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Effects of seed dormancy level and storage container on seed longevity and seedling vigour of jute mallow (*Corchorus olitorius*)

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The study was conducted at the laboratory of the Crop Production Department, of the Federal University of Technology, Minna, Nigeria in 2009. The purpose was to determine the effect of hot-water steeping and storage container on seed longevity and seedling vigour of *Corchorus olitorius*. The study was also to determine if and when seed dormancy would be alleviated during the storage of the seeds of this crop. Samples of steeped (mildly dormant: md) and the unsteeped (strongly dormant: sd) seeds were packaged in glass bottles, and paper envelopes and stored at 30°C for 22 weeks. Seed germination, using the between paper method, seedling length and fresh seedling weight were determined at the onset of storage and subsequently at two weeks interval. Prior to storage, germination percentages of 72 and 28 were recorded for md and sd seeds respectively. There were some increases in germination percentages, seedling length and weight within the first six to eight weeks of storage and the level of increase depended on container and dormancy depth. A decline in the scores of all the parameters was subsequently recorded. Germination remained poor in the unsteeped seeds and viability was better preserved in glass bottles than in paper envelopes. Dormancy was not alleviated to any appreciable extent during the storage period. There were indications that seed death occurred even in the dormant state and that dormancy did not confer longevity superiority on the seed of this crop.

Key words: Jute mallow, *Corchorus olitorius,* dormancy, longevity, vigour.

INTRODUCTION

Jute mallow (*Corchorus olitorius*) is a leading leaf vegetable in many African countries and is cultivated in some Asian and Caribbean countries and Brazil. The two cultivars ("Amugbadu" and "Oniyaya") of this crop that are widely grown in Nigeria have been described by Akoroda (1988) and the seeds are known to possess dormancy (Fondio and Grubben, 2004). Dormancy normally results in non-uniformity in germination and seedling emergence, a problem that is a source of worry to vegetable growers (Gilberstone et al., 1981). However, Ndinya (2005) opined that seed dormancy may be a blessing as it may ensure the continuation of the seed over time and through periods of environmental stress. Seed dormancy in *C. olitorius* is caused by the hard seed coats (Schippers, 2000). According to Hartmann et al. (1997), germination in seeds that posses hard coats can be increased by any method that can soften or scarify the coverings. Seed coat-imposed dormancy has been

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described to be a survival strategy of many species by Kelly et al. (1992). Dark seeds of proso millet (*Panicum miliaceum* L.) which are known to have heavier seed coats have been shown to persist longer in soil than seeds with lighter coats (Khan et al., 1996). Debeaujon et al. (2000) have also shown that seeds of Arabidopsis with structural and/or pigmentation defects are less dormant. They also deteriorated faster in storage than the wild type which have complete testa layers and normal pigmentation and therefore less permeable. One of the techniques that have been developed to obtain uniform seed germination and seedling emergence is priming. This refers to controlled hydration followed by drying (Tarquis and Bradford, 1992; McDonald, 2000; Schwember and Bradford, 2010). However, whereas the technique has been reported to enhance longevity in some studies (Probert et al., 1991; Butler et al., 2009), the reverse was the case in others (Chojnowski et al., 1997; Schwember and Bradford, 2010).

To obtain high germination and uniform seedling emergence in *C. olitorius,* Schippers (2000) recommended the steeping of seeds in boiling water for five seconds followed by drying and planting. The effect this treatment might have on subsequent seed longevity has not been documented. Frequently used seed packaging containers include glass bottles, aluminum cans, laminated aluminum foil packets, etc (Rao et al., 2006). However, some farmers (especially in rural areas) may more readily have access to glass bottles and paper envelopes. Adebisi et al. (2008) listed glass bottles as one of the effective packaging containers in the storage of okra seeds. In seeds of some plant species, some period of after-ripening has been reported to alleviate dormancy (Probert, 2000; Steadman et al., 2003; Bair et al., 2006; Bazin et al., 2011). Information in this respect seems to be non-existing for *C. olitorius*. The aims of this study therefore, were (i) to determine the effects of hot water-steeping and packaging materials on the longevity of *C. olitorius* seeds. (ii) to study the changes in seed dormancy levels of untreated seeds as they aged during storage.

