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The Effect of Container Types, Seed Dressings and Desiccants on the Viability and Vigour of Roselle (*Hibiscus sabdariffa* L. var. *sabdariffa*) Seeds

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Abstract: An experiment was conducted to investigate the effects of seed dressings (neem leaf powder, tobacco leaf powder, wood ash and control), container types (earthen pots, bottles, polythene sacks, plastic containers and gourds) and desiccants (toasted rice and powdered charcoal) on the viability and vigour of roselle (*Hibiscus sabdariffa* L. var. *sabdariffa*) seeds. The leaves were dried and ground separately into fine powders. These were mixed with the roselle seeds and put into the various containers. The neem leaf powder (NLP) and tobacco leaf powder (TLP) were each applied at the rate of 50% (W/W) and 100% for wood ash (WA). Also added were the desiccants (10 g charcoal and 10 g toasted rice) to absorb any moisture that might be generated during respiration of the seeds in the containers. Some seeds were stored in the containers without dressings or desiccants to serve as control. The containers and their contents were stored at room temperature (21-30°C) and relative humidity (40-70%) for a period of one-year after which they were sown to determine viability and vigour. After 14 and 20 days since sowing, the germination percentage and vigour index data were recorded, respectively. NLP and WA did not have any adverse effect on the vigour of treated roselle seeds. The best container for roselle seed storage was plastic containers, followed by bottles and polythene bags in that order. The results also showed that charcoal was a better desiccant than toasted rice and the former improved the viability and vigour of seeds stored in gourds and earthen pots.

Key words: Roselle, seed dressings, desiccants, containers, viability, vigour

INTRODUCTION

Roselle *(Hibiscus sabdariffa* L. var. s*abdariff*a), like many other indigenous leafy vegetables, (ILVS), plays an important role in income generation and subsistence among rural farmers. It also contributes to a more balanced diet for many communities (Shippers, 2000) especially the disadvantaged in society.

Roselle is presently propagated from seeds and farmers in Northern Ghana store untreated seeds in various containers such as earthen pots, gourds, polythene bags, plastic containers, empty tins or bottles (Yeboah *et al.*, 2002). The farmers also some times use ash and neem products to control pests The cultivation of ILVs in the Upper East Region of Ghana for example depends mainly on seeds retained from previous harvests of farmers (83% of respondents); some farmers (17%) also receive seeds from neighbours and relatives whilst others (38%) buy seeds from local markets (Anonymous, 2002). These seeds handled by the farmers and the market women are of poor quality and lose their viability in a very short time just after storage. However, it is known that farmers' entire crops depend on the quality of seeds used for sowing or planting (Singh, 1988). If the seed has poor germination, the farmer will have a poor stand, which would ultimately result in a poor yield of crop. Therefore, the purpose of seed storage is to maintain the seed in good physical and physiological condition from the time they are harvested until the time they are planted(Singh, 1988).

However, little research has been done to evaluate the local containers used for seed storage and the various materials available to peasant farmers that could be used as seed dressings and desiccants to control pests and regulate moisture absorption respectively during storage.

The aim of the study was therefore to find out the effect of storage container types, some seed dressings and some local hygroscopic substances (desiccants) on the viability and vigour of roselle seeds.

Local vegetable farmers from developing countries may benefit from the outcome of this research, as most of them cannot afford to use cold storage facilities.

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MATERIALS AND METHODS

The experiment was conducted at the University for Development studies, Tamale, in the northern region of Ghana.

