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RESEARCH ARTICLE

Effect of pre-sowing invigouration treatments on performance of ageing *Dendrocalamus strictus* seeds

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Abstract

Seed quality is one of the key factors affecting successful germination of seeds but this trait declines during prolonged storage. Maintenance of seed viability has been a matter of great concern to mankind during prolonged storage. Invigouration treatments that include Infusion, Fortification and Osmopriming with various bioactive chemicals, are known to improve the seed performance. Treated seeds were stored at controlled temperature and humidity (in desiccators at 4 °C). Infusion was done with GA_3, IAA,IBA (conc. used was 10, 20 and 50 ppm each) and PEG-6000(conc. used was 2%, 5% and 10%). Fortification was done with Ascorbic acid and Potassium dihydrogen phosphate (conc. used was 2%, 5% and 10%) and GA_3. Statistically all the fortification and infusion materials were effective but GA_3(50 ppm) was most effective in maintaining germination percentage and vigour index of both fortified and infused seeds. Similarly, osmopriming was done with KCl, KNO_3 and PEG-6000. Effective conc. of KCl for maintaining germination and vigour index for up to 18 months was found to be 10%. It was observed that the osmopriming with KCl (10%) resulted in maximum germination percentage of 83.1% and vigour index of 1272, 1282 and 1290 at 2%, 5% and 10% respectively which was more than the germination under control (80.2%) . It is concluded that seeds lose viability over a period of time even under controlled conditions and in order to regain seed viability before sowing , invigouration treatments offer promising results.

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INTRODUCTION

Bamboos are one of the most unique and versatile plants known to mankind. They are distinguished from other members of the family by having woody culms, complex branching , a complex and generally robust rhizome system, and infrequent flowering. They are intermingled with the tradition and culture of rural tribal populations from times immemorial due to which they have been variously called as the cradle to coffin plant' , The poor man's Timber; Friend of the people', Green Gasoline', and 'The Green Gold'. Bamboos can be propagated from rhizomes, Culm/branch cutting or by multiplication of nursery- raised seedlings. However, seeds serve as the best material for large – scale plantation and germplasm conservation . This source is natural ,doesnot involve extra inputs in terms of money, labour and space. Seeds in general play a vital role in man's life since they serve as a source of food, fibre, spices, beverages, oil and drugs. Ageing in seeds has been defined as the progressive deterioration of the structure and functions of the seed over the time(Mohamed- Yasseen, 1991). Bamboo seeds, have very short viability of 1-3 months and are therefore useful as propagules for only a short period of time. When seeds deteriorate, they lose vigour and become more sensitive to stresses upon germination. Eventually seeds lose the ability to germinate. Non availability of viable seed is a major drawback in enhancing productivity. Seed quality can be maintained by either storing them in a controlled conditions or by invigouration treatments. Seed invigouration is a simple technique for improvements in seed performance by post harvest treatments resulting in improved

germinability , greater storability and better yield performance (Ali *et al.*, 1990).It is reported that seed priming,fortification and infusion are important techniques to help rapid and uniform germination and emergence of seeds and increase seed tolerance to adverse environmental condition (Heydecker,1974;Harris et al.,1999). Inview of this present investigation was taken up to find out the effect of pre sowing invigouration treatments on bamboo seeds.

Material and Methods:

Seeds of *Dendrocalamus strictus* were procured from KFRI, Peechi. These were stored in two lots : one treated with invigouration chemicals whereas the second lot was untreated seeds which served as control.Control seed lot was stored at normal temperature and humidity whereas the other seeds which were used for pre sowing treatments were stored under controlled conditions (in desiccator at 4^0 C).

Seeds having initial germination of 80.1% were subjected to presowing invigouration treatments. Seeds were surface sterilized by soaking them in 0.5% $HgCl_2$ for two minutes followed by thorough washing in running water. 10 randomly selected surface sterilized seeds were placed equidistantly in pre sterilized petridishes (9.0 cm) lined with filter paper. The entire experiment was conducted in laboratory condition in seed germinator where temperature was maintained at 28^0 C. Seeds were observed daily 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. In pre- sowing treatments, Seeds were infused with GA_3, IAA, IBA(10 ppm, 20 ppm and 50 ppm conc.) and PEG-6000(2%,5% ,10% conc.). Seeds were fortified with varying concentrations of ascorbic acid, dipotassium phosphate (2%,5% ,10% conc.), GA_3 (10 ppm, 20 ppm and 50 ppm conc.). Seeds were soaked in solution of equal volume for duration of 6hrs and 12 hrs to 16 hrs till it raises the moisture content of the seed to 20-25%, just enough for endogenous impregnation of chemicals by exogenous application. All the chemicals were applied in 3 different concentrations to three replicates of 10 seeds and the seeds were kept in germination chamber during these experiments. Solution to seed ratio was 1:2.5 for all the treatments. Similarly , seeds were osmoprimed with potassium chloride (KCl), potassium nitrate (KNO3), polyethylene glycol-6000. (PEG-6000) each at 2%, 5% , 10% conc. Thereafter, the seeds were rinsed with tap water three times and one time with distilled water. The treated seeds were surface dried and then dried at 25°C. Three replications of 10 seeds were germinated in 90mm Petri plates at 25±1°C under dark condition for 14 days.

