RESEARCH ARTICLE

INFLUENCE OF STORAGE MEDIA AND CONTAINERS ON SEED GERMINATION AND SEEDLING QUALITY IN *GARCINIA GUMMI-GUTTA* L.

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Abstract: A laboratory study was undertaken at Department of Forest Biology and Tree Improvement, College of Forestry, Sirsi, University of Agriculture Sciences, Dharwad during 2016-17 to find out the suitable media and containers for storage of ***Garcinia gummi-gutta*** seeds. Uniform sized and healthy seeds were stored in different medium and containers under ambient temperatures at laboratory using completely randomized design. Seed without any medium was treated as control. In treatment T_2 dried seeds were mixed with ash at the rate of 1:2 ratios. One kg of dried seed packed in the perforated gunny bag was considered as treatment (T_3). In treatment T_4 and T_5 dried seeds were mixed with sawdust and sand at the rate of 1:2 ratios respectively. One kg of dried seed packed in the pet jar was T_6 treatment. At interval of every 30 days, 100 seeds from each treatment in four replications were taken up from stored seed lot till six months of storage for germination studies. Seeds were sown at monthly interval up to six months.During six months of storage, the fresh seeds recorded maximum germination (18.75 per cent) and decline in germination was noticed with advancement in the storage period. Among the storage media and container, seed stored in pet jar recorded maximum germination per cent (14.50 per cent, 11.50 per cent, 9 per cent and 4.75 per cent) in third, fourth, fifth and sixth months of storage respectively. Germination per cent in control is negligible after 3 months of storage. Maximum mean daily germination and peak value was in seed stored in pet jar and the lowest in control and sand media at end of six months of storage. The mean daily seed germination, peak value and germination value were exhibiting the negative trend as advancement in seed storage period. The seedling length was non-significantly influenced by all storage media in first and third months of storage. Higher seedling length (11.70 cm, 12.98 cm) was recorded in pet jar at fourth and fifth months of storage respectively. Seedling vigour index was non-significant at first month of storage of seed at different medium. At the end of second month of storage, the maximum seedling vigour index (194) was recorded in saw dust.

Keywords: Pet jar, Saw dust, Sand germination, Vigour

INTRODUCTION

Majority of economically important trees species found in tropics are recalcitrant seeds, storage of which is one of the major problems. *Garcinia gummi-gutta* is one of the most economically recalcitrant species which lose its viability within few days under natural conditions, when the seed moisture content reduces below a high critical value. Most recalcitrant seeds are non-dormant or viviparous, because germination is initiated around shedding from the maternal plant (Farrant *et al.*, 1988; Berjak and Pammenter, 1996). There is a major hypothesis to explain the rapid germination of recalcitrant seeds. Seeds pass from a development to germination mode and the seedlings become established more rapidly when environmental conditions are continuously favorable (e.g. in moist tropical forests; Berjak and Pammenter, 2000). Storage environment is obviously very important in extending the life of seeds. The ideal metabolic rate in storage will conserve as much of the stored food reserves in the seeds as possible, yet operate at a level that maintains the integrity of the embryos. Although, seed are propagated virtually no systematic work has been done either for their multiplication or to know the causes for their dormancy and poor germination in *Garcinia gummi-gutta*. As the germination of this tree is very poor and late, there is a need to study these problems especially on germination, dormancy, seed moisture content and storage behavior etc. in order to uplift or enhance the quality for better and quick germination.

A major problem in using the seeds of many trees in reforestation programmes is the short storage life of their seeds. Sometimes it is not even possible to store the seeds from harvest until the next sowing season. Indeed, for some species it is hardly possible to maintain viability during collecting and transportation. Improved methods for short- or medium-term storage and for handling are required to enable the use of these species in reforestation programmes. Long-term storage for genetic conservation presents even greater problems.

The demand for nursery grown seedlings has increased manifold for planting under social forestry programme and massive afforestation programme taken up by the government agencies. Lack of standard nursery techniques hinders such attempts. Even poor natural regeneration, low rate of seed germination makes the situation more badly in case of certain species. Seed moisture content and storage of seeds play an important role to produce healthy and vigorous seedling at nursery.

