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Impact of Pelleting (Pre-storage) on the Germination Studies of two different Species of Ageing Bamboo Seeds

Geetika Singh, Richa, M. L. Sharma

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Abstract

The effect of invigoration treatments of seed pelleting on various germination parameters of seeds of two bamboo species i.e. *Dendrocalamus hamiltonii* and *Bambusa bambos* have been studied for 18 months period. Our studies were directed to investigate the effectiveness of invigoration treatments on vigor and viability of seeds. During storage, treated seeds (Pre-storage seeds) were stored at controlled temperature and humidity (in desiccators at 4 °Celsius). Pelleting of seeds was done with Calcium oxychloride, Calcium carbonate and turmeric powder in both the species. Statistically, it was observed that pelleting with turmeric powder resulted in maximum germination percentage of 36.4 % and 24.9% over control at 12 and 18 months, respectively, which was zero in *Dendrocalamus hamiltonii*. In case of *Bambusa bambos* all the pelleting materials were effective but Calcium oxychloride was most effective in maintaining germination with maximum germination of 31.2% and 15.8% over control at 12 and 18 months, respectively which was zero after 12 months. Moreover, 10% concentration of turmeric powder in *Dendrocalamus hamiltonii* and 10% concentration of Calcium oxychloride in *Bambusa bambos* was statistically significant at 5% level in all the treatments for maintaining germination.

Keywords invigoration, membrane integrity, pelleting, seed quality, viability

Introduction

Bamboos comprise the most diverse group of plants in grass family. They possess different features as compared to other family members like convoluted but strong rhizome organization, occasional flowering and woody culms. It can be propagated from rhizomes, culm/branch cutting or by multiplication of nursery-raised seedlings. Bamboos show cyclic flowering with most of the species showing both sporadic and gregarious flowering. Seeds serve as a best material for large-scale plantation, germplasm conservation and improvement of genotypes. Seeds in general play a vital role in man's life since they serve as a source of food, fiber, spices, beverages, oil and drugs. Bamboo seeds have very short viability of 1-3 months and are therefore useful as propagates for only a short period of time. After breaking, seeds lose vigor and develop more susceptibility to stresses and ultimately, their ability to germinate diminishes. Rate of this deterioration is influenced by temperature and moisture content of storage conditions and the quality of seed. Seed degradation is a type of metabolic progression that aborts their growth and existence, causing retarded viability mainly due to loss of endogenous hormones as shown by the previous work done in our lab [1]. Seed deterioration is reported to accompany changes in enzyme activity during ageing [2, 1]. Different policies are being implemented to extend the storage tolerance of seed by employing some physical and chemical manipulative approaches [3-7], such as pre storage technique of pelleting and hardening. Seed invigoration is an expansion in seed quality following the postharvest application of chemicals that upgrades germination, longer storage and yield potential [8].

Methodology

The present investigation was carried on the seeds of *Dendrocalamus hamiltonii* and *Bambusa*

Geetika Singh ✉ Richa, M. L. Sharma
Department of Botany, Panjab University, Chandigarh, India
✉ geetika_phd@yahoo.com

Table 1 Effect of seed pelleting (pre-storage treatments on germination percentage and vigor index of *Dendrocalamus hamiltonii* seeds

S.No.			Fresh		6 Monthly		12 Monthly		18 Monthly	
	Treatment	Conc.	G%	Vigor index	G%	Vigor index	G%	Vigor index	G%	Vigor index
1.	Calcium Oxychloride	2%	82.1*	1254	56.7	839	33.1	483	16.7*	231
		5%	83.3*	1256	56.7	839	36.7*	530	16.5*	242
		10%	83.4*	1304	60*	914	33.3	512	20*	280
2.	Calcium Carbonate	2%	83.3*	1274	54	900	36.7	530	15.5	212
		5%	82	1286	56*	856	38.3*	604	15.6*	230
		10%	83*	1307	60*	924	34.1	512	18*	241
3.	Turmeric powder	2%	83.3	1274	55.7	856.17	31.1	490	23.1	330.8
		5%	84.3*	1320	60*	888	33.1*	514	20	292
		10%	86.7*	1369.7	61.7*	930	36.4*	560	24.9*	360.8
	Control		80.2	1012	20	114	0	0	0	0
			Treat	Treat X	Treat.	Treat X	Treat	Treat X	Treat	Treat X
	LSD#		4.34	8.34	3.23	6.10	2.2	3.2	1.12	2.01

