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Hot water-steeping enhanced germination of jute mallow (*Corchorus olitorius*) seeds

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A B S T R A C T

Hot water-steeping on the germination and viability maintenance of seeds of jute mallow (*Corchorus olitorius*) was investigated at the Federal University of Technology, Minna. Seed moisture content was adjusted to 5.3, 11.6 and 16.5% . The packaged seeds were in rubber-stoppered glass bottles and stored at 30oC for 16 weeks. Germination was tested at two weeks interval for 12 weeks and finally at 16 weeks. Seeds were steeped in boiling water for 2 seconds prior to storage, 5 second prior to storage, 2 second on each testing day and 5 second on each testing day to break dormancy before germination was tested. Unsteeped seeds served as the control. Germination of unsteeped seeds was low allthroughthe storage period irrespective of storage moisture content. Steeping of seeds in boiling waterfor two seconds significantly increased seed germination at all storage duration an indication that seed dormancy was not lost with age. Seeds stored better at low moisture content than at higher ones. Packaging of *Corchorus olitorius* seeds in moisture-proof containers at moisture below 11.6% is recommended. Prior to sowing, hot-water steeping of seeds from such lots may be necessary for rapid and uniform germination irrespective of storage duration.

1- Introduction

Corchorus olitorius (jute mallow) is one of the commonly cultivated indigenous leaf vegetable of Africa and members of the family Tiliaceae. It is quite popular for its leaves that are used as vegetable. Jute leaves are consumed as a popular vegetable in various parts of the world. It is made into a common soup or sauce in some West Africa cooking tradition. Jute is also a popular dish in the Northern provinces of the Philippines where it is known as "salvyot" (Moses et al., 2004). The leaves are rich in beta carotene, iron, calcium and vitamin C. The plant is particularly good for sick people who have difficulties in swallowing as it is slippery in texture (Moses et al., 2004). Seeds of *Corchorus olitorius* are also known to exhibit dormancy and steeping in hot water at 97^{oC} for five seconds to ensure high germination has been recommended by Oladiran (1986). It has been shown in other crop species that the rate of loss of seed dormancy may vary with seed moisture content and storage temperature. Information appears to be lacking on the relationship between storage period and environment on the rate of dormancy depletion in *C. Olitorius*. The objective of this study was to determine the effects hot water pretreatment and seed moisture content might have on *C. olitorius* seeds dormancy depletion and longevity.

2- Materials and methods

The experiment was conducted at the Laboratory of Crop Production Department, Federal University of Technology, Minna, Nigeria. Seed moisture content of "Oniyaya" varietyof *Corchorus olitorius* was adjusted to 11.6% and 16.5%from an initial moisture content of 5.3%using the relationship described by Ibrahim and Robert (1983) thus:

W= S (mf-mi)/(100-mi)

Where: W= weight of water to be added
S= weight of seed which moisture content is to be adjusted
mi= initial moisture content (on % fresh weight basis)
mf= desired moisture content.

- Treatments and experimental design:

Seeds were packaged in rubber-stoppered glass bottles with screw cap, further secured with candle wax to prevent leakage, were stored at 30^{oC} for 16 weeks. Seedling emergence and growth were tested at 0, 2, 4, 6, 8, 10, 12, 14, and 16 weeks after storage. On each testing day, samples of the unsteeped (control) seeds were steeped for 2 or 5 sec. in boiling water to break dormancy; unsteeped seeds serve as control. The two factors: seed moisture level (5.3%, 11.6% and 16.5%) and hot water-steeping (0, 2sec. steeping prior to storage, 5sec. steeping prior to storage, 2sec. steeping on testing day and 5sec. steeping on testing day), were factorially combined in a completely random design.

- Seed germination:

On each testing day, four replicates of steeped and unsteeped seeds from each of the treatment combinations stated above were counted and placed on water moistened filter paper in plastic Petri dishes and then incubated at 30 oC. These were indexed using germination rate (GR) and synchronization (Z). Germination counts were taken every-other-day and the result expressed in percentages. Germination rates (GR) were calculated according to Labouriau (1983) as follows:

$$GR = \frac{(n1xt1)+(n2xt2)+(n3xt3)+\ldots+(nixti)}{T}$$

Where n is the number of days for each germination count; t, the number of germinated seeds at each counting day; T, the total number of germinated seeds.