Collection and storage of recalcitrant seeds is only first step in ex-situ conservation. Saving the seeds for

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future, forms the most important and crucial aspect of conservation (Ellis *et al*., 1990). Due to their poor storability, collection and cleaning, proper storage of recalcitrant seeds becomes essential. Seeds upon harvest from trees must be processed on site. The decision to extract the seeds from the fruit at a central seed processing depot or close to the site or soon after must be made in the light of local conditions. The longevity of recalcitrant seeds is very short: it varies from a few days to a few months or a year under proper storage conditions. Therefore recalcitrant seeds are to be sown immediately after seed collection. Because of their short longevity, viability which varies from few days, they may be kept within the fruit itself for some time. But due to high moisture content it may enhance the pathogen entry and create germination loss. Almost all the researches had the same opinion regarding the storing of seeds in tin containers which resulted in poor storage due to improper ventilation, accumulation of carbon-dioxide and increased metabolic heat. Storage in polybags was considered as most favourable if seeds were placed in a moist media (Srimathi, 1997)

MATERIAL AND METHODS

A comprehensive laboratory study entitled "**Influence of storage media and containers on seed germination and seedling quality in *Garcinia gummi-gutta* L.**" was undertaken at Department of Forest Biology and Tree Improvement, College of Forestry, University of Agriculture Sciences, Dharwad during 2016-17.

Plate 4: Seed storage in different media and containers

To find out the suitable media and containers for storability of seeds, uniform sized and healthy seeds were stored in different medium and containers under ambient temperatures at laboratory using completely randomized design. Seed without any medium was treated as control. In treatment T_2 dried seeds were mixed with ash at the rate of 1:2 ratios. One kg of dried seed packed in the perforated gunny bag was considered as treatment (T_3). In treatment T_4 and T_5 dried seeds were mixed with sawdust and sand at the rate of 1:2 ratios respectively. One kg of dried seed packed in the pet jar was T_6 treatment. At interval of every 30 days, 100 seeds from each treatment in four replications were taken up from stored seed lot till six month for germination studies. Seeds were sown at monthly interval up to six months. Seeds sown were considered germinated when plumule emerged above the soil. Daily observations were taken till 150 days from the date of sowing. The observations on seed germination, mean daily germination, peak value, germination value, shoot length, root length, seedling length, seedling dry weight and vigour index were recorded.

RESULTS AND DISCUSSION

Influence of storage media and period on germination percentage of *Garcinia gummi-gutta* seeds was studied. The seeds were evaluated initially and at monthly intervals upto 6 months for seed quality parameters. The study revealed highly significant treatment variation for all the seed and seedling quality characters. At the first month of the storage the maximum germination was observed in ash treatment (18.75 per cent) and minimum in control (15.5 per cent). At the second month of the storage the maximum germination (16.75 per cent) was observed in saw dust treatment and minimum (11.25 per cent) in control and gunny bag. After the end of third month of storage the maximum germination (14.50 per cent) was recorded in pet jar and minimum (5.50 per cent) in control (Table-1 and Fig-2). At the fourth month of storage the maximum germination was recorded in pet jar (11.50 per cent) and minimum at control (0.75 per cent), at the fifth month of storage of seed the maximum germination (9 per cent) in pet jar and minimum (5.25 per cent) in sand were observed and at the end of sixth month storage the maximum germination (4.75 per cent) in pet jar and minimum in sand (1.50 per cent) were recorded. Germination per cent in control is negligible after 3 months of storage. This might be due to ageing induced seed deterioration during the storage.

Present study revealed that as the period of storage increased germination per cent decreased i.e., viability of seeds decreased. Similar results were recorded by Kumar and Chacko (1999) in seeds of *Bhesa indica*. Gouda *et al.* (2006) reported that fresh seeds of *Garcinia indica* stored in trays containing sand recorded 77.66 per cent germination whereas those stored for one month showed 59.33 per cent. Singh *et al.*, (2009) reported that average germination in

Celtis australis was 42.6 per cent in freshly collected seeds which decreased to 22.4 per cent after 18 month of storage at ambient room temperature.