MATERIALS AND METHODS

The experiment was conducted in the laboratory of the Department of Crop Production, Federal University of Technology, Minna, Niger State (9° 40' and 6° 30' E), Nigeria. Some seeds of "Oniyaya" variety of *C. olitorius* were steeped in hot water at 97°C for five seconds to break dormancy as recommended by Oladiran (1986). They were subsequently spread on some layers of absorbent paper and dried in the shade to a moisture content of 8%. Samples of steeped (mildly dormant- md) and unsteeped (control referred to as strongly dormant- sd) seeds were then packaged in rubber-stoppered glass bottles and paper envelopes and stored at 30°C and 75% relative humidity for 22 weeks. Seed samples were drawn for germination test prior to storage and at an interval of two weeks thereafter. The between paper (BP) method was used for the germination test. At 22 weeks after storage (WAS), sd seeds packaged in stoppered-bottle were steeped as described above to ascertain their real viability level. On each testing day, four replicates of 50 seeds each were counted and placed at equidistant spacing on two layers of moist kitchen towel. Two other layers of moist kitchen towel were then placed over the seeds. The set up was rolled carefully and arranged upright in plastic bowls and then incubated at 30°C. The kitchen towel and seeds were kept constantly moist with distilled water. Germination counts and measurement of seedling length and fresh seedling weight were taken after 14 days. To do this, the set up was normally carefully unrolled on a table and the covering layers of kitchen towel carefully lifted to prevent seedling damage. Germination counts were expressed as a percentage of the number of seeds sown. Seedling lengths and weights were thereafter recorded. The data collected on all parameters were subjected to analysis of variance (ANOVA) using Minitab (2003).

RESULTS

Figure 1 shows the survival curves of mildly (md) and strongly dormant (sd) seeds stored in glass bottle and paper envelope. Before storage, germination for the mildly dormant seeds was 72%; there was a general increase in germination up to 6/8 WAS followed by a decline. As from 8 WAS, the germination of the seeds packaged in paper envelope was generally significantly poorer than the values for seeds stored in glass bottles. The germination of strongly dormant seeds was poor all through the study period (a range of 10 to 35%). However, a slight improvement in germination up to about 4 and 8 WAS in paper envelope and glass bottled packages respectively was also recorded for them. When a sample of this class of seed (sd) packaged in glass bottle and stored for 22 weeks was steeped in hot water and the viability tested, a value of 64.5% was obtained as against 15% obtained for the unsteeped lot of the same age. The value is however, not significant from the 70% recorded for the mildly dormant seeds at age (22 WAS).

The seedling lengths from md and sd seeds were 6.08 and 7.53 cm, respectively prior to storage (Figure 2) with subsequent improvement within 2 to 8 WAS depending on treatments. This was followed by a decrease in value. Seedlings from the md seeds that were stored in glass bottle were generally significantly longer than those stored in paper envelope from the 2 to 20 WAS. Except at 14 and 16 WAS (when packaging in paper envelope gave better result), there were generally no significant differences in the length of the seedling from strongly-dormant seeds packaged in the different containers. An improvement in fresh seedling weight was also recorded within 2 to 6 WAS (Figure 3). Seedlings from mildly dormant (md) seeds packaged in glass bottle were generally superior to those from other treatments within the first 14 WAS.

DISCUSSION

The initial general increase observed for the parameters measured in this study could be linked to the loss of