Roselle seed capsules were acquired from a local farmer in Nyankpala, Northern Region of Ghana. The capsules were spread to dry on a cemented floor under a shade to avoid over heating of the seeds. The capsules were then crushed and seeds separated by simple winnowing. The initial germination percentage and moisture content of the seed lot were determined to be 85 and 11.1% respectively. The seed dressings used were neem leaf powder (NLP), tobacco leaf powder (TLP) and wood ash (WA). The powders were prepared by drying the leaves in the sun for one week when temperatures were between 36 to 40°C with a relative humidity of between 50 and 60%. The WA was obtained after burning charcoal from the wood of *Afzelia africana*. The WA and the powders were sieved using a mesh of diameter 0.003 mm. Five grams each of NLP and TLP were mixed with 10 g of seed on weight for weight basis to give a concentration of 50% each. With the WA, equal quantities were used i.e., 10 g WA to 10 g seed giving rise to 100% (W/W) concentration. Also 10 g toasted rice or 10 g ground charcoal were added as desiccants in the containers.

Each of the twelve treatment combinations of seed dressings and desiccants (4 dressings x 3 desiccants, including a zero control level of each) were put in five container types namely: gourds, polythene bags, bottles, earthen pots and plastic containers and replicated four times (240 containers in all). The experiment was therefore 5 x 4 x 3 factorial in complete randomized design. The seeds were stored for twelve months; from November 2001 to October 2002 in a store room where day room temperature ranged between 21 and 30°C with relative humidity of between 40 and 70% during the storage period. After storage, four sunken beds were prepared each measuring 5.4 x 1 m. The beds were filled with river sand up to a depth of 10cm to give a homogenous surface. Sixty drills 9 cm apart were made in the sand across each bed. One hundred seeds from each replicate (container) were randomly assigned to one of the 60 drill rows of each of the beds. The germination test was done following the method described by Agrawal (1995) to determine the viability of the treated seeds. The germination count was done on the 14th day after sowing. Twenty days after sowing, the seedlings were uprooted and the shoot and root lengths of each plant were measured with a ruler. The average length of seedlings per treatment was calculated and the Vigour Index determined using the following formula:

Vigour Index = (Shoot length + Root length) x % germination (Abdul-Baki and Alderson, 1973).

The analysis of variance was used to partition the variation for all parameters measured using SPSS statistical package. Means were separated using Fischer least square difference, LSD, ($p<0.05$) when significant differences were observed.

RESULTS

The three way interaction (containers x seed dressings x desiccants) was not significant ($p>0.05$). Only the results of the two way interactions that were significant are presented below.

In earthen pots, seeds treated with NLP and WA recorded the highest mean germination percentage (59.4 and 58.6%, respectively) and was significantly higher than those treated with TLP, which had the least (50.8%) (Table 1).

Within the bottles, there were no significant differences ($p>0.05$) between the seeds treated with the various seed dressings.

Within the plastic containers, seeds treated with WA germinated best as compared to others. There were no significant differences between seeds treated with NLP, TLP and the control at 5% significant level.

For seeds stored in polythene sacks, seeds treated with WA produced the highest germination percentage (80.0%) which was the best among all the seed dressings. The germination percentages of seeds treated NLP and TLP were equivalent and their values were statistically similar to control at 5% significant level.

Results from the seeds stored in gourds indicated no significant differences between the means of the treatments at 5%.

Generally, seeds stored in plastic containers performed best in terms of germination percentage under all the seed dressings (Table 1), followed by bottles and then polythene sacks. Seeds stored in earthen pots were more viable than those in gourds; an effect that was greatest on the control and NLP treatments.

Within the earthen pots, seeds treated with NLP and WA had the highest mean vigour index of 10.5 (Table 2). However, the seeds treated with TLP were less vigorous as compared to the control.

Within the bottles, seeds treated with the various seed dressings did not show any significant differences in vigour index.