The mean daily germination and peak value was also significantly influenced by all the storage media treatments at different storage period. Highest mean daily germination (0.13) was recorded in both pet jar and ash and highest peak value (0.13) was recorded in pet jar at first month of storage (Table-2& 3). Lowest mean daily germination and peak value was 0.10 and 0.11 respectively in control at first month of storage. At the second month of storage the maximum mean daily germination (0.11) and peak value (0.20) was recorded in saw dust treatment and lowest mean daily germination (0.07) and peak value (0.08) was recorded in control. The higher mean daily germination (0.11, 0.08, 0.06 and 0.03) and peak values (0.10, 0.08, 0.06 and 0.03) were obtained in treatment with pet jar at third, fourth, fifth and sixth months of storage respectively. There was an increase in both parameters over other treatments. This may be due to prevention of moisture loss from the seeds.

The germination value was significantly influenced by all storage media and containers treatments only in first month storage of seeds. The highest germination value (0.02) was recorded in ash, saw dust and pet jar treatments and lowest value (0.01) in control, gunny bag and sand treatments at first month of storage. The shoot length was non-significantly influenced by all storage media and containers treatments up to third month. Higher shoot length (3.95 cm, 4.10 cm and 4.48 cm) were obtained in treatment with pet jar at fourth, fifth and sixth months storage respectively. And lowest shoot length (2.25 cm) wad recorded in control at fourth month of storage of seed. The lowest shoot length (3.33cm and 4.08cm) was recorded in sand at fifth and sixth months of storage of seed (Table-4).

The root length was non-significantly influenced by all storage media and containers treatments in first and third months of storage of seed. At second month of storage of seeds, the highest root length (7.13 cm) was recorded in saw dust and minimum (5.70 cm) in control. The root lengths 7.28 cm, 7.58 cm and 8.48 cm were obtained in treatments with pet jar at fourth, fifth and sixth months of storage respectively (Table-5). The minimum root length (4.13 cm) was in control at fourth month of storage of seed. The lowest root length (6.58 cm and 6.73 cm) was recorded in sand at fourth and fifth months of storage of seed.

The seedling length was non- significantly influenced by all storage media and containers in first and third months, however, at end of second month of storage the highest seedling length (11.58

cm) was recorded in saw dust treatment (Table-6). At fourth month of storage the highest seedling length (11.48 cm) was recorded in pet jar and minimum (6.38 cm) in control. Again the highest seedling length (11.70 cm, 12.98 cm) was recorded in pet jar and minimum (9.90 cm and 10.20 cm) in sand treatment at fourth and fifth storage respectively.

The seedling dry weight was non-significantly influenced by all storage media and containers in first and second months of storage of seeds. At third month of storage of seeds, the maximum seedling dry weight (0.33 g) was recorded in saw dust treatment and minimum (0.27 g) in control. The maximum seedling dry weight (0.31 g, 0.33g and 0.37 g) was recorded in pet jar at fourth, fifth and sixth months of storage of seeds respectively (Table-7).

Seedling vigour index was non-significant at first and second months of storage of seed at different medium and containers (Table-8 and Fig-2). However, the maximum seedling vigour index (160,132,106 and 62) was recorded in pet jar at third, fourth, fifth and sixth months of storage respectively.

Among the different treatments of media and containers, the present investigation revealed that the pet jar treatment maintained longer viability of seeds with germination percent of 4.75% followed by saw dust (2%) and sand treatment (1.50%) at the end of six months of storage of seeds. It may be due to longer retention of moisture in seeds in case of pet jar treatment. These results are in conformity with that of Chaturvedi and Das (2004), who reported that *Acacia auriculiformis and Acacia nilotica* seeds showed higher germination percentage (more than 60 percent) even after 10-12 months of storage in air tight plastic container in room temperature as compared to other treatments.

Table 1. Influence of storage media and containers on seed germination of *Garcinia gummi-gutta* seeds during storage.