Z was estimated using the relationship as expressed by Primack (1980) as:

$$Z = \sum C_{ni,\,2} / N, \text{ with } C_{ni,\,2} = n_i(n_i-1)/2 \text{ and } N = \sum n_i (\sum n_i-1)/2$$

Where Cni, 2: combination of the seeds germinated in the time i and ni: number of seeds germinated in the time i. Z = 1 when the germination of all seeds occur at the same time and Z = 0 when at least two seeds could germinate, one at each time.

- Data analysis:

The data collected on all the parameters were subjected to analysis of variance (ANOVA) using SAS and where significant differences among treatments were obtained, means were separated using Duncan multiple range test (DMRT) and Least Significant Difference (LSD). All data in percentages were converted to arcsin values before statistical analysis were conducted.

3- Results and discussion

Steeping treatment (S) significantly affected seed germination throughout the storage period. The effect of moisture content (M) was significant all through except at 0, 4 and 6 weeks after storage (WAS). Germination values of unsteeped seeds was significantly lower than the those recorded for steeped ones all through the storage period. Furthermore the germination values of all steeped were generally similar for the first 12 weeks of storage. Seeds steeped for 2 and 5 seconds prior to storage germinated significantly poorer than those steeped on testing date at 14 and 16 WAS. S x M interaction effect was also significant except at 0 and 6 WAS .Seeds stored at 5.3% mc germinated significantly higher than those at 16.5% except at 0, 4 and 6 WAS. Also, the superiority of 5.3% over 11.6% mc became more evident at 14 and 16 WAS.

Table1 shows the effect of steeping treatment and moisture content on the germination rate of Corchorusolitorius. The germination rate among steeped seeds were generally similar throughout the duration of storage (Table 1). Significantly higher values (an indication of slower germination) were generally recorded for unsteeped seeds compared to steeped ones. Though significant germination rate differences were recorded among seed stored at different moisture content, the trend was not consistent. Furthermore, the interaction between steeping duration and moisture content recorded no significant different except in week 6, 10 and 16 (Table 1 and 2). Table 2 shows that at both 6 and 10 WAS, unsteeped seeds with 5.3 and 11.6% mc were significantly slower in germination than steeped seeds. However, all seed lots packaged at 16.5% mc germinated at similar rate irrespective of steeping treatment.

Table3 shows the effect of steeping treatment and moisture content on germination synchronization of *Corchorus olitorius*. Germination was better synchronised in steeped than in unsteeped seed throughout the period of storage (Table 3) and synchronization was similar in all steeped seeds up to 12 WAS. At 14 and 16 WAS, germination synchronization was significantly better in seeds steeped for 2 and 5 seconds on testing day than in those stored following hot water-steeping for 2 and 5 seconds. Seed germination synchronization values were generally similar at all moisture contents up to 12 WAS. At both 14 and 16 WAS, synchronization values of seeds stored at 16.5% were significantly poorer than those at 5.3 and 11.6% mc which were at pair. There was no significant interaction of steeping treatment and seed moisture content throughout the storage period.

4- Discussion

Hot water-steeping of seed resulted in significant improvement in germination compared to unsteeped seeds. This agrees with the findings of Oladiran (1986) and the report of Schippers (2000). The improvement in germination was said to be due to the softening of the hard seed coat. Dhillon and Singh (1996) are of the view that this treatment might improve seed germination by the creation of some cracks on the seed coat which then permit easy germination.Except in few instances in this study, seed packaged at 5.3% mc gave higher germination percentages than those at 11.6% and 16.5% with or without hot-water steeping. This is expected since jute mallow produces orthodox seeds which are reputed to have long storability because biochemical activities are slowed down at low moisture content (Vartucciet al., 1994). Low storage moisture content are therefore always recommended to slow down the deterioration processes during storage (Vertucci et al., 1994) and thus reducing the loss of seed viability (Raoet al., 2006). Without hot-water steeping, the germination of seeds stored at the three moisture contents in this study remained at low levels throughout the storage period. This result is contrary to what had been reported in other crop species in which the presence of hard seed coat was said to be responsible for dormancy. In peach, the seed coat is known to provide physical impediment (mechanical resistance) to germination (Mehanna and Martins, 1985) and a significant increase in the germination of the seed was recorded when stratification was done for up to 75 days (Sharma and Singh, 1978). In Cucumissativa, the requirement for after-ripening of seed at 37 or 47OC was report by Weston et al. (1992) to significantly reduce the time required to attain 50% germination of the seed lot. In little mallow (Malvaparviflora), the seeds of which also required scarification, germination was reported to increase with storage time even though, germination did not exceed 47% in 13 months. The absence of improvement in the germination of unsteeped Cor*chorus olitorus* seed in this study despite the setting in of loss of viability at the tail end of storage may suggest one or two things. It is either that the storage moisture contentwere not high enough, or the storage duration was too short. More studies involving the use of higher seed moisture contents are recommended for a better understanding of the relationship between storage moisture content and dormancy depletion in this crop.

