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Full Length Research Paper

Seed Treatment and Storage Duration Effects on Emergence and Quality of African Breadfruit Seedlings

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The effects of factorial combinations of four storage duration (in days after seed extraction) and surface sterilization with three dilution levels of sodium hypochlorite on seedling emergence and seedling quality of African breadfruit were studied. Storage duration significantly influenced days to seedling emergence, cumulative emergence and seedling quality traits. The effect of sterilization was, however, only significant on deformed seedlings and seedling foliage development. The combined effects of storage duration and sterilization were significant on all traits measured. Seedlings arising from previously sterilized seeds and planted within six days of extraction had fewer cases of deformity and had better foliage development. It was conclusive that after-ripening treatment was necessary to enhance the number of seedling emerging and quality of seedlings of African breadfruit. Sterilizing seeds with 10% dilution of NaOCl and air-drying under ambient tropical room condition for three to six days were found most appropriate, and thus, recommended.

Key words: Seed storage, sterilization, seedling emergence, seedling quality.

INTRODUCTION

African breadfruit (*Treculia africana var. africana* Decne) belongs to the family Moraceae. It is an evergreen forest fruit tree in tropical Africa. The plant produces large compound fruit, usually round, and covered with rough pointed outgrowths. The seeds are buried in spongy pulp of the fruits (Keay, 1989) . The seed is an important food item, popularly known as “Ukwa” by the Igbo tribal group of southeastern Nigeria. The seed is variously cooked as pottage, or roasted and sold with palm kernel (*Elaeis guineensis* Jacq) as roadside snack. The flour has high potential usage for pastries (HN Ene-Obong, Professor of Human Nutrition, personal communication, Sept. 2003). The seeds are highly nutritious and constitute a cheap source of vitamins, minerals, proteins, carbohydrates and fats (Okafor and Okolo, 1974). African breadfruit is an important natural resource for the poor, contributing significantly to their income and dietary intake.

Despite the socio-economic importance of African breadfruit to a very large population of people in southern Nigeria, the plant is still a protected crop and or semi-domesticated species. Increasing human population and agricultural practices have put pressure on forest reserves thereby depleting some genetic resources. To abate total loss or extinction of some these important forest species, they must be cultivated regularly. Significant to achieving this is the propagation of the concerned species, either by seed or stem cuttings. Seed propagation is more amenable to the subsistence farm practice of the rural people. Normally, fruits are allowed to fall off the tree and rot before seeds meant for food or planting are extracted (Ugwuoke et al., 2003). Thus, there is usually a high microbial build up in such seeds. Few empirical studies (Ugwuoke et al., 2003; Baiyeri, 2003; Ugwunze, 2003) used fresh seeds for planting, and reported less than 80% seedling emergence. Besides, practical observations showed that viability decreases as

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Table 1. The main effect of number of days of seed storage on seedling emergence and seedling quality.

Days in storage	DFSE	PTE	PDS	PSTL	NTL
0	14.5	94.0	44.4	68.4	14.1
3	13.0	90.0	27.5	71.4	14.1
6	12.6	90.0	47.4	38.7	7.4
9	19.0	76.7	0.0	30.9	5.3
$LSD_{(0.05)}$	1.7	8.7	13.3	15.5	3.3

DFSE: Number of days to first seedling emergence; PTE: Percent total seedling emergence; PDS: Percent deformed seedling; PSTL: Percent seedling with true leaf; NTL: Number of leaves per treatment.

the seed looses moisture over time.

In this study therefore, we evaluated the effects of factorial combinations of four storage duration (in days after seed extraction) and surface sterilization with three dilution levels of sodium hypochlorite on seedling emergence and quality. The specific objective was to identify the after-ripening treatment that could boost seedling emergence percent and the quality of seedlings obtained thereof.

MATERIALS AND METHODS

The experiment was conducted in a controlled environment in the Department of Crop Science, University of Nigeria, Nsukka, Nigeria, between July and September 2003. Seeds were extracted from a single ripe fruit of *Treculia africana var. africana.* Seeds were washed and only viable seeds, determined by floatation method, were used. The seeds were air-dried for a couple of hours and only properly filled seeds were sorted out for use. Six hundred well-filled seeds were finally selected for the experiment.

