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Full Length Research Paper

Effect of dressing of hot water-steeped and unsteeped seeds on longevity and seedling emergence in *Corchorus olitorious* L.

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The study was conducted at the laboratory of the Department of Crop Production, Federal University of Technology Minna. Seeds of cultivars "Amugbadu" and "Oniyaya" of *Corchorus olitorius* were steeped in hot water at 97°C for five seconds (for the purpose of breaking dormancy) and subsequently air dried to about 10% moisture content (wet weight basis). They were then treated with seed-plus, Apron-star (As) or Wood ash (Wa) at the rate of 10 g per 4 kg seed, packaged in paper envelopes and stored for 20 weeks at 30°C while the unsteeped seeds served as the control. Germination ability and seedling emergence were determined before and during storage. Before storage, 90 and 95% germination levels were recorded for hot-water steeped seeds of "Amugbadu" and "Oniyaya" respectively in contrast to 25 and 33% germination for the unsteeped seeds. There was a general decline in both germinability and seedling emergence with storage period irrespective of treatments. In non-dormant "Amubgadu" seeds, viability was better maintained without seed dressing or when seeds were dressed with wood ash. In "Oniyaya", viability was poorest in As-dressed seeds. Significantly better seedling emergence was recorded in non-dormant seeds dressed with wood ash. Unsteeped (dormant) seeds germinated poorly throughout the storage period. Dormant seeds from which zero germination was recorded after 12 weeks of storage gave about 75% germinations followed by steeping in hot water. It is postulated from this observation that the poor germination of stored seeds might be due to a decline in the germination energy of the seeds which made their radicle unable to rupture the endospermic tissue and seed coat. This is an indication that the seeds were still viable at this age but required the weakening of the seed coats (which was effected by hot water-steeping) to permit germination.

Key words: Longevity, seed dressing, seedling emergence, jute mallow.

INTRODUCTION

Jute mallow (*Corchorus olitorious*) leaves are consumed as pot herb in many countries of the world (Jansen et al., 2004). The leaves are rich in beta carotene, Iron, Calcium (Ca), and vitamin C. The plant has antioxidant activity with a significant vitamin E constituent and is particularly good for sick people who have difficulties in swallowing as it is slippery in texture (Moses and Ramsey, 2004). It is also said to be the second most important vegetable fibre after cotton for making sacks and cloths (Chattapadhyay et al., 2004). The role of the seed coats

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as a germination constraint is well known (Debeaujon and Koorneef, 2000; Koornneef et al., 2002). However, one of the positive roles played by the seed coat is to protect the embryo against detrimental agents from the environment and it also limits the detrimental activity of physical and biological agents during seed storage (Debeaujon et al., 2000). In theory, seeds with impermeable coats would present a barrier to moisture and fungi and would therefore be expected to live longer than those with permeable coats. In tandem with this view Clerkx et al. (2004) reported that mutants of Arabidopsis with seed coat alterations showed a stronger reduction in germination percentage after storage. The authors stressed that this was an indication of the importance of a functional seed coat for seed longevity. *C. olitorious* seeds are known to posses dormancy due to hard seed coats (Schippers, 2000), which can be broken by steeping seeds in boiling water at about 97°C for five seconds or by scarifying the seed coat (Oladiran, 1986). Some flavonoid pigments which are synthesized by plants and accumulated in the cells of the testa have been reported to act in defense against predators and pathogens (Dixon et al., 2002).

According to Pourcel et al. (2005), their derivatives that may be produced strengthen the testa, protect the embryo and endosperm from biotic and abiotic stresses. Observations from unpublished works have shown that when *C. olitorius* seeds are steeped in hot water, the soak water becomes brownish in colour which is an indication of the leaching of some of the coat pigments. This suggested that, seed steeping may not only soften the seed coat, it also results in a change in coat structure even when such seed may have been dried back. Damages of this sort may render the seed coat less protective resulting in faster embryo death during storage due to pathogen invasion. In situations in which damages to seed coats are not suspected, extra precautions are still being taken to protect seeds meant for planting and or storage. Proper seed dressing with appropriate chemicals that are known to be effective against wide range of pathogens (FAO, 2007), had been reported to enhance seed longevity in storage. Classen (1995) reported that, proper storage and treatment of seed with chemicals slow down deterioration in all seed species, preserving viability and vigour. Okra seeds treated with baselin (fluchoralin) at 2kg a.i/ha have been shown to exhibit higher vigour, seedling emergence and yield. Similarly, Adebisi et al. (2004) obtained significantly longer storage life by treating soyabean seeds with Apron plus, Almithio and Aldrex T. Contrary to the above however, Adebisi et al. (2003) observed that seeds treated with Apron plus, Almithio and Aldrex T did not last longer than the untreated control.