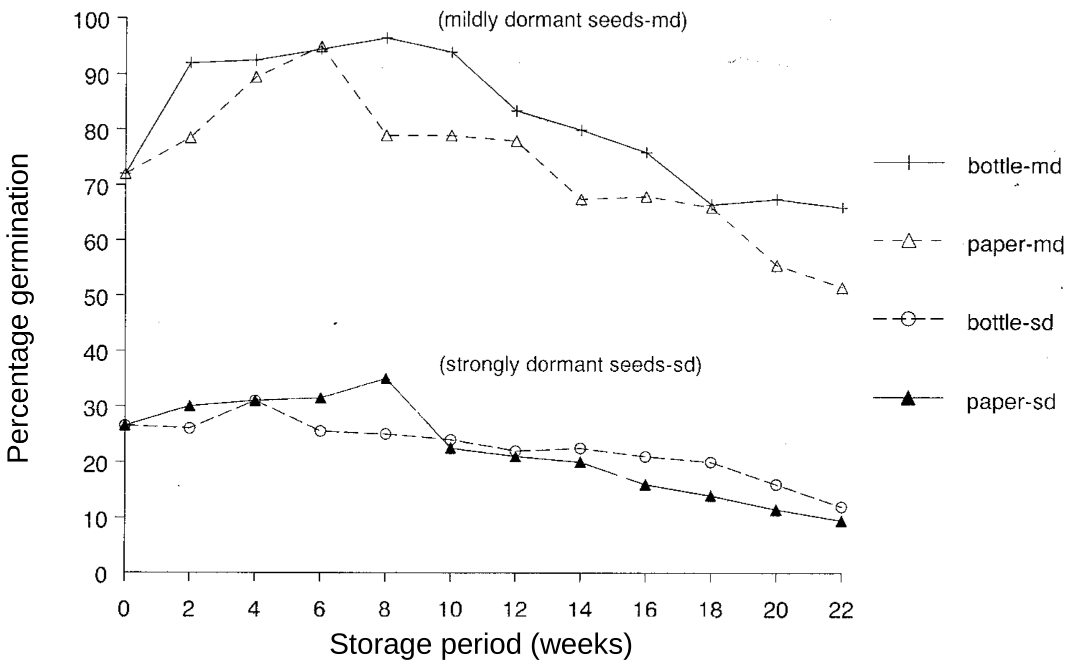

Figure 1. Effect of dormarncy status (mild and strong) packaging container (bottle and paper envelop) on seed longevity at 30°C.

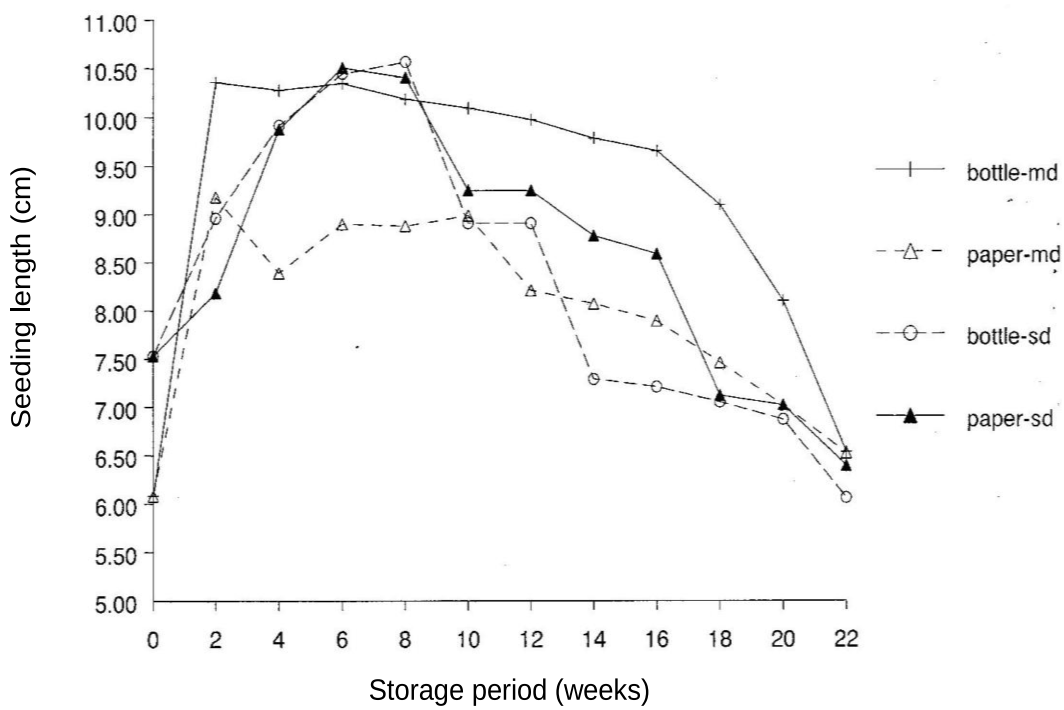

Figure 2. Effect of seed dormarncy status (mid-md or strong-sd) packaging materials on seeding length prior to and after storage at 30°C.

