude à (1000oC) pour les durées suivantes; Pas de traitement thermique (contrôle), 12 min, 24 min,, 36 min., 48 min. et 60 min. désignés comme T0, T1, T2, T3, T4 et T5 respectivement. Le pourcentage le plus élevé de germinabilité (100) était en T1 et le plus bas (17) en T0, pourcentage de pourriture était le plus élevé et le plus bas en T0 (25) etT5 (0), respectivement .T1 et T5 donnaient le plus haut alors que T 2, 3 et 4 donnaient le taux de germination le plus bas (25). Enfin, le pourcentage de viabilité était le plus élevé (100) en T 1 et T5 et le plus bas (80) en T0. En conclusion, la dormance des graines est principalement attribuée à la couche de graines, comme on le trouve couramment dans la plupart des légumineuses fourragères et peut être brisée par traitement avec de l'eau chaude pour casser

la dormance mais pas trop longtemps dans la mesure où elle affecte négativement la viabilité de la graine. À partir de cette étude, prétraitement des graines avec de l'eau chaude pendant 12 minutes à 60 minutes est recommandé pour un taux de germination élevé.

Mots-clés: Cassia, germinabilty, l'eau chaude, prétraitement.

Introduction

To survive the harsh economic situation, Nigeria needs to fall back heavily on Agriculture which had been the mainstay of the economy in times past. All forms of Agriculture need to be exploited in order to sustain the economy (Buck *et al.,* 1997; Ogungbesan *et al.,* 2013). Agrosilvo-pastoralism belongs to a group of practices commonly known as agroforestry, where trees (leguminous and non-leguminous) are grown in the same area where livestock are raised (Bansh and Paul,1992; Nair,1984; Rao *et al.,*1998;Motis,2007; Ogungbesan *et al*.,2013). Animals may graze in existing forests, or trees may be grown in pastoral land (Copland, *et al.,*1994). Silvopastoralism can help mitigate climate change, and protect soils from degradation (Copland, *et al.,*1994; Ogungbesan *et al.,* 2013).They further stated that trees act as carbon sinks by absorbing CO_2 as they grow. For this reason plantations of timber are likely to become part of a carbon credit economy. Trees also contribute to environmental protection in grazing areas by protecting steep land from erosion. (Ivory, 1990; Steppler and Nair,1993; Rao *et al*.,1998). In order to produce these trees, good viable seeds are required to enhance early emergence, uniform germination and healthy seedlings (Ogungbesan*,* 2004). Although, stem cuttings can be used to propagate them, it has limited advantages over seeds as a source of tree regeneration. Seeds are portable, storable, easy to plant and easy to transport. Seed dormancy however is a limitation to the use of seeds to regenerate trees.

According to Maher *et al*.,(2011), the seeds of legume species usually have a hard seed coat or testa, which make them impermeable to water and gases. Seeds must therefore be pre-treated before germination. This is to break dormancy in order to facilitate early and uniform germination. Although pre-treatment methods have been developed and described for many plant species, dormancy still causes problems of low germination percentages and rates for several tropical species. This is due to lack of general knowledge of their seed physiology and to variation in dormancy rate. For this reason, Maher *et al*., (2011) stated that seeds require some form of treatments for good imbibition of water to ensure a uniform germination and early emergence of forage legumes to be used as pasture. Dormancy in hard seed can be broken by breaking the testa or seed coat (Baskin and Baskin, 1998; Schmidt, 2000; Ogungbesan *et al.,* 2008; Babalola *et al.,* 2014). *Cassia siamea* is a valuable multipurpose leguminous tree because of its ability to improve soil fertility through nitrogen fixation (Amira and Mohamed, 2013). And also because of the reverse vegetation cycle of this tree, which produces green leaves in the dry season for feeding animals, who in turn spread manure on the field (N.A.S.,1980; Amira and Mohamed, 2013). Therefore the study was designed to determine the effect of hot water on percentage germinability, rottenness, viability and germination rate of *Cassia siamea* seeds.