The experiment was a factorial laid out in a completely randomized design. The factors were number of days in storage and sterilization with sodium hypochlorite (NaOCl, 3.5% active ingredient). Storage durations were 0, 3, 6, and 9 days, while levels of sterilization were 100% water (control), 90% water plus 10% NaOCl (10% dilution) and 95% water plus 5% NaOCl (5% dilution). There were therefore, 12 treatment combinations, each replicated five times, and each replicate were sown with ten seeds. Two hundred seeds were soaked for 10 min in each level of sterilization treatment. Thereafter, a portion representing no storage treatment was planted immediately, while the remaining portion was air- dried under ambient room condition before storage in unceiled thin cellophane. Subsequently, seeds were taken and planted until the ninth day of storage. Seeds were sown in 10 x 10 cm black polybag filled with a cured and sterilized ricehull. Medium sterilization followed procedure described by Agbo and Omaliko (2006) Watering was with deionized water.

Parameters measured included number of days to seedling emergence, percent cumulative emergence, total number of true leaves produced by emerged seedlings per treatment combination, percent emerged seedlings that had produced true leaves and percent deformed seedlings. True leaves were leaves other than the embryonic leaves; foliage development parameters were taken seven weeks after planting. Seedlings were counted as deformed if the plumule coils or twisted or is needle- like with no embryonic or true leaves; deformed seedling eventually dies.

Data were analyzed with GENSTAT Discovery Edition 1 Release 4.23 (GENSTAT, 2003), following factorial in a completely randomized design procedure. Means separation to detect the effects of storage, sterilization and storage by sterilization interaction were by Least Significant Difference (LSD) at 5% probability level.

RESULTS

Analysis of variance (data not shown) revealed that the main effects of storage duration and the interaction between storage duration and sterilization were significant ($P < 0.05$) for all traits evaluated. The main effect of sterilization was significant ($P < 0.05$) only on percent deformed seedlings, proportion of seedlings with true leaves and the number of leaves produced by seedlings.

Seeds stored for three or six days before planting emerged earlier than those planted immediately after extraction from the fruit pulp or those stored for nine days. Cumulative percent seedling emergence was statistically similar if seed planting was not delayed beyond six days of extraction (Table 1) . Percent seedling emergence when seeding was delayed for nine days was relatively low but there was no deformed seedlings, compared to more than 40% seedling deformity when seeds were either sown immediately after extraction on planted six days thereafter. Higher proportion (71%) of seedlings arising from seeds planted after three days of storage produced true leaves within the study period. Early seed sowing enhanced more leaf production.

Seed sterilization resulted into lower proportion of deformed seedlings. About 63% of seedlings arising from seeds previously treated with 10% dilution of NaOCl had true leaves and each seedling thereof had more leaves (Table 2). The effect of seed sterilization was non-significant on number of days to seedling emergence and cumulative percent emergence.

The combined effects of storage and sterilization on days to seedling emergence and percent cumulative seedling emergence are shown in Figure 1. Sterilization was effective only when seed sowing was delayed for nine days, in which case, seeds treated with 5% dilution of NaOCl emerged faster than others (Figure 1a) but had lower percent cumulative emergence (Figure 1b). Sterilization with 10% dilution increased emergence slightly when seeds were planted after three days of storage. However, sterilized seeds had poorer emergence when sowing was delayed for nine days.

Table 2. The main effect of surface sterilization of seed with various dilution of sodium hypochlorite on seedling emergence and seedling quality.

Sterilization	DFSE	PTE	PDS	PSTL	NTL
10% dilution	15.5	88.0	19.9	62.5	12.5
5% dilution	14.5	84.5	23.7	49.6	9.7
Control (Water)	14.4	90.5	45.8	44.9	8.6
$LSD_{(0.05)}$	ns	Ns	12.1	13.4	2.9

DFSE: Number of days to first seedling emergence; PTE: Percent total seedling emergence; PDS: Percent deformed seedling; PSTL: Percent seedling with true leaf; NTL: Number of leaves per treatment.

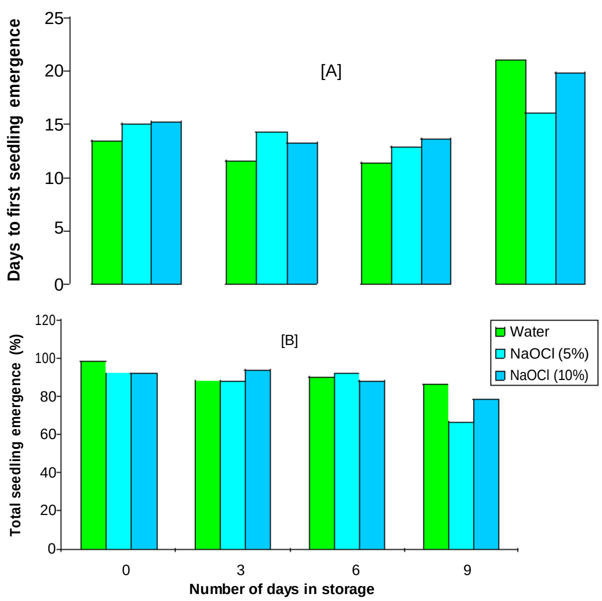

Figure 1. The effects of number of days of seed storage and surface sterilization with sodium hypochlorite at different dilutions on (A) days to first seedling emergence and (B) percent total seedling emergence.