The objective of this study was to assess the effectiveness of seed treatment with wood-ash, Seed-plus (Sp) and Apron-star (As) on the germination and seedling emergence from dormant and non-dormant jute mallow (*C. olitorious*) seeds.

MATERIALS AND METHODS

The study was done between March and September 2010 using seeds of two cultivars ("Amugbadu" and "Oniyaya") of *C. olitorius* that are widely grown in Nigeria. Some seeds of the two cultivars were steeped in hot water as described by Oladiran (1986) to break dormancy; they were then spread on paper and air-dried under shade to a moisture content of about 10%. Samples of steeped (non-dormant) and unsteeped (dormant) seeds of both cultivars were dressed with As 42WS (consisting of 20% w/w thiamethoxam, 20% w/w metalaxyl-M and 20% w/w difenoconazole), Sp 30WS (consisting of Imidacloprid 10% + Metalaxyl 10% + Carbendazim 10% WS) (which are both manufactured by Shandong Xinghe Crop Technology co. Ltd Jinan) or wood-ash. The substances were applied at 10 g per 4 kg seed. The former two substances possess both fungicidal and insecticidal properties; untreated seeds served as the control. Seeds of the different treatment combinations were packaged in paper envelopes and stored at 30°C for 20 weeks. Seed samples were drawn for germination and seedling emergence tests prior to storage and at 2 weeks intervals. A sample of some dormant seeds stored for 12 weeks was steeped in hot water and then incubated to ascertain if there would be any difference in their viability level compared to the unsteeped and those stored following steeping.

For the germination test, 50 seeds of 4 replicates of each of the treatment combinations were counted and placed on layers of moist absorbent paper in plastic petri dishes and incubated at 30 °C; germination counts were taken every-other-day. The absorbent paper and seeds were kept constantly moist with distilled water. For the seedling emergence study, 4 replicates of 10 seeds from each treatment were sown into soil in plastic pots on each sampling day. The plastic pots were watered a day prior to sowing and twice weekly after sowing. All data in percentages were transformed to arcsin values before statistical analysis was done. Probit analysis (Finney, 1971) was also conducted on the germination data obtained from all treatments to determine the potential seed longevity (that is, the constant K_i), the slope, which is the rate of seed deterioration and the seed half-viability period (P_{50}), that is, the time taken for viability to drop to 50%, which according to Ellis and Roberts (1980) is a measure of absolute seed longevity.

RESULTS

Figures 1 and 2 showed the survival curves of Dormant (D) and Non-dormant (Nd) seeds of "Amugbadu" and "Oniyaya" cultivars. Before storage, 90 and 99.5% germination levels were recorded for Nd seeds of "Amugbadu" and "Oniyaya", respectively in contrast to 25 and 33% germination for D seeds. As storage progressed, there was a general decline in the germination of D and Nd seeds of both cultivars, irrespective of treatment. Both D and Nd seeds of "Amugbadu" cultivar stored better when untreated (control) or treated with wood ash (Wa) than when treated with As or Sp which values declined sharply after only 2 weeks of storage (Figure 1). The control performed better than Wa during the first four weeks of storage in Nd seeds and only at 2 weeks of storage in D seeds. Figure 2 showed the superiority of Nd, non-treated "Oniyaya" seeds over As and Sp