Treatments	Germination percentage					
	Months of storage					
	1	2	3	4	5	6
Control	15.25 (23.10)*	11.25 (19.59)*	5.50 (13.50)*	0.75 (4.31)*	0.00 (0.00)*	0.00 (0.00)*
Ash	18.75 (25.65)*	15.25 (22.98)*	9.25 (17.68)*	3.00 (9.90)*	0.00 (0.00)*	0.00 (0.00)*
Gunny bag	16.50 (23.93)*	11.75 (20.02)*	6.25 (14.45)*	2.00 (8.45)*	0.00 (0.00)*	0.00 (0.00)*
Saw dust	18.00 (25.10)*	16.75 (24.15)*	13.75 (21.76)*	10.00 (19.13)*	8.25 (16.67)*	2.00 (7.99)*
Sand	16.25 (23.76)*	13.50 (21.54)*	10.25 (18.66)*	7.75 (16.16)*	5.25 (13.21)*	1.50 (6.94)*
Pet jar	18.00 (25.09)*	16.50 (23.96)*	14.50 (22.38)*	11.50 (19.80)*	9.00 (17.45)*	4.75 (12.55)*
SEm±	**0.62**	**0.59**	**0.51**	**0.44**	**0.32**	**0.28**
CD@1%	**1.83**	**1.75**	**1.53**	**1.31**	**0.96**	**0.84**

Table 2. Influence of storage media and containers on mean daily germination of *Garcinia gummi-gutta* seeds during storage.

Treatments	Mean daily germination					
	Months of storage					
	1	2	3	4	5	6
Control	0.10	0.07	0.04	0.01	0.00	0.00
Ash	0.13	0.10	0.06	0.02	0.00	0.00
Gunny bag	0.11	0.08	0.04	0.01	0.00	0.00
Saw dust	0.12	0.11	0.09	0.07	0.05	0.01
Sand	0.11	0.09	0.07	0.05	0.03	0.01
Pet jar	0.13	0.11	0.10	0.08	0.06	0.03
SEm±	**0.01**	**0.004**	**0.003**	**0.003**	**0.002**	**0.002**
CD@1%	**0.01**	**0.01**	**0.01**	**0.009**	**0.007**	**0.01**

Table 3. Influence of storage media and containers on peak value of *Garcinia gummi-gutta* seeds during storage.

Treatments	Peak value					
	Months of storage					
	1	2	3	4	5	6
Control	0.10	0.08	0.04	0.01	0.00	0.00

Ash	0.13	0.11	0.07	0.02	0.00	0.00
Gunny bag	0.11	0.08	0.04	0.02	0.00	0.00
Saw dust	0.13	0.12	0.10	0.07	0.06	0.01
Sand	0.12	0.10	0.07	0.05	0.04	0.01
Pet jar	0.13	0.12	0.11	0.08	0.06	0.03
SEm±	**0.004**	**0.004**	**0.004**	**0.003**	**0.002**	**0.002**
CD@1%	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**

Table 4. Influence of storage media and containers on germination value of *Garcinia gummi-gutta* seeds during storage.

Treatments	**Germination value**					
	Months of storage					
	1	**2**	**3**	**4**	**5**	**6**
Control	0.01	0.01	0.00	0.00	0.00	0.00
Ash	0.02	0.01	0.00	0.00	0.00	0.00
Gunny bag	0.01	0.01	0.00	0.00	0.00	0.00
Saw dust	0.02	0.01	0.01	0.01	0.00	0.00
Sand	0.01	0.01	0.01	0.00	0.00	0.00
Pet jar	0.02	0.01	0.03	0.01	0.00	0.00
SEm±	**0.001**	**0.001**	**0.001**	**---**	**---**	**---**
CD@1%	**0.003**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 5. Influence of storage media and containers on shoot length of *Garcinia gummi-gutta* seeds during storage.

Treatments	**Shoot length (cm)**					
	Months of storage					
	1	**2**	**3**	**4**	**5**	**6**
Control	4.10	3.54	3.60	2.25	0.00	0.00
Ash	4.23	3.63	3.73	3.58	0.00	0.00
Gunny bag	4.15	3.70	3.63	3.50	0.00	0.00
Saw dust	4.20	4.13	3.95	3.83	4.05	3.53
Sand	4.20	3.80	3.73	3.80	3.33	3.48
Pet jar	4.20	4.10	3.93	3.95	4.08	4.48
SEm±	**0.17**	**0.16**	**0.15**	**0.34**	**0.07**	**0.06**
CD@1%	**NS**	**NS**	**NS**	**1.00**	**0.21**	**0.14**

Table 6. Influence of storage media and containers on root length of *Garcinia gummi-gutta* seeds during storage.