Table 1: Effects of seed dressings and containers on the mean germination percentage (%) of Roselle seeds

	Containers					
Seed dressings	Earthen pot	Bottle	Plastic container	Polythene sack	Gourd	LSD
NLP	59.4	77.8	78.1	70.0	51.7	
TLP	50.8	75.8	81.8	66.9	50.2	5.8
WA	58.6	75.4	87.8	80.0	55.4	
Control	56.2	73.2	82.3	67.4	50.0	
LSD	5.8					

Coefficient of variation: 10.05%

Table 2: Effects of Seed dressings and containers on the mean vigour index*

	Containers					
Seed dressings	Earthen pot	Bottle	Plastic container	Polythene sack	Gourd	LSD
NLP	10.5	11.4	13.7	11.6	8.8	
TLP	7.6	12.0	12.3	11.4	8.3	1.6
WA	10.5	11.4	15.6	14.8	10.2	
Control	9.3	12.3	12.6	12.6	8.5	
LSD	1.6					

Coefficient of variation: 11.45%, *Higher values mean higher vigour

Table 3: Effects of desiccants and containers on mean germination Percentage (%) of seeds

	Containers					
Desiccants substances	Earthen pot	Bottle	Plastic container	Polythene sack	Gourd	LSD
Toasted Rice	51.7	71.7	79.0	68.8	51.7	
Charcoal	59.6	70.8	81.8	70.0	52.7	5.1
Control	50.6	71.7	81.6	65.1	49.9	
LSD	5.1					

Coefficient of variation: 10.05%

Table 4: Effects of desiccants and containers on mean vigour index of Roselle seeds

	Containers					
Desiccants	Earthen pot	Bottle	Plastic container	Polythene sack	Gourd	LSD
Toasted Rice	9.3	10.7	13.7	12.1	9.5	
Charcoal	10.4	13.5	15.7	13.7	9.7	1.4
Control	8.8	11.8	13.5	11.2	7.6	
LSD	1.4					

Coefficient of variation: 11.74%, *Higher values mean higher vigour

Seeds in plastic containers dressed with WA had the highest mean vigour index (15.6) while the TLP had the lowest mean vigour index (12.3). There was no significant difference in vigour between the seeds treated with TLP and the control when stored in plastic containers.

Storage of seed with WA as a seed dressing again emerged with the highest mean vigour index (14.8) in polythene sacks and TLP had the least mean vigour index (11.4). TLP and NLP were as vigorous as the control.

In the gourd containers, WA had the highest mean vigour index (10.2) which was higher than the untreated seeds (control). The NLP and TLP had the same vigour index as the control.

Generally, seeds stored in plastic containers had the highest vigour index under all the seed dressings, followed by bottles and polythene sacks and then earthen pots and gourds, though as described above the container type effect varied among treatments.

In the earthen pots, seeds stored with charcoal as a desiccant (Table 3) had significantly highest mean germination percentage (59.6%). The mean values obtained for the seeds with toasted rice and that of the control were not shows to differ statistically when tested at 5% significance probability. Apart from what prevailed in the earthen pot, seeds stored with the various desiccants in the other containers did not show any significant differences despite the fact that in most cases seeds with charcoal as a desiccants had the highest germination (%) value.

In earthen pots, bottles, plastic containers and polythene sacks, seeds stored with charcoal had the highest mean vigour index which in all cases were significantly better than the untreated seed (control) (Table 4). There were no significant differences between seeds mixed with toasted rice and control in all cases except, in gourds, where seeds stored with both the toasted rice and charcoal had similar vigour index which were significantly better than the control.

Generally, seeds stored in plastic containers were most viable and vigorous under all the desiccants (Table 2 and 3), followed by bottles and polythene sacks and then in earthen pots and gourds.

DISCUSSION

Generally, all the treatments showed a fair to very good germination percentages (Table 1 and 3) although their best of 81.8% fell below the initial test of 85%. The drop in germination may be attributed to the unfavourable storage conditions (especially the relatively high temperature and relative humidity. The seeds were stored under room temperature of 21- 30°C and relative humidity range of 40 to 70%. Hall (1970) observed that high temperatures (21-43°C) speed up life processes in organisms and Toole (1950), observed that most crop seeds loose viability at relative humidity approaching 80% and temperature of 25-30°C.