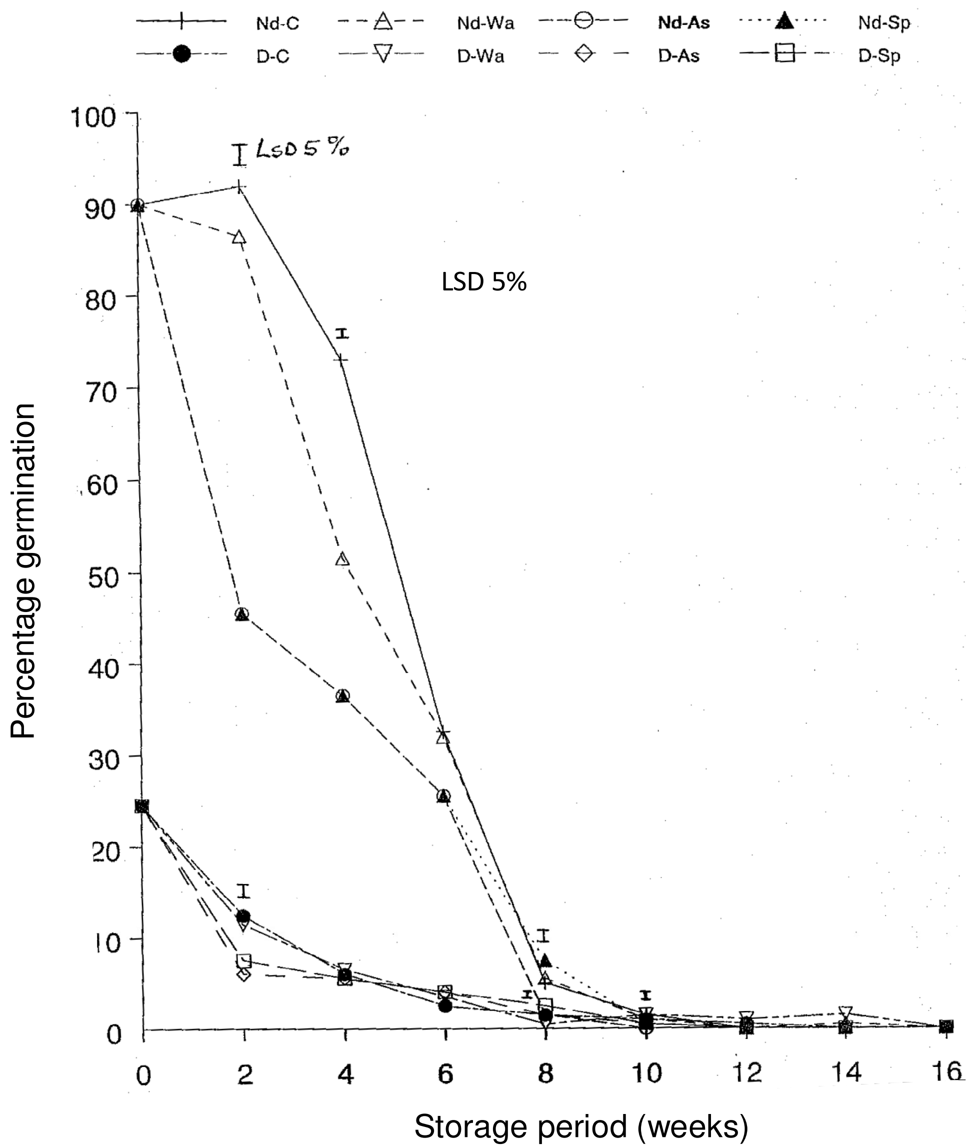

Figure 1. Germination levels of treated and untreated Dormant (D) and Non-dormant (Nd) seeds of Cv. “Amugbadu”. Treatment: Control-C, Wood ash (Wa), Apron-star Ws), Seed plus (Sp).

treatments within the first 6 weeks of storage. Viability of Wa-treated seeds was also poorer than the control at 4 and 6 WAS. Performance was consistently poorest in As-treated seeds irrespective of dormancy status. The germination of As dressed seeds dropped from about 100 to about 27% within 2 weeks of storage.

Prior to storage, seedling emergence of 60 and 80% were recorded for Nd seeds of “Amugbadu” and “Oniyaya” respectively in contrast to 20 and 30% for D seeds (Figures 3 and 4). A general decline in values was recorded as from 2 weeks of storage irrespective of dormancy status and seed dressing treatment. For the first 6 weeks of storage, seedling emergence was similar in “Amugbadu” seeds irrespective of the dressing material used. Shortly thereafter and up to the end of storage however, the superiority of Wa- and Sp-dressed seeds (more especially the former), became evident. Furthermore, though no significant differences were recorded among seed treatment materials in D seeds, higher seedling emergence values were obtained in untreated seeds and those treated with Wa, compared to the As-and Sp-treated seeds.

