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Evaluation of Storage Duration, Storage Containers and Storage Temperatures on the Germination of Mango (*Mangifera Indica L.*) Seed stones

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Abstract: **This experiment was carried out under nursery conditions at Department of Horticulture, University of Khartoum during season 1999-2000. The aim of this study was to find out the influence of storage of mango seed stones in different containers for different duration at different degrees of temperatures on germination percentage. The results showed that sowing of seed stones after 2 weeks from extraction resulted in fewer days to germinate and gave higher values of germination percentage than storage for 4 and 8 weeks, however seed stones which were sown after 12 weeks failed to germinate. Germination percentage of seed stones stored at room temperature was higher than storage in the refrigerator. Poly ethylene bag + charcoal were the best media for seed stones storage followed by cloth bag + charcoal.**

Keywords: **Mango Germination, Storage Containers, Storage Duration, Storage Temperatures.**

I. INTRODUCTION

Storage of mango seed stones is very serious problem; so, many researchers have started to give attention to the storage of mango stones during last decays. Nurseries needs to provided seeds at different season time so as to face the expansion of mango planting in different new area. Therefore, the development of satisfactory storage method for supplying nurseries with seed is of vital importance. Mango seed stone are classified as recalcitrant (i.e. unable to withstand desiccation and freezing temperature (Chin, 1978). Freshly extracted seed stones give the best germination percentage. Any increase in the duration between extraction and sowing of seed stones result in reduction of germination percentage. When fresh recalcitrant seeds begin to dry, viability is first slightly reduced as moisture is lost but then begins to decline considerably at a certain moisture content termed "critical" moisture content (12-31%). If drying continues further viability will eventually be reduced to zero (King and Roberts, 1979). It is generally recognized that the viability of seed which undergo marked desiccation at physiological maturity is prolong by reducing their moisture content and storing them at low temperature. Since seed moisture content equilibrates with the moisture in the surrounding atmosphere, stored seed required the protection of moisture proof containers or controlled relative humidity. Choice of seed containers is usually influence these, cost of materials, ease of opening and resealing, ease of handling and availability of appropriate size (Freire, Marlene, Mumfor and Paline, 1986). Several factors have been identified for the storage of recalcitrant seeds such as temperature, moisture and oxygen (Roberts, 1980). On other hand Doijode (1995) indicated that to date there is no successful method for effective long term preservation of recalcitrant seed especially mango.

Different studies were made on storage of mango seed stones on different media for different intervals at various conditions. Maximum germination was obtained when seed stones were stored in polyethylene bags and sown after two weeks of extraction than when seed stone stored in poly ethylene bags plus moss, Seed stored for four weeks in open plates and cloth bags showed no germination at all. Avery poor germination was recorded from seed stones stored for six weeks in poly ethylene bags but no germination in the remaining containers at this interval (Singh and Tawill, 1968). On other hand the best germination 40% after 90 days was obtained with seed stored in poly ethylene + charcoal at 25 C. Two months delayed in sowing caused reduction in germination percentage from 80 percent to 12 percent. The seed lost their viability as they dried though sensitivity to dehydration depend on the species, all seed died when their moisture content fell to about 17% for *Shorea roxburghii* and *Hopea odorata* , 30% for *Mnagifera indica* and 37 % for *Symphonieedlinga globulifera.* Wet storage of these material is difficult since the temperature must be low enough to prevent germination or reduce growth rate but this introduce a risk of chilling injury which can lead to death of seeds or seedlings. At temperature too high to cause chilling injury growth is usually too fast for prolong storage (Corbineau and Come, 1988). The purpose of such containers is to maintain seed at safe storage moisture level. Ordinary paper and cloth is least effective while various laminate and polyethylene material were moderately effective. Metal cans were completely effective in sealing the seed (Copeland and McDoland, 1985). The objective of the present investigation is to evaluate storage containers, storage temperature and storage duration on the viability and germination of mango seed stones of Kitchiner cultivar.

II. MATERIAL AND METHOD

This experiment was carried out to investigate the effect of intervals between extraction and sowing of mango seed stones after (2, 4, 8 and 12) weeks and to compare different storage containers (cloth bag, cloth bag +charcoal, polyethylene, polyethylene + charcoal) at 2 degrees of temperatures, room temperature (28- 40) and refrigerator (10-12Co) on germination percentage of

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mango seed stones, fresh and dry weight and number of days required for emergence of mango seedlings.