5- Conclusion

Evidence from this study reveals that seeds of *C. olitorius* stored better at 5.3% mc than at 11.6% mc and 16.5%. Also, germination was significantly enhanced 2 second steeping for both prior to storage and on the test day. Furthermore, no significant improvement in the germination of unsteeped seed was recorded under all treatments. Hot water-steeping may always be necessary if seeds are stored within the range of moisture used in this study.

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Table 1- Effect of steeping treatment and moisture content on germination rate of *Corchorus olitorius*.

Treatment	Storage duration (weeks)								
	0	2	4	6	8	10	12	14	16
Steeping duration (D) sec.									
0	5	5	4	4	4	6	3	3	1
2	2	2	2	2	2	2	2	2	2
5	2	2	2	2	2	2	2	2	2
2s	2	2	2	2	2	2	2	1	2
5s	2	2	2	2	2	2	2	2	1
SE±	0.3	0.1	0.1	0.1	0.2	0.2	0.1	0.4	0.2
LSD (0.05)	0.8	0.3	0.5	0.5	0.7	0.6	0.4	1	0.6
Moisture content (M)									
5.3	3	3	2	2.5	3	3	2	2	2
11.6	3	3	3	3	2	3	2	3	2
16.5	2.6	3	3	2	3	3	2	1	1
SE±	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.3	0.2
LSD (0.05)	NS	NS	0.4	0.4	0.5	NS	NS	0.8	0.5
Interaction D*M	NS	NS	NS	*	NS	**	NS	NS	*

0 = unsteeped (control); 2 = 2 sec. steeping on testing day; 5 = 5 sec. steeping on testing day; 2s = 2sec. steeping prior to storage; 5s = 5 sec. steeping prior to storage; ** = highly significant; * = significant; NS = not significant.

Table 2- Interaction effect of steeping treatment and moisture content on germination rate of *Corchorus olitorius.*

		Storage Duration (weeks)	
Moisture Content (%)	Steeping treatment	6	10
	0	4.0a	4.2b
	2	2.0b	2.1c
5.3	5	2.0b	2.3c
	2s	2.1b	2.0c
	5s	2.1b	2.0c
	0	4.7a	5.8a
	2	2.2b	2.1c
11.6	5	2.1b	2.3c
	2s	2.0b	2.1c
	5s	2.0b	2.1c
	0	2.8b	2.1c
	2	2.0b	2.3c
16.5	5	2.0b	2.1c
	2s	2.1b	2.0c
	5s	2.6b	2.0c
SE±	-	0.3	0.4

Means followed by the same letter in a column are not significantly different at p=0.05 using DMRT.
0 = unsteeped (control); 2 = 2 sec. steeping on testing day; 5 = 5 sec. steeping on testing day; 2s = 2sec. steeping prior to storage; 5s = 5 sec. steeping prior to storage.

Table 3- Effect of steeping treatment and moisture content on the germination synchronisation of *Corchorus olitoriusseed.*