#Least significant differences of means (5% level)
*Significant figures

bambos. Both the species were procured from KFRI, Peechi. In both the species, seeds were stored in two lots: one is subjected to natural ageing and stored at normal room temperature and humidity whereas second lot is subjected to invigoration treatments and stored at 4°C (in a desiccator) over anhydrous calcium chloride. Seeds having initial germination of 80.2% and 76% in *Dendrocalamus hamiltonii* and *Bambusa bambos*, respectively were subjected to prestorage invigoration treatments.

Germination studies

Ten randomly selected seeds were surface sterilized by soaking them in 0.5% $HgCl_2$ for two minutes followed by thorough washing in running water and finally in distilled water. These surface sterilized seeds were placed equidistantly in pre sterilized petri dishes (9.0 cm) lined with filter paper. These petri dishes were maintained at 28+/-2 in dark in BOD incubator. Germination percentage and emergence of radicle was considered as an indicator of germination. The observations for number of seeds germinated and their respective root and shoot length were recorded. The experiment was run in triplicate and seeds were daily observed and the number of seeds germinated were recorded for 14 days. The experiment was repeated after regular intervals of 6 months for one and a half years. The germination test was conducted in a completely randomized block design with 3 replications. Daily count on the no. of seeds germinated separately for each treatment. Observations on seed germination, vigor index were done. Germination studies were conducted to see the effects after 18 months.

These studies were repeated in seeds given with invigoration treatments after regular intervals of 6 months for one and half year of ageing seeds of both the species stored under controlled conditions (in desiccator over $CaCl_2$ at a temperature of 4°C. In case of pelleted seeds, Seed Pelleting [9], seeds were enclosed with a small quantity of inert material just large enough to produce a globular unit of standard size. Three basic steps involved in seed pelleting were stamping, coating and rolling. Seeds were subjected to three treatments Calcium oxychloride, calcium carbonate and turmeric powder concentration, 2%, 5% and 10%, respectively. Initially, seeds were uniformly coated with adhesives and chemicals mentioned in correct

Table 2. Effect of seed hardening (pre-storage) treatments on germination percentage and vigor index of bamboo seeds (Bambusa bambos)

S.No.			Fresh		6 Monthly		12 Monthly		18 Monthly	
	Treatment	Concentration	G%	Vigor index	G%	Vigor index	G%	Vigor index	G%	Vigor index
1.	Calcium Oxychloride	2%	76.1*	1101.2	51.5	823.1	29	500.1	11*	152.1
		5%	76.2*	1101.2	51.4	824.1	30.2*	560.2	11.2*	153.1
		10%	79.2*	1184.2	60*	920	31.2	580.1	15.8*	186.1
2.	Calcium Carbonate	2%	75.4*	1011	45.4	780.2	28.5	512.2	10	148
		5%	75.4	1082	48.2*	799.5	28.6*	512.2	10.8*	148.2
		10%	76.1*	1099.5	48.1*	798.2	29.4	513.1	9.2*	141.2
3.	Turmeric powder	2%	76.5	1098.6	55	858.2	32.5	501.2	15.2	230
		5%	78.5*	1099.6	56.1	867.1	33.6	533.1	15.3	231
		10%	78.5*	1100.2	56.5	868.2	36.7*	551.2	15.2*	218.2
	Control		76	1099	18	104	0	0	0	0
			Treat	Treat X	Treat	Treat X	Treat	Treat X	Treat	Treat X
	LSD#		3.12	6.34	3.12	6.01	2.01	3.10	1.02	1.98

#Least significant differences of means (5% level)
*Significant figures

quantity. Further, filler materials were properly sprayed on the coated seeds for uniform coating. Seeds were introduced into a pan with an amalgam of pelleting materials (calcium oxychloride 10 g, calcium carbonate 10 g and turmeric powder 20 g) and cementing adhesive gum arabic was used to form pellet.