Treatments	**Root length (cm)**					
	Months of storage					
	1	**2**	**3**	**4**	**5**	**6**
Control	7.20	5.70	6.40	4.13	0.00	0.00
Ash	7.53	6.73	6.98	6.38	0.00	0.00
Gunny bag	7.40	5.95	6.53	6.10	0.00	0.00
Saw dust	7.75	7.45	6.98	6.90	7.45	6.78
Sand	7.73	6.63	6.73	6.98	6.58	6.73
Pet jar	8.18	7.13	7.13	7.28	7.58	8.48
SEm±	**0.32**	**0.34**	**0.25**	**0.60**	**0.13**	**0.07**
CD@1%	**NS**	**1.03**	**NS**	**1.78**	**0.38**	**0.21**

Table 7. Influence of storage media and containers on seedling dry weight of *Garcinia gummi-gutta* seeds during storage.

Treatments	**Seedling dry weight (mg)**					
	Months of storage					
	1	**2**	**3**	**4**	**5**	**6**
Control	0.32	0.27	0.27	0.17	0.00	0.00
Ash	0.34	0.29	0.28	0.27	0.00	0.00
Gunny bag	0.32	0.27	0.28	0.26	0.00	0.00

Saw dust	0.33	0.32	0.33	0.30	0.33	0.28
Sand	0.30	0.29	0.28	0.29	0.28	0.27
Pet jar	0.33	0.33	0.31	0.31	0.33	0.37
SEm±	**0.05**	**0.02**	**0.03**	**0.03**	**0.01**	**0.01**
CD@1%	**NS**	**NS**	**0.04**	**0.11**	**0.03**	**0.05**

Table 8. Influence of storage media and containers on seedling vigour index of *Garcinia gummi-gutta* seeds during storage.

Treatments	**Seedling vigour index**					
	Months of storage					
	1	**2**	**3**	**4**	**5**	**6**
Control	186	104	55	6	0	0
Ash	220	160	92	30	0	0
Gunny bag	179	120	61	23	0	0
Saw dust	215	194	151	116	82	21
Sand	195	141	98	84	61	16
Pet jar	196	185	160	132	106	62
SEm±	11.59	10.12	7.69	5.91	4.42	3.45
CD@1%	NS	20.05	22.84	17.55	13.14	10.25