Treatment	Storage duration (weeks)								
	0	2	4	6	8	10	12	14	16
Steeping									
0	0.42b	0.38b	0.50b	0.46b	0.33b	0.42b	0.69b	0.08c	0.00c
2	0.98a	0.88a	0.98a	0.95a	0.90a	0.88a	0.94a	0.97a	0.96a
5	0.95a	0.89a	0.99a	0.98a	0.92a	0.84a	0.94a	0.96a	0.89a
2s	0.97a	0.95a	0.98a	0.97a	0.99a	0.99a	0.98a	0.63b	0.65b
5s	0.97a	0.94a	0.97a	0.89a	1.00a	0.99a	0.97a	0.64b	0.58b
SE±	0.2	0.1	0.3	0.1	0.2	0.2	0.3	0.1	0.3
%Moisture content									
5.3	0.81a	0.76a	0.91a	0.94a	0.79a	0.85a	0.88a	0.83a	0.78a
11.6	0.85a	0.83a	0.84a	0.79b	0.86a	0.77a	0.97a	0.76a	0.73a
16.5	0.91a	0.83a	0.89a	0.81b	0.84a	0.85a	0.86a	0.38b	0.34b
SE±	0.3	0.4	0.2	0.1	0.3	0.2	0.1	0.3	0.2
Interaction D*M	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter in a column within a factor are not significantly different at p=0.05 using DMRT.
0 = unsteeped (control); Steeping treatment: 2 = 2 sec. steeping ontesting day; 5 = 5 sec. steeping on testing day; 2s = 2sec. steeping prior to storage; 5s = 5 sec. steeping prior to storage; NS = not significan

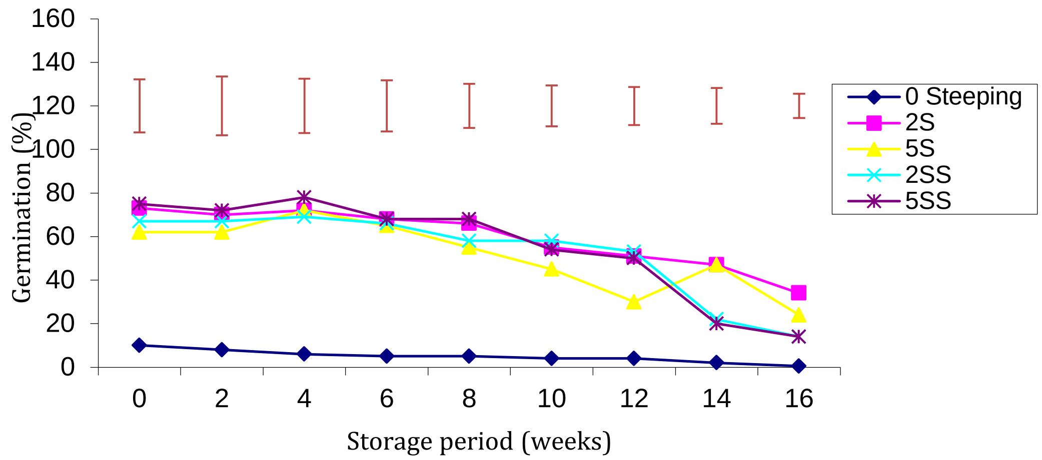

Fig. 1- Effect of steeping on germination of *Corchorus olitorius.*

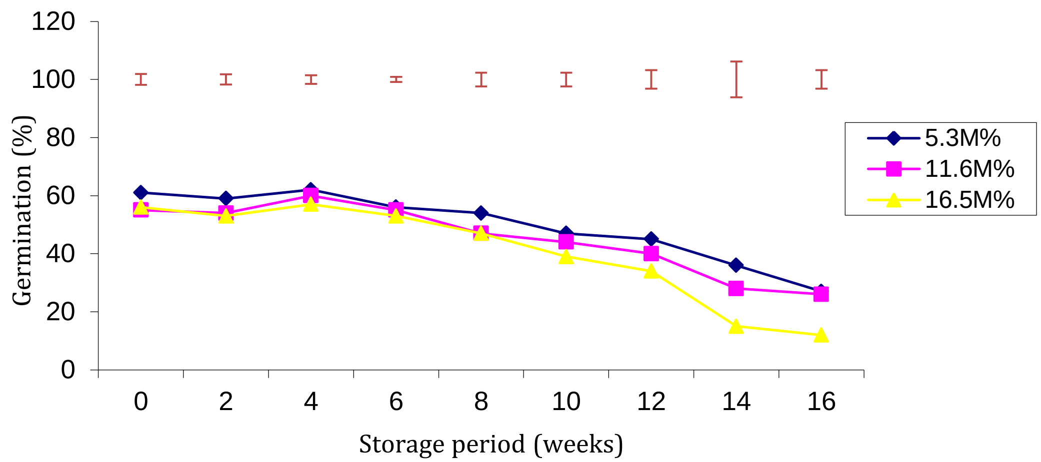

Fig. 2- Effect of moisture content on germination of *Corchorus olitorius.*