Vigour index values were computed using formula given by (Abdul- Baki and Anderson, 1973) . V.I = G% × Root length.

Seed germination was calculated by the following formula.

$$\text{Germination Percentage (\%)} = \frac{\text{Total number of germinated seeds}}{\text{Total No. of seeds sown}} \times 100$$

Result and Discussion:

Fresh seeds having germination of 80.1 and vigour index of 1014 loses its germination to 20 % after 6 months and germination reduces to zero after one year. However treated seeds showed different results than the control untreated seeds.

After 6 months interval, seeds were evaluated for seed quality characteristics *i.e.* germination percentage (G%) and vigour index (V.I) .Vigour index values were computed using formula: V.I = G%× Root Length (cms) as per Abdul –Baki and Anderson (1973). One way (ANOVA) Analysis of variance was applied to the germination parameters (G%) to find out which treatment and concentration was statistically significant in enhancing various germination parameters while LSD test (0.05) was used to compare the differences among treatment means.

Fortification:

Fortification with ascorbic acid resulted in maximum germination percentage of 81.1, 82.4 and 82.4 and V.I 1281, 1318.2 and 1218.2 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 50.1, 56.8 and 53.3 respectively. After 12 months of ageing G% recorded was 25.4, 28 and 26.1 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 16.7, 20 and 20.1 and V.I 232.13 , 233 and 234.2 at 2%,5% and 10% concentrations respectively. Statistically , the most effective concentration of ascorbic acid for maintaining germination and vigour index for 18 months was found to be 5%

Fortification with GA_3 resulted in maximum germination percentage of 82.4, 83.2 and 82.8 and V.I 1280, 1264 and 1285 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 56.4, 58.2 and 60.2 respectively. After 12 months of ageing G% recorded was 30, 36.7 and 36.2 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 21.1, 23.3 and 24.4and V.I 280 , 328.5 and 337.4 at 2%,5% and 10% concentrations respectively.

Statistically , the most effective concentration of GA_3 for maintaining germination and vigour index for 18 months was found to be 50 ppm.

Fortification with KH_2PO_4 resulted in maximum germination percentage of 82.4, 82.1 and 83.2 and V.I 1265, 1255 and 1267 at 2%,5% and 10% concentrations respe ctively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 52.4, 56.7 and 52.4 respectively. After 12 months of ageing G% recorded was 25.4, 26.7 and 30 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 16.7, 18 and 18.1 and V.I 231.4, 282 and 280.2 at 2%,5% and 10% concentrations respectively Statistically , the most effective concentration of KH_2PO_4 for maintaining germination and vigour index for 18 months was found to be 5%.

Among all the treatments GA_3(50ppm) is the most effective in maintaining best germination and VI over control at 5% level of significance as shown in TABLE 1

TABLE 1

Effect of seed fortification (Pre-sowing) on ageing *Dendrocalamus strictus* seeds

S.No.			Fresh		6 Monthly		12 Monthly		18 Monthly	
	Treatment	Conc.	G%	V.I	G%	V.I	G%	V.I	G%	V.I
1.	Ascorbic acid	2%	81.1	1281	50.1	755	25.4	390	16.7	232.13
		5%	82.4	1318.2	56.8*	848	28*	428	20	233
		10%	82.4*	1318.2	53.3	818.5	26.1*	397.2	20.1*	234.2
2.	GA3	10 ppm	82.4	1280	56.4	845.2	30	444	21.1	285
		20ppm	83.2*	1264	58.2*	889	36.7*	556.2	23.3*	328.5
		50ppm	82.8	1285	60.2*	910.2	36.2*	572.4	24.4*	345.4
3.	KH_2PO_4									
		2%	82.4	1265	52.4	781.2	25.4	390.2	16.7	231.4
		5%	82.1	1255	56.7*	856	26.7*	392.4	18	259
		10%	83.2*	1267	52.4	784.2	30*	447	18.1*	261
4.	Control untreated seeds		80.2	1014	20	104	0	0	0	0
	LSD #		Treat 5.21	Treat x 9.12	Treat 3.13	Treat x 5.87	Treat 1.08	Treat x 3.08	Treat 0.88	Treat x 1.03