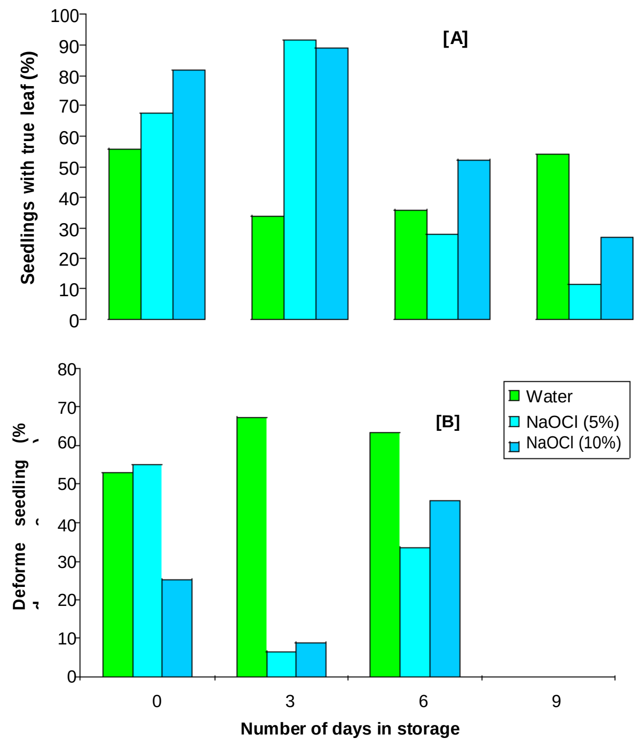

Figure 2. The effects of number of days of seed storage and surface sterilization with sodium hypochlorite at different dilutions on (A) percent seedlings with true leaves and (B) percent deformed seedling.

Higher proportion of seedlings arising from seeds earlier sterilized with 10% dilution of NaOCl and planted within six days of extraction, produced true leaves (Figure 2a). Seeds planted three days after extraction showed distinctively the effect of sterilization on foliage development. Deformity is unwanted. It results into seedlings unfit for field establishment. Figure 2b showed that there were no deformed seedlings arising from seeds stored for nine days. Sterilization however, significantly reduced the proportion of deformed seedlings arising from seeds store for three or six days. More than 50% of seedlings arising from seeds not previously sterilized and were planted either immediately or stored for up to six days were deformed.

DISCUSSION

The results of this study showed that seeds of African breadfruit probably need an after-ripening treatment before planting to reduce the number of deformed seedlings. The causes of deformity were suspected to be physiological and pathological; physiological because delayed planting reduced deformity, and pathological because increasing concentration of NaOCl used for seed sterilization reduced the number of deformed seedlings. Delaying planting till the ninth day of seed extraction had no deformed seedlings, there was how-ever, relatively low percent seedling emergence, possibly due to loss of viability. The reduction in viability might probably be associated with loss of moisture.

Irrespective of treatment, percent seedling emergence was relatively high but a proportion of emerged seedlings were deformed. Those deformed seedlings emerged probably due to little or no compaction of the potting medium (ricehull). A previous study (Baiyeri, 2003) and a more recent one (Baiyeri and Mbah, 2006), using soil-based and soilless media recorded relatively lower percent seedling emergence, probably because germinated seeds in those studies could not emerged due to deformity and the bulk density of the potting media. It could be deduced from the current study therefore, that seedling deformity is inherent and may account for low percent emergence obtained when empirical studies are conducted.

Sterilization enhanced foliage development of the seedlings probably because there was reduced competition with pathogens, which could have impeded the rate of growth and development of those seedlings. However, this was not obvious on seedlings arising from seeds stored for nine days before planting probably because the protective effect of NaOCl concentration was not sustained, suggesting that either higher concentration might be required or that after six days of storage, the seeds might require a re-sterilization before planting.

It was evident from the study that storage duration influenced earliness to emergence and the total number of seedling emerging whereas sterilization significantly affected the quality of seedlings produced. Seedlings arising from previously sterilized seeds had fewer cases of deformity and had better foliage development. It was conclusive that after-ripening treatment was necessary to enhance the number of seedling emerging and quality of seedlings of African breadfruit. Sterilizing seeds with 10% dilution of NaOCl and air-drying under ambient tropical room condition for three to six days were found most appropriate, and thus, recommended.

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