Figure 4 shows the general superiority of Wa-treated Nd “Oniyaya” seeds over all other materials. Again, performances were poorest in seeds treated with As and Sp. Table 1 showed the estimates in respect of some storage parameters obtained from probit analysis of germination data. It reveals that treatment of seeds with Wa, Sp and As reduces the potential of seed longevity in comparison with the untreated control. Furthermore,

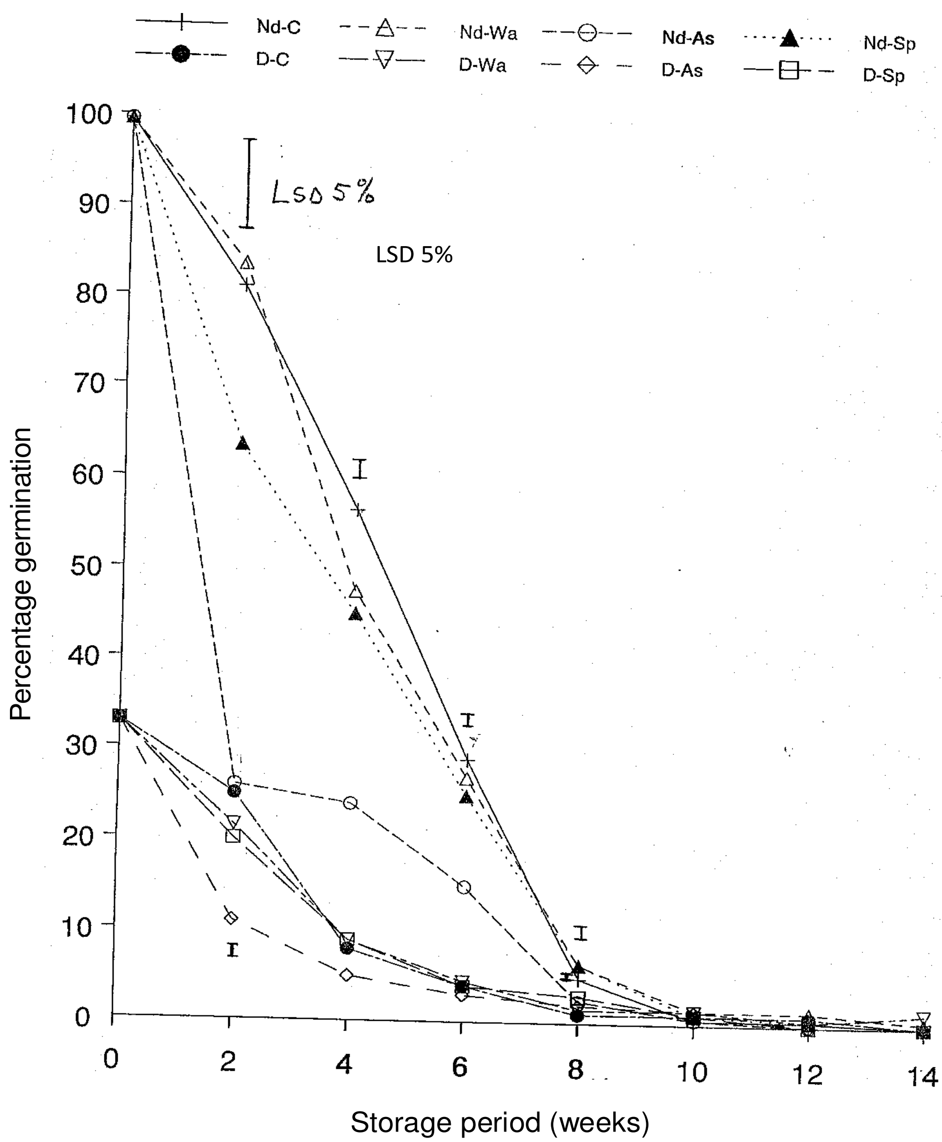

Figure 2. Germination levels of treated and untreated Dormant (D) and Non-dormant (Nd) seeds of Cv. "Oniyaya". Treatment: Control-C, Wood ash (Wa), Apron-star Ws), Seed plus(Sp).

treatment with Sp and As resulted in rapid seed deterioration which is reflected in reduced P_{50}. When a sample of the dormant seed stored for 12 weeks was tested for germination, values of 76 and 75% were recorded for "Amugbadu" and "Oniyaya", respectively compared to 0% recorded for both the unsteeped dormant and the non-dormant seeds of the two cultivars. In addition to the above, it is noteworthy that the seeds of *C. olitorius* lost vability without dormancy alleviation.