seed dormancy. Oladiran and Kortse (2002) reported that pepper seeds that were dormant when freshly harvested, gave higher germination values as storage progressed. A situation of this type is an indication that some seeds of *C. olitorius* must have acquired the ability to germinate during dry storage, a process referred to as after-ripening

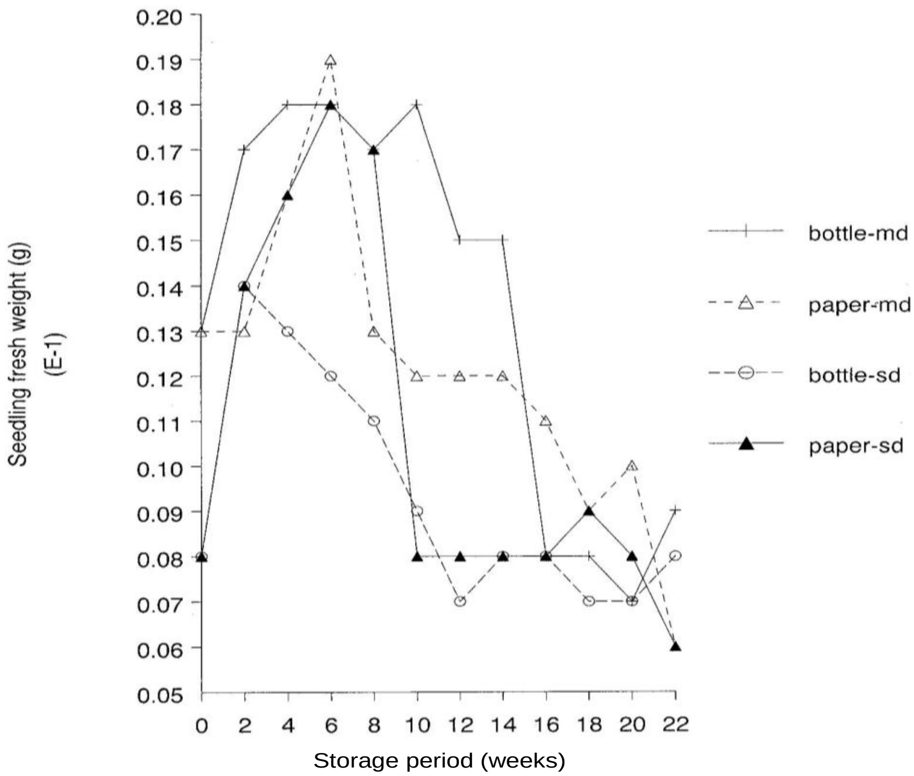

Figure 3. Effect of seed dormarncy status (mild-md or strong-sd) and packaging materials on seedling fresh weight prior to and after storage at 30°C.

(Bazin et al., 2011). Results of this study shows further that decline generally set in after the attainment of peak performance. This trend is normal in seed storage as has been shown to be the case by Ellis and Roberts (1980), Palma et al. (1995), Oladiran and Agunbiade (2000), who reported that as seeds aged they undergo gradual changes which lower their potential vigour and performance capability. According to Gilberstone et al. (1981), seedlings that emerge from old seeds show various cytological abnormalities such as chromosome breakage and the disturbance of mitotic spindle. Seedling growth reduction has also been shown to be recorded with age in storage by Mwai and Abukutsa-Onyango (2005). Results also revealed that strongly dormant seeds germinated poorly all through the study period. However, when a sample of the strongly dormant seeds stored in glass bottle for 22 weeks and which gave only 15% germination was steeped in boiling water and tested for germination, a value of about 65% was recorded in comparison to 70% obtained for mildly dormant seeds of the same age and in similar container. This is an indication that dormancy might not have conferred superior longevity on seeds in this crop. This is contrary to the findings reported by Khan et al. (1996) and Debeaujon et al. (2000) in which less dormant seeds deteriorated faster than more dormant ones. Furthermore, unlike the negative effect of priming on seed longevity reported by Maude et al. (1994) and Chojnowski et al. (1997), hot water steeping as was practiced in this study, was not injurious to seeds of *C. olitorius*. The steeping of *C. olitorius* seed in hot water is normally done to alleviate dormancy which is due to hardseededness (Schippers, 2000; Fondio and Grubben, 2004). The improvement recorded in this study in respect of germination, seedling length and weight within the first 8/10 WAS (depending on treatment), may mean that dormancy may not be due to hard seed coat alone. This view agrees with Abukutsa-Oniyango (2007) who reported that some physiological aspects beside hardness of the seed could be contributing dormancy in this crop. Desal (1997) also reported that in some seeds, germination may be prevented by the presence to some inhibitory mechanisms within the seeds which must be removed before germination can occur. According to Bennett and Evans (2002), the need for after-ripening is due to a form of endogenous dormancy termed physiological dormancy. The use of heat and hot water have been reported to create cracks in seed coat and thereby alleviating dormancy (Dhillion and Singh, 1996). The failure of a large proportion of unsteeped sd seeds to germinate in this study even up to the point of viability decline after a long period of storage, is an indication that there might not have been any alteration in the seed coat structure that would have permitted germination. The ecological implication of this is that the annual bush fire, that is known to burn off seed coat, may be the only option to be relied on for the germination of dormant *C. olitorius* seeds in nature. The superiority of the glass bottle over paper envelope must, may no doubt, be due to the former's impermeability to moisture, making it an effective packaging material for seed conservation (Adebisi et al., 2003; Rao et al., 2006).