Materials and Methods

Site description:

The experiment was carried out at the

laboratory of Crop Production and Environmental Biology of the College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro. Seeds of *Cassia siamea* were collected from the Pasture and Range unit of Olabisi Onabanjo University, Ogun State, Nigeria. It is located within longitude 2º 45' E and 3º 5'E, latitude 6º 55' N and 7º 15' N, 90-120 metres above sea level; Temperature:- 28. 9^0c; Rainfall :- 1945mm; R.H.:-72.81%, Evaporation:- 1806.9m; soil type:- oxic paleustalf (FAO. 2006); soil texture:-sandy loam and vegetation; sub-humid forest mosaic savanna type; Elements (Cmo^1kg^{-1}) Na. 50, K. 22, Ca. 95, Mg. 86, H^+ 0.13, C.E.C. 2.67,pH (H20) 5.55, P(MgKg1) 6.86, Zn (MgKg1) 6.75, OC. (%).79, OM (%) 1.19, N (%).079, Sand (%) 75.16, Clay (%) 15.57, Silt (%) 9.25). The area is undulating, which is drained mainly by River Rori and River Ayinbo (Ogungbesan *et al.*, 2013).

Seed preparation

Healthy (matured, dried about to split before harvesting (HSU,1994) seeds based on size, colour, smoothness and good appearance were sorted out. They were counted and divided into six batches of 240 seeds (40 in 6 replicates) according to the treatments. Each batch was put in a 1mm tabular wire mesh before immersion in boiled (100^0C) water. This was to allow for quick removal of seeds when time of soaking was up .The pre-sowing treatments were as follows:

Hot water treatment

T0: control (intact seeds without soaking), T1: seeds were soaked in hot water for 12 minutes,T2: seeds were soaked in hot water for 24 minutes,T3: seeds were soaked in hot water for 36 minutes,

T4: seeds were soaked in hot water for 48 minutes and T5: seeds were soaked in hot water for 60 minutes (Babalola *et al.*, 2014).

Seed planting

The pre-treated seeds were sown in petri-dishes covered with transparent lid lined with two layers of filter paper and watered to its moisture capacity without allowing any excess water film or water logging around the seeds (IBPGR, 1984). The experimental design was complete randomized design (CRD).

Data collection

The seeds in each treatment were examined on a daily basis and germination was recorded daily until the end of the experiment (21 days after sowing). Germinated and rotten seeds were removed as soon as they were observed.

The cumulative percentage germinability percentage rottenness, germination rate and percentage viability were calculated as follows:

$$\text{Germination (\%)} = \frac{\text{Number of germinated x 100}}{\text{Initial number of planted seeds}}$$

(Babayemi *et al.,* 2003)

$$\text{Rotteness (\%)} = \frac{\text{Number of rotten seeds x 100}}{\text{Initial number of planted seeds}}$$

(Okpako, 2008)

Germination rate = $1/t_n\ (\sum G_n)$

Where G is the number of seeds sprouted at time *tn* (in days).

(Babayemi *et al.,* 2003)

$$\text{Percentage viability} = \frac{\text{Germinated seeds + ungerminated seeds - rotten seeds x 100}}{\text{Initial number of planted seeds}}$$

(Okpako, 2008)

Data Analysis

The values were transformed using arc sine perior to analysis. Data was analysed using SAS, 2002 and when means were significant, they were separated using the Least Significance Difference (LSD) at 0.05 level of significance (S.A.S., 2002).

Results

Cassia seed percentage germinability as shown in Figure 1 was highest among seeds treated with hot water at all treatments (that is T1 to T5) levels. T1 was the highest with 100%, followed by the other treatments (T2, T3, T4, and T5) with 97.5 %except T0 where percentage germinability was low (17). These are seeds without any hot water treatment (T0).Percentage rottenness as shown in Figure 2 was highest with a value of 25.00 among seeds that were not treated with hot water that is T0. T3 ranked next in order of high percentage rottenness with 11.88, followed by T4. T1 and T5 had the lowest percentage rottenness value of 0.

Discussion

The percentage germinability implies that hot water greatly influenced the germination of *Cassia siamea. Cassia siamea* is a legume and exhibits mainly seed coat induced dormancy as stated by Argel and Humprey (1983); Babayemi *et al*. (2003) and Ogungbesan *et al*. (2008). Most species of the family Fabaceae exhibit physical dormancy caused by advanced morphological structures of the seed coat. The seed coat consists of four distinct layers namely; the cuticle, the macrosclereids, osteosclereids and parenchyma layer (Schmidt, 2000). The cuticle is the outer layer which is a waxy and water-repellent in character. Macrosclereids or palisade layer consists of long, narrow, tightly packed vertical cells. Osteosclereids is a layer of more loosely packed cells and parenchyma layer is made up of little differentiated cells. Impermeability of the leguminous seed coat is ascribed to the two outer layers of cuticle and macrosclereids (Babalola *et al.*, 2014). Other factors that can influence germinbability for example, are storage duration, environment; light and temperature along with various storage procedure (Sasithorn *et al.*,2005) and maturity stage at harvest (Baskin and Baskin,1998).