DISCUSSION

Seeds are normally dressed to protect them from pathogenic organisms and so delay seed deterioration during storage (Sekaramarthy et al., 1994). The opposite was however the case in this study. The general poor performance of seeds dressed with As and Sp might be an indication of the toxicity of these chemicals to *Corchorus*. Adebisi (1999) reported that, the dressing of soybean seed with Ap, Adrex T and Fernasan D was ineffective in the maintenance of viability beyond 2 months. Adebisi et al. (2003) also observed that, okra seeds treated with Ap and stored for 6 months had significant reduction in speed of germination. Ajala (2003) explained that, a reduction of the potency of the active ingredients of the chemical might occur during storage resulting in shorter seed life than expected. Just as Sp and As lowered both K_i and P_{50} in this study.

Adebisi et al. (2004) showed that, M-350 soybean

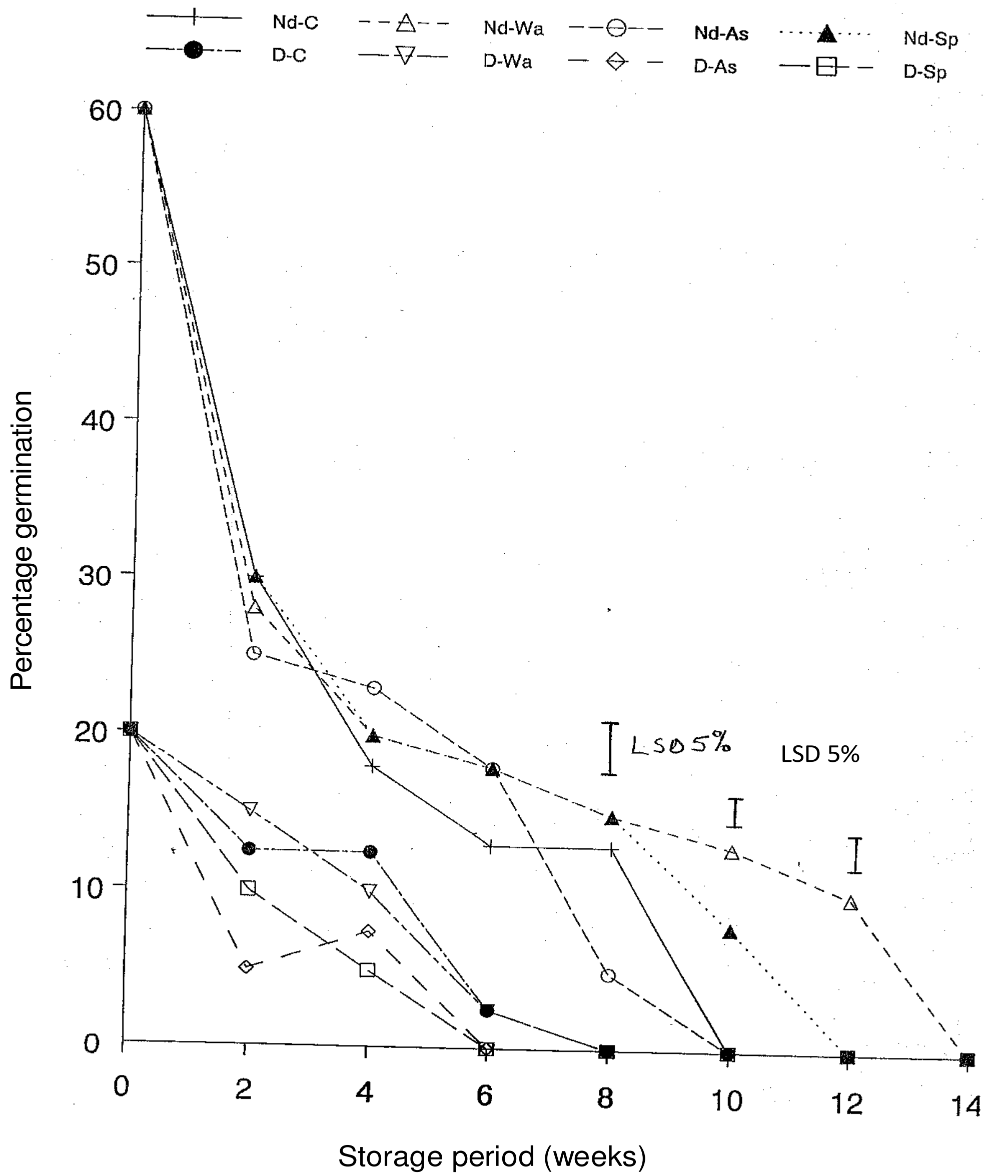

Figure 3. Seedling emergence from treated and untreated Dormant (D) and Non dormant (Nd) seed of cv "Amugbadu". Treatment: Control-C,Wood ash (Wa), Apron-star (As), Seed-plus (Sp).

variety seeds treated with Aldrex T had lower Ki and P_{50} values compared to the control. The authors also showed that different varieties of the same crop could exhibit differences in K_i and P_{50} values just as it was the case in this study. If seedling emergence is used to assess the effectiveness of the various seed dressing materials used in this study, then Wa showed some potential. Abdullahi (2006) did an analysis of the Wa obtained from a bakery in Minna, Niger State, Nigeria to determine its chemical composition. The sample contained SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, K_2O, and NaO. Wa is appreciated as a liming agent (Clapham and Zibilske, 1992) and it is known to increase soil pH in addition to the concentrations of K, Ca, B, Mg and other elements except N (Mandre, 2006).

We postulate that, the positive effect of Wa on seedlingemergence in this study might be linked probably to increase in the pH of the soil immediately around the seed. Bukvic et al. (2007) recorded the highest germination of pea seed at pH = 6 compared to higher and lower pH values. They also reported that, the pH requirement for optimum seedling growth may vary with seed age. For example, whereas the stem length of seedlings development for 33 months old seeds was greatest at pH = 6, the values obtained from 21 months old seeds was greatest at pH = 5.

In this study, the significantly high germination recorded for dormant "Amugbadu" and "Oniyaya" seeds that were steeped in hot water following storage for 12 weeks