Seeds from healthy ripe fruits of kitchiner (960 seed stones) were selected for uniformity and size were divided into two lots, one lots was divided into 4 storage containers and then stored in room temperature. The same other lots form treatments were stored in refrigerator. The experiment was arranged in completely Randomized Design with 4 reps and 5 seeds| plot. Sowing was in small polyethylene bags (14 x 20) containing soil mixture of river silt and sand 2:1 (by volume). Germination percentage, fresh weight and number of days required for emergence of seedlings was recorded.

III. Result and Discussion

Effect of storage duration, storage containers and storage temperature had a significant effect on germination percentage and fresh weight of mango seed stones Table (1). Storage duration: It had a significant effect on germination percentage. Storage for 2 and 4 weeks resulted in higher germination percentage than 8 weeks Table (2) when seed stones stored for 12 weeks they failed to germinate in both seasons. Storage of seed stones for 2 weeks resulted in higher fresh weight in all storage containers, while storage for 12 weeks had the lowest fresh weight with the exception of poly ethylene bag + charcoal Table (3). Storage for 2 weeks resulted in lower number of days for emergence than 8 weeks in both seasons Table (4). These findings are in agreement with the result of (Singh and Tawill, 1968) and (Abdallah, 1996) and (Corbineau and Come, 1986). This may be due to the fact that recalcitrant seeds cannot survive desiccation even at high moisture content (close to fully imbibed) and tend to show short longevity (Roberts, 1973) and highly susceptible to desiccation injury (Farrant., Pammente and Berjak, 1988). Dry seeds take longer time to emerge because they required more water and longer time for imbibitions and germinate (Harrington, 1972).

Storage containers and storage conditions: Storage containers and storage duration had significant on germination percentage Table (5). When mango seed stones stored for 2 and 4 weeks at poly ethylene bag +charcoal was better than other containers at room temperature followed by cloth bag + charcoal. Seed Storage for 2 weeks had higher fresh weight than other duration and polyethylene bag + charcoal and poly ethylene bag had higher fresh weight than other containers Table(6). (Teotia and Sigh, 1971) reported that charcoal powder were better medium for storage of mango seed stones, Similar findings was reported by (Patil., Dunjate, and Salvi, 1986) who found best storage was obtained from seed stones stored with polyethylene bag + charcoal at 25^0 C. This also agrees with (Singh, 1960) who stated that seed stones can be stored for about month or so in between charcoal layers.

The differences between the two seasons probably due to variability which resulted from segregation attending sexual propagation (Hartmanm and Kester 1968) combined with climatic variation between two seasons in addition to internal variation such as amount of moisture that saturated and softened the seed (Adriance and Brison, 1955).

Table (1): Mean squire for the effect of duration and storage temperature and storage containers on germination percentage of mango seed stone of Kitchiner cultivar**.**

		Germination percentage	
Source of variation	d.f.	1999\2000	2000\2001
Total	31		
Duration	3	3517.7**	19.7**
Storage temperature	1	41.3^{ns}	24.7**
Duration x temperature	3	57.2^{ns}	7.1**
Error	24	90.9	1.2
Containers	3	172.2^{ns}	4.9^{ns}
Stprage temperature	1	65.6^{ns}	24.7^{ns}
Containers x temperature	3	54.9^{ns}	0.09^{ns}
Error	24	497.0	3.9

*Significant at 0.05 level of probability
** Significant at 0.05 level of probability
Ns: not significant

Table (2): Effect storage duration and storage condition on germination percentage of mango seed stone of Kitchiner cultivar.

Storage duration	Season 1999 \ 2000			Season 2000 \ 2001		
	Room temp.	Refri.	Duration	Room temp.	Refri.	Duration

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			mean			mean.
2 weeks	62.5	53.8	58.1[a]	46.3	5.0	25.6 [a *y]
4weeks	43.8	43.8	43.8 [a]	22.5	6.3	14.4[ab]
8 weeks	8.8	12.5	10.6 [b]	10.0	5.0	7.5 [b]
12 weeks	0.0	0.0		0.0	0.0	
Condition mean	28.8	27.5		19.7 [a *z]	4.1[b]	

*y Means of column followed by the same letters are not significantly different at 0,05 level of probability according to Duncan's multiple range test (DMRT).
*z Means within rows \ row followed by the same letters are not significantly different at 0,05 level of probability according to Duncan's multiple range test (DMRT)

Table (3): Effect of interaction between storage conditions X Storage duration X storage containers on fresh weight of mango seed stones of Kitchiner cultivar. Season 2000\ 2001.