Concerning rottenness, probably, the treatment speedily broke dormancy in the seeds and allowed emergence of radicle and cotyledon while in the control treatment, the cotyledon using up all the nutrients stored in it could not emerge due to hard seed coat which could have resulted in the death of the seeds (Baskin and Baskin,1998) .There is

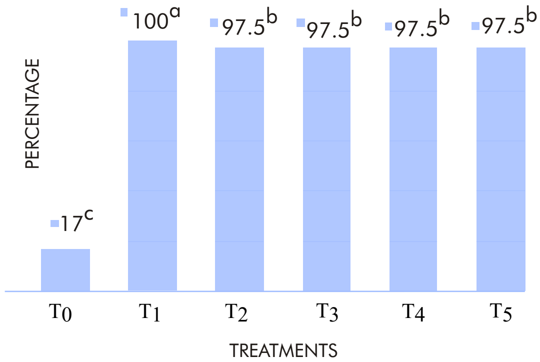

Fig 1: Effect of hot-water treatments on the percentage germinability of *Cassia siamea*

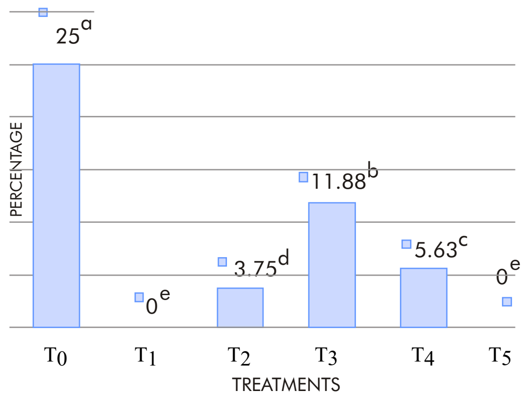

Fig 2: Effect of hot-water treatments on the percentage rottenness of *Cassia siamea*

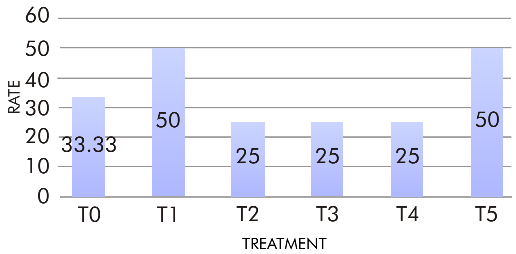

Fig 3: Effect of hot -water treatments on the germination rate of *Cassia siamea*

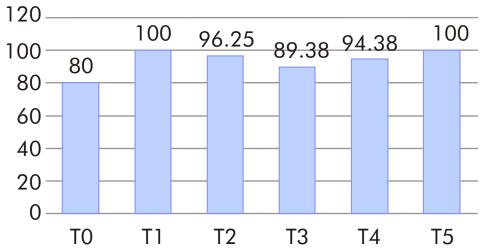

Fig 4: Effect of hot-water treatments on the percentage viability of *Cassia siamea*

also the likelihood that the hotness in addition to softening of the seed coat by the hot water (100^{0}C),t had also done some disinfection thereby reducing the microbial load that could engender the growth and multiplication of microbes leading to rottenness and decadence (Babalola *et al.,* 2014).

From the result obtained in the germination rate, T1 and T5 are recommended as the most suitable treatments for high germination rate in Cassia siamea seeds (Baskin and Baskin, 1998; Amira and Mohamed, 2013; Babalola *et al.,* 2014). It is also suggested that probably some additional dormancy due to chemicals such as Abscisic acid, Gibberellins and Auxin (Baskin and Baskin, 1998; Pessarakli, 2001) might have been broken when these chemicals probably leached out after soaking the seed in water thereby leading to increase germination rate (Baskin and Baskin, 1998).

The viability trend shows that hot water treatments influenced the viability of Cassia siamea seeds (Ogungbesan *et al.,* 2008).The reasons given for rottenness is also applicable to this process in that those seeds exposed to hot water were more viable than the control (Babalola *et al.*, 2014).

Conclusion and Recommendations

The results revealed hard seed coat as the factor behind seed dormancy in *Cassia siamea* seeds. The use of hot water proved to be highly effective in breaking seed dormancy in *Cassia siamea* seeds as shown from the result, which suggest the fact that the seeds need just little time when treated with hot water before they lose their seed coat dormancy.

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