TLP treated seeds performed badly in terms of germination percentage and vigour index when stored in gourds and earthen pots (Table 1 and 2). It seems nicotine acts negatively in the non-airtight containers. WA performed best in almost all the containers. This conforms to Wegmann (1983) who said that WA is very suitable material for protection of grain in storage and that it is just effective as chemical pesticide. WA treated seeds were better than the control in all the containers ($p<0.05$). This implies WA does not have adverse effect on germination of seeds. Ash has been reported as a desiccant (Hayma, 1990). Generally, germination percentage and the vigour index values of seeds treated with various seed dressings (Except TLP treated seed in earthen pots) as shown in Tables 1 and 2 were not significantly lower than the control. The implication is that all the seed dressings (except TLP) did not have any adverse effect on the viability and vigour of seeds. This conforms to earlier literature that NLP and WA are suitable for treating sowing seeds (Nyarko, 1998; Hayma, 1990)

Generally, within earthen pots and gourds, seeds stored with charcoal produced the best results (Table 3 and 4) possibly because the charcoal was able to absorb any excess moisture that might have found it way into those containers since the two containers were not air tight. Charcoal's good performance is an indication that it is a better desiccant than toasted rice. Buady (2002) also found that seeds stored with charcoal were more viable and vigorous than those stored with toasted rice in all containers. Charcoal therefore seems to be able to absorb moisture in the seed micro environment thereby reducing the rate of respiration that might have resulted in the vigorous seedlings. The control was as viable as seeds stored with charcoal and toasted rice in bottles, plastic containers and polythene sack. This is probably due to the fact that they are air-tight containers and might not have allowed any change in relative humidity within their contents that could cause deterioration of seeds. Plastic containers came up with the highest mean germination percentage and vigour index (Table 1 and 2), followed by bottles and polythene sacks. The containers that can afford water proof and airtight conditions (e.g. plastic container, bottles) are best for seed storage (Taylor, 1997). Polythene sacks performed least among the three containers possibly because they were black and less than 0.25 mm thick. The contents might have therefore absorbed more heat than the other two containers under study. Temperature has direct influence on longevity of seeds and the rate of deterioration increases as temperatures increases at a relative humidity (Janick, 1992). Temperatures in black polythene bags, bottles and plastic containers were 33, 31.5 and 31°C respectively. Hayman (1990) mentioned polythene sacks as one of the best containers to store sowing seeds, but they should be thicker than 0.25 mm.

Seeds stored in gourds and earthen pots had low germination percentage (Table 1 and 3) and vigour (Table 2 and 4) values, after one-year storage period. Gourds and pots are somehow porous and their porosity might have resulted in the gain of more than necessary moisture in seeds as a result of increased relative humidity in the storage environment. Shippers (2000) also stated that when the humidity is high, there is a chance that seeds will grow in their capsules and that seed need to be stored in airtight containers, to prevent them from regaining humidity from the air or otherwise.

- Generally, wood ash and neem leaf powder did not have any adverse effect on the viability and vigour of the roselle seeds whereas tobacco leaf powder adversely affected the vigour of seeds stored in earthen pots (porous containers).
- Generally, charcoal performed better as a desiccant in the non-air tight containers (Earthen pot and Gourds) as compared to the control in terms of viability. Further, charcoal as a desiccant enhanced the vigour of roselle seeds in all the storage containers. Toasted rice seemed not to be good desiccants since seeds stored with it had their viability and vigour statically similar to the control in almost all containers.
- With respect to both viability and vigour, seeds stored in plastic containers performed best, followed by those stored in bottles and polythene sacks and then earthen pots and gourds.

Following from the points advanced above therefore, it is only prudent to recommend the use of neem leaf powder and wood ash to vegetable farmers for use as seed dressings since they do not affect the viability and vigour of seeds. Farmers should stored seeds in airtight

containers but if gourds and earthen pots are used charcoal must be used as a desiccant.

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