Conclusion

It is concluded that the steeping of *C. olitorius* seed did not reduce it longevity and that seeds of this crop could therefore be steeped in hot water, dried back to moisture content of about 8% and then packaged in glass bottles for future planting. However, if the temperature of the environment is as high as 30°C, seed viability may not be maintained at acceptable level (≥70%) for longer than about 16 weeks. Furthermore, the dormancy of the seeds of this crop may not be broken to any appreciable level during storage and viability may be lost without loss of dormancy.

REFERENCES

Abukutsa-Onyango M (2007). Seed production and support systems for African leafy vegetables in three communities in west Kenya. Afr. J. Agric. Nutr. Dev. 7(3):1-15.

Adebisi MA, Akintobi DCA, Oyekale KO (2003). Preservation of okro seed vigour by seed treatments and storage containers. Nig. J. Hort. Sci. 12:17-23.

Adebisi MA, Daniel IO, Ajala MO (2008). Storage life of soybean (*Glycine max* L. Merril) seeds after seed dressing. J. Trop. Agric. 42(1-2):3-7.

Bair NB, Meyer SE, Allen PS (2006). A hydrothermal after-ripening time model for seed dormancy loss in *Bromus tectorum* L. Seed Sci. Res. 16:17-28.

Bazin J, Batlla D, Dussert S, El-Maarouf-Bouteau H, Bailly C (2011). Role of relative humidity, temperature and water status in dormancy alleviation of sunflower seeds during dry after-ripening. J. Exper. Biol. 62(2):627-640.

Bennett MA, Evans AF (2002). Seed dormancy mechanisms in vegetable crop species. The Ohio State University Seed Production Seminar-Santiago, Chile. pp. 93-99.

Butler LH, Hay FR, Ellis RH, Smith RD, Murray TB (2009). Post-abscission, pre-dispersal seeds of *Digitalis purpurea* remain in a developmental state that is not terminated by desiccation *ex planta*. Ann. Bot. 103(5):785-794.

Chojnowski M, Corbineau F, Come D (1997). Physiological and biochemical changes induced in sunflower seeds by osmopriming and subsequent drying, storage and aging. Seed Sci. Res. 7(4):323-331.

Debeaujon I, Leeon-Kloosterziel KM, Koornneef M (2000). Influence of the testa on seed dormancy, germination and longevity in arabidopsis. Plant Physiol. 122(2):403-414.

Desal MH (1997). Association of seed colour with emergence and seed yield of snap beans. J. Am. Soc. Hort. Sci. 99(2):110-114.

Dhillion WS, Singh U (1996). Breaking of seed dormancy in different leguminous forage species. Int. Rice. Res. Notes 21(1):45-46.

Ellis RH, Robert EH (1980). Improved equation for the prediction of seed longevity. Ann. Bot. 45:13-30.