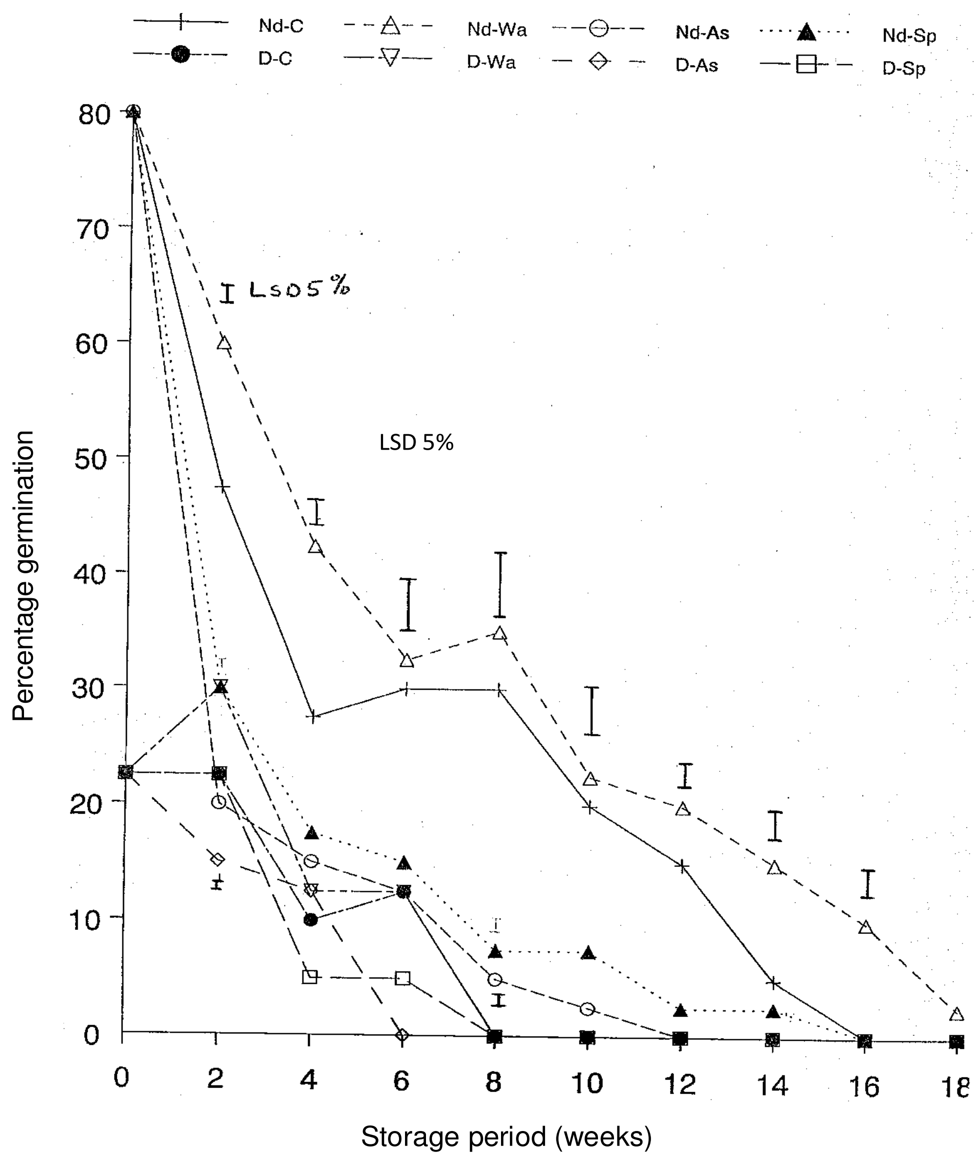

Figure 4. Seedling emergence from treated and untreated Dormant (D) and Non dormant (Nd) seed of cv "Oniyaya". Treatment: Control-C, Wood ash (Wa), Apron-star (As), Seed-plus (Sp).

Table 1. Estimates of the potential longevity (Ki) and the time taken for viability to drop to 50% (P_{50}) and R^2, the coefficient of determination of non-dormant *C. olitorius* seeds.

Crop variety	Seed dressing material	K_i	P_{50}	R_2
"Oniyaya"	Control	7.344	4.40	0.98
	Wood ash	6.850	4.80	0.97
	Apron star	6.477	3.00	0.93
	Seed plus	6.746	2.80	0.95
"Amugba"	Control	7.044	4.1	0.94
	Wood ash	6.686	2.50	0.89
	Apron star	6.163	2.50	0.89
	Seed plus	6.305	3.00	0.92

R^2 = Determination coefficient.

compared to the zero germination recorded for non-dormant seeds of the same age suggests that dormancy conferred longevity superiority on the seeds of this crop. This has also been shown to be the case in Arabidopsis by Debeaujon et al. (2000). The germination percentages of about 75% recorded for the two cultivars following the steeping of seeds at 12 WAS was however much lower than the 90 to 100% recorded for steeped seeds prior to storage. Also, the germination of 0% recorded for the unsteeped seeds of the two cultivars at 12 WAS, was much lower than the 25 to 33% obtained at the onset of storage. Two things must have been responsible for the decrease in values: One is the decline in vigour that is normally associated with seed age (Ibrahim et al., 2011) while the second could be linked to the reduction in germination energy that is known to decline as seed ages (Bukvic et al., 2007). Therefore, at 12 WAS, some seeds that though were still viable, might not have possessed enough energy to rupture the seed coats.

According to Oladiran (1986), hot water steeping might promote *Corchorus* seed germination by softening the seed coat which offers a mechanical restriction to embryo growth. An anatomical study of *Corchorus* seed revealed that the embryo is embedded in the endospermic tissue (Unpublished) which the radical would have to puncture to emerge during germination. Furthermore, Juntila (1973) and Watkins and Cantiliffe (1983) reported that, seed endosperm might constitute a mechanical restriction to radicle emergence. Aged seeds may have therefore reduced in vigour in this study and the weak embryo might therefore not be able to overcome the mechanical restriction of the seed coat and or the endospermic tissue in unsteeped seeds. Hot water steeping might have therefore, helped to alleviate the restrictions. This may need to be investigated empirically.

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