Statistical analysis

Data were statistically analyzed using the software GENSTAT Discovery edition. Analysis of variance (ANOVA) was used to test the significance of variation sources, while LSD test (p= 0.05) was used to compare the differences among treatment means.

Results

Dendrocalamus hamiltonii

Seeds show maximum germination percentage of 86.7% and vigor index of 1369.7 after treatment with turmeric powder (concentration 10%) over control which was 80.2% in fresh seeds. After six months of further storage, germination reduced to 20% in control whereas treated seeds showed increased germination with all the treatments. All the treatments increased vigor index over control and most of them were statistically significant at 5%. At 12 months, there was complete loss of the seeds viability under control, while treated seeds showed germination of 36.7% with calcium oxychloride at concentration 5%; 38.3% with calcium carbonate at concentration 5%; and 33.1% and 36.4% with turmeric powder at 5 % concentration and 10% concentration, respectively. All of these were statistically significant at 5% level. At 18 months, treated seeds with Calcium oxychloride showed statistically significant result of germination percentage of 16.7, 16.5 and 20, respectively at concentration of 2%, 5% and 10% each. With calcium chloride, seeds showed germination percentage of 15.6 and 18 at concentration of 5% and 10%, while with turmeric powder at 10% concentration, germination was 24.9 % which was statistically significant at 5% level as shown in Table 1.

Bambusa bambos

Seeds show maximum germination percentage of 79.2% and vigor index of 1184.2 after treatment with turmeric powder (concentration 10%) over

control which was 76 % in fresh seeds. After six months of further storage, germination reduced to 18% in control; whereas treated seeds showed increased germination with all the treatments over control and most of them were statistically significant at 5% level. Further storage at 12 months led to complete loss of viability of the seeds in control, while those treated with calcium oxychloride and turmeric powder at concentration 5% and 10% showed 30.2% and maximum germination of 36.7 %, respectively. At 18 months, seeds under control completely lost the viability, whereas turmeric powder treated seeds at concentration 10% showed significant maximum germination of 15.2% at 18 months. Treated seeds with calcium oxychloride at all concentrations i.e. 2%, 5% and 10% showed germination percentage which were statistically significant as shown in Table 2.

Discussion

Seeds of both the species became completely non-viable after 6 months of ageing. In *Dendrocalamus hamiltonii* when germination became zero, all the pelleted treatments were effective in increasing the G% but higher concentrations were significantly effective showing that treatments improve the germination. All concentrations of turmeric powder (10%) were effective in enhancing germination over the control. Such beneficial influence of eco-friendly and cheap botanicals in enhancing storability of seeds was reported by Nargis and Thiagarajan [10] in tomato. In contrast to *Dendrocalamus hamiltonii*, in case of *Bambusa bambos* seeds, calcium oxychloride and not turmeric powder proved effective. Seed pelleting is a seed enhancement technique which has positive effects on different aspects of seeds. Seed pelleting with nutrients raised the germination percentage through accelerated growth and development as reported by Demir et al. [11] and Dogan and Zeybek [12]. In this study, seeds were evaluated for their physiological and morphological qualities. The treatments increased the germination percentage due to modification of physiological and biochemical nature of embryo i.e. pre- enlargement of embryo. Data on morpho-physiological parameters of *Dendrocalamus* seeds revealed pelleting with turmeric powder and showed enhanced germination even after 18 months as compared to the other treatments.

This indicates that mode of action differed for various chemicals at different concentrations. Our results were in conformity with the reports of Tonapi [13] in cowpea seeds and Parashivamurthy [14] in soybean. In pelleted seeds among all the treatments, turmeric powder (10%) could be recommended for *Dendrocalamus hamiltonii* seeds as a pre storage invigoration treatments and in maintaining the best germination and VI over control at 5% level of significance.

In *Bambusa bambos* among all the treatments Calcium oxychloride (10%) could be recommended as a prestorage invigouration treatment for bamboo seeds and in maintaining the best germination and VI over control at 5% level of significance. Seed viability can be recovered to major extent by the application of seed invigoration treatments with some appropriate chemicals. These techniques can prove their commercial important to increase the longevity of bamboo seeds so that these could be used for longer period of time for raising plantations.

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