Storage cont	Storage duration	Cloth bags	Cloth babs +charcoal	Polyethylene bags	Polyethylene bags+ charcoal	Cond. X cont. mean
	2 weeks	29.4[ab]	21.4[h]	25.3[cdefg]	23.8[defgh]	24.9[ab y]
Room temp.	4 weeks	20.9[hi]	18.4[ij]	23.2[fgh]	21.1[hi]	20.9[d]
	8 weeks	17.4[jk]	13.5[lm]	17.2[ij]	14.1[lm]	15.6[e]
	12 weeks	14.8[klm]	12.6[m]	13.5[lm]	13.1[ml]	13.5[f]
	2 weeks	22.3[gh]	26.5[cde]	26.2[cde]	27.7[abc]	25.7[ab]
Refri.	4 weeks	25.9[cdef]	25.9[cdef]	26.8[bcd]	26.8[bcd]	26.3[a]
	8 weeks	27.6[abc]	23.7[efgh]	23.9[defgh]	23.9[defgh]	24.8[b]
	12 weeks	15.9[irl]	22[in]	25.2[cdefg]	29.9[a]	23.3[c]
Cont. mean		21.8[b z]	20.5[c]	22.6[a]	22.6[a]	

*y Means of column followed by the same letters are not significantly different at 0,05 level of probability according to Duncan's multiple range test (DMRT).
*z Means within rows \ row followed by the same letters are not significantly different at 0,05 level of probability according to Duncan's multiple range test (DMRT).

Table (4): Mean squires for the effect of storage of seed stones at 2 storage temperatures for different duration on days required for emergence of Kitchiner cultivar.

Source of variation	d.f.	Days for emergence	
		1999\2000	2000\2001
Total	23		
Storage temperature	1	1998.4**	486.0**
Storage duration	2	862.1*	432.4*
Temp. X Duration	2	604.7 [ns]	350.4*

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	18	214.7	65.0

*Significant at 0.05 level of probability
** Significant at 0.05 level of probability
Ns: not significant.

Table (5): Effect of storage containers and storage conditions on germination percentage of mango seed stones of Ketchiner cultivar, Season 1999\2000 and 2000\ 2001.

Storage containers	Season 1999\2000			Season 2000\2001		
	Room temp.	Refri.	Cont. mean	Room temp.	Refri.	Cont. mean
Cloth bag	27.8	27.8	27.5	15.0	0.0	7.5
Cloth bag +charcoal	28.8	32.5	30.6	17.5	3.8	10.6
Polyethylene bag	33.8	41.3	37.5	16.3	3.8	10.0
Polyethylene bag +charcoal	25.0	21.3	23.1	30.0	12.5	21.3
Condition mean	29.1	30.6		19.7 [a *z]	5.0 [b]	

*z Means of row followed by the same letters is not significantly different at 0.05 level of probability according to Duncan's multiple range test (DMRT)

Table (6): Effect of storage containers and storage duration on fresh weight of mango seed stones of Kitchiner cultivar, Season 2000/2001.

Storage duration	Cloth bag	Cloth bag + charcoal	Polyethylene bag	Polyethylene bag+ charcoal	Duration mean
2 weeks	25.9 [a *z]	23.9 [abc]	25.8 [a]	25.8 [a]	25.3 [a *y]
4 weeks					23.6 [b]
8 weeks	23.4 [bcd]	22.2 [cde]	24.9 [ab]	23.9 [abc]	20.2 [c]
12 weeks					18.4 [d]
Containers mean	21.8 [b *z]	29.5 [c]	22.7 [a]	22.6 [a]	

1- *y Means of colmn followed by the same letters are not significantly different at 0,05 level of probability according to Duncan's multiple range test (DMRT).
2- *z Means within rows \ row followed by the same letters are not significantly different at 0,05 level of probability according to Duncan's multiple range test (DMRT)

CONCLUSIONS

The results point to the beneficial effects of storage duration, storage containers and storage temperatures on the germination of mango (*Mangifera indica L.*) seed stones stated that:

1- Any increase in duration between extraction and sowing resulted in lower germination percentage.

2- Seed could be stored in polyethylene + charcoal at room temperature for not more than 4 weeks only.

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