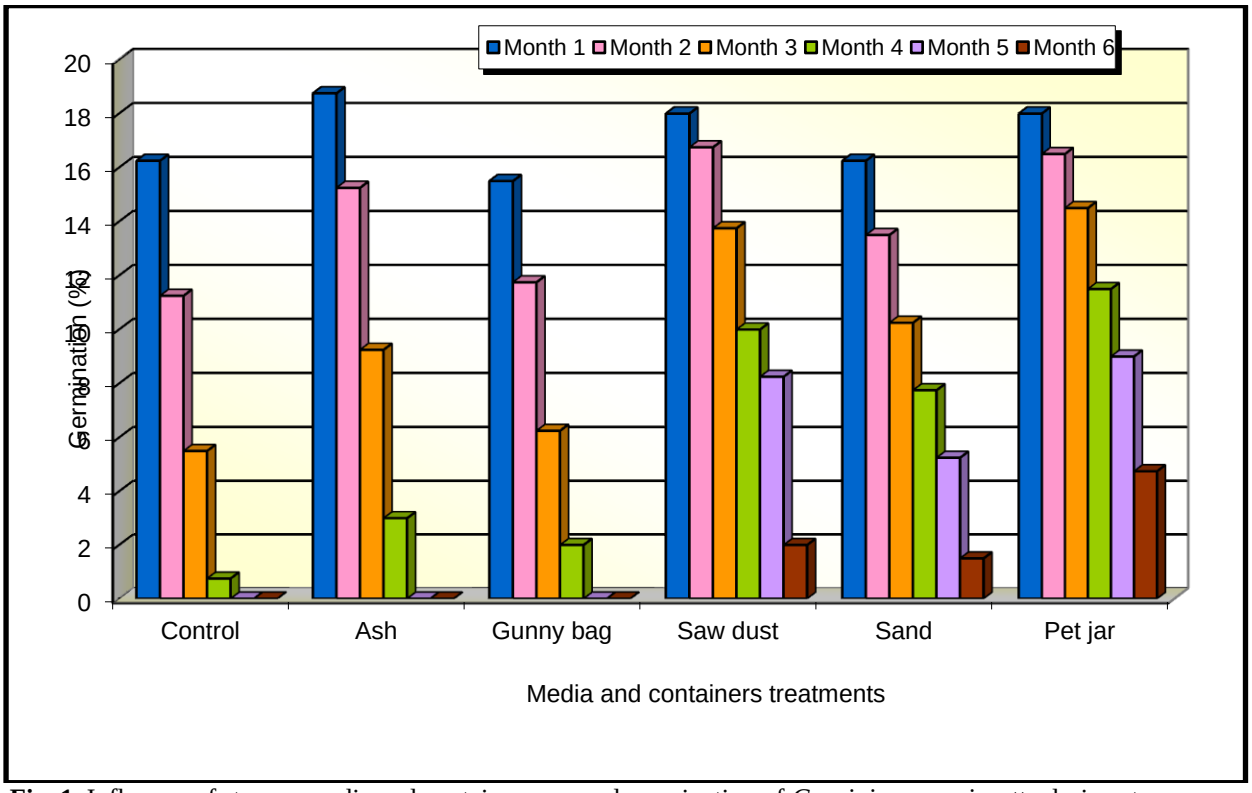

Fig. 1. Influence of storage media and containers on seed germination of *Garcinia gummi-gutta* during storage

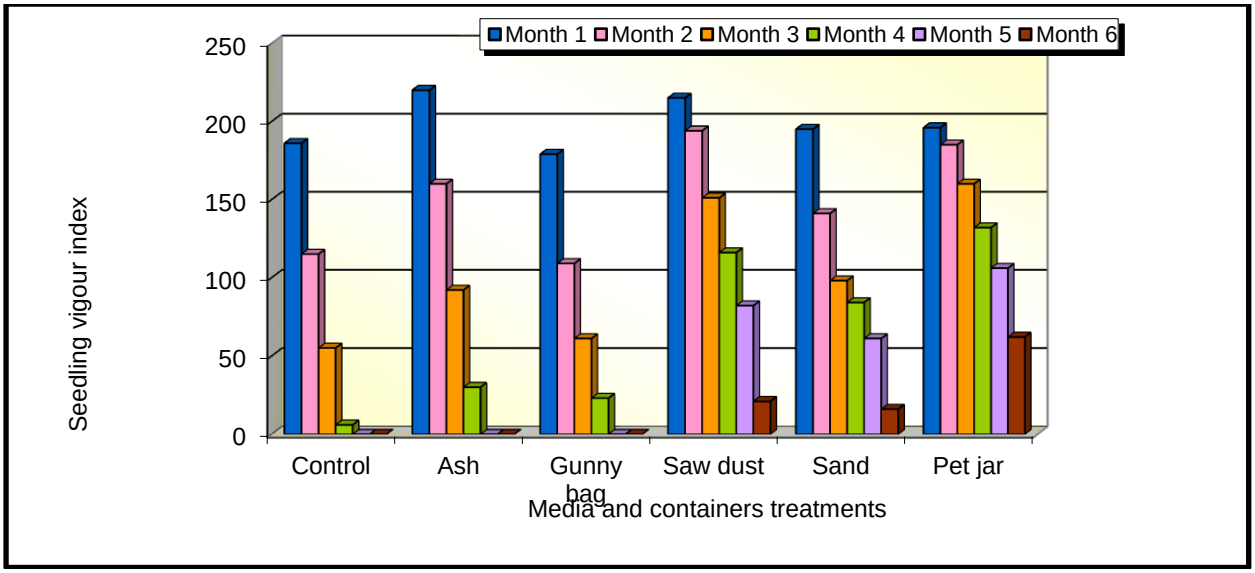

Fig. 2. Influence of storage media and containers on Seedling vigour index of *Garcinia gummi-gutta* during storage

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