Fondio L, Grubben GJH (2004). *Corchorus olitorius* L. In: Grubben, GJH, Denton OA (Editors) Plant Resources of tropical Africa 2. Vegetables. PROTA Foundation, Wageningen, Netherlands/Baack-huys Publishers, Leiden, Netherlands/CTA, Wageningen, Netherlands. pp. 217-221.

Gilberstone TL, Ferris ML, Brenner AC, Wilkins HF (1981). Effect of storage temperature on endogenous growth substances and shoot emergence in Freesia hybrid corns. J. Am. Soc. Hort. Sci. 112(4):641-644.

Hartmann HT, Kester DE, Davies Jr, FT, Geneve RL (1997). Plant propagation: Principles and Practices. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, Sixth edition.

Kelly KM, Van Staden J, Bell WE (1992). Seed coat structure and dormancy. Plant Growth Regul. 11:201-209.

Khan MM, Cavers PB, Kane M, Thompson K. (1996). Role of the pigmented seed coat of proso millet (*Panicum millaceum L*.) in imbibitions, germination and seed persistence. Seed Sci. Res. 7:21-25.

Maude RB, Drew RLK, Gray D, Bujaiski W, Nienow AW (1994). The effect of storage on the germination and seedling abnormalities of leek seeds primed and dried by different methods. Seed Sci. Technol. 22:299-311.

McDonald MB (2000). Seed priming. In: Seed Technology and its Biological Basic (Eds. M. Black and J. Bewley). Sheffied Academic press Ltd. Sheffields. pp. 281-325.

Minitab Inc. (2003). Minitab Statistical Software, Release 14 for Windows, State College, Pennsylvania, USA.

Mwai GN, Abukutsa-Onyango M (2005). Potential salinity resistance in spider plant (C*leome gynandra* L.). Afr. J. Food Agric. Nutr. Dev. 4:2.

Ndinya C (2005). Seed production and supply system of three African leafy vegetables in Kakamega District. In: Muriithin AN, Anjichi VE, Ngamau, K. Agong, SG, Frickle A; Hau B, Stutzel, H. (Eds). Proceedings of the third horticulture workshop on sustainable horticultural production in the tropics. Maseno University; Maseno. pp. 60-67.

Oladiran JA (1986). Effect of stage of harvesting and seed treatment on germination, seedling emergence and growth in *Corchorus olitorius* cv. "Oniyaya".

Oladiran JA, Agunbiade SA (2000). Germination and seedling development from pepper (*Capsicum annum*) seeds following storage in different packaging materials. Seed Sci. Technol. 28:413-419.

Oladiran JA, Kortse PA (2002). Variations in germination and longevity of pepper (*Capsicum annum* L.) seed harvested at different stages of maturation. Acta Agron. Hung. 50(2):157-162.

Palma B, Vog G, Neville P (1995). Endogenous factors that limit seed germination of *Acaccia senegalensis* wild Phyton. Int. J. Exp. Bot. 57:97-102.

Probert RJ, Bogh SV, Smith AJ, Wechsberg GE (1991). The effects of priming on seed longevity in *Ranunculus sceleratus* L. Seed Sci. Res. 1:243-249.

Probert RJ (2000). Role of temperature in the regulation of seed dormancy and germination. In: Fernner M. ed. Seeds. The ecology of regeneration in plant communities. Oxon: ABI Publishing. pp. 261-292.

Rao NK, Hanson J, Dulloo ME, Ghosh K, Nowell D, Larinde M (2006). Manual of seed handling in genebanks. Handbook for Genebanks No 8. Bioversity international, Rome, Italy.

Schippers RR (2000). African Indigenous vegetables. An overview of the cultivated species. Chattam, UK: Natural Resources Institute. P. 214.

Schwember AR, Bradford KJ (2010). Quantitative trait loci associated with longevity of lettuce seeds under conventional and controlled deterioration storage conditions. J. Exp. Bot. 61(15):4423-4436.

Steadman KJ, Craeford AD, Gallagher RS (2003). Dormancy release in *Lolium rigidum* seeds is a function of thermal after-ripenig time and seed water content. Funct. Plant. Biol. 30:345-352.

Tarquis AM, Bradford KJ (1992). Prehydration and priming treatments that advance germination also increase the rate of deterioration of lettuce seeds. J. Exp. Biol. 43:307-317.