LSD# represents least significant difference at 5% level of significance

*Significant figures

Osmopriming : Osmopriming with KCl resulted in maximum germination percentage of 82.3, 82.3 and 83.1 and V.I 1272, 1282 and 1290 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 45.2, 45 and 52.1 respectively. After 12 months of ageing G% recorded was 28.2, 32.5 and 32.2 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 16.1, 16.2 and 18 and V.I 230 , 231 and 260 at 2%,5% and 10% concentrations respectively. Statistically , the most effective concentration of KCl for maintaining germination and vigour index for 18 months was found to be 10%

Osmopriming with KNO_3 resulted in maximum germination percentage of 83.2, 83.1 and 82.2 and V.I 1295, 1291 and 1276 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 46.2, 50.1 and 51.4 respectively. After 12 months of ageing G% recorded was 26.2 , 28.2 and 30 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 14.5, 14.5 and 15.6 and V.I 201 , 211 and 230 at 2%,5% and 10% concentrations respectively. Statistically , the most effective concentration of KNO_3 for maintaining germination and vigour index for 18 months was found to be 10%

Osmopriming with PEG-6000 resulted in maximum germination percentage of 83.2, 84.2 and 82.1 and V.I 1257,

1278 and 1280 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 45.7, 53.1 and 44.2 respectively. After 12 months of ageing G% recorded was 25.4, 28.5 and 28.4 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 11.2 , 14.2 and 13.8 and V.I 150, 209 and 188.2 at 2%,5% and 10% concentrations respectively. Statistically , the most effective concentration of PEG-6000 for maintaining germination and vigour index for 18 months was found to be 5% .

Among all the treatments, priming with 10% KCl is the most effective in maintaining best germination and VI over control at 5% level of significance as shown in TABLE 2.

TABLE 2:

Effect of seed osmopriming (Pre-sowing) on ageing *Dendrocalamus strictus* seeds

S.No.			Fresh		6 Monthly		12 Monthly		18 Monthly	
	Treatment	Conc.	G%	V.I	G%	V.I	G%	V.I	G%	V.I
1.	KCl	2%	82.3	1272	45.2	702	28.2	420.1	16.1	230
		5%	82.3	1282	45.0	702.3	32.5*	513	16.2	231
		10%	83.1*	1290	52.1*	820	32.2	512	18*	260
2.	KNo_3	2%	83.2*	1295	46.2	709	26.2	397	14.5	201
		5%	83.1*	1291	50.1	824.5	28.2	422	14.5	211
		10%	82.2	1276	51.4*	830.1	30*	442	15.6*	230
3.	PEG-6000	2%	83.2*	1257	45.7	702	25.4	390.1	11.2	150
		5%	84.2*	1278	53.1*	845	28.5*	415	14.2*	209
		10%	82.1	1280	44.2	690	28.4	412	13.8	188.2
4.	Control untreated seeds		80.2	1014	20	108	0	0	0	0
	LSD#		Treat 4.35	Treat x 8.1	Treat 3.5	Treat x 5.06	Treat 1.70	Treat x 3.02	Treat 0.90	Treat x 1.07

LSD# represents least significant difference at 5% level of significance.

*Significant figures

Infusion : Infusion with GA_3 resulted in maximum germination percentage of 82.2, 84.3 and 86 and V.I 1274, 1309 and 1447 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 56.4, 56.3 and 60 respectively. After 12 months of ageing G% recorded was 34.7, 34.8 and 40 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 23.3, 23.3and 26 and V.I 341, 360 and 443 at 2%,5% and 10% concentrations respectively. Statistically , the most effective concentration of for GA_3 maintaining germination and vigour index for 18 months was found to be 50ppm.

Infusion with IAA resulted in maximum germination percentage of 83.1, 83.1 and 85.2 and V.I 1291, 1264 and 1312 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 54.4, 53 and 54 respectively. After 12 months of ageing G% recorded was 25.4, 25.2 and 27.1 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 16.4, 20 and 16.4 and V.I 234, 282.3and 244.1 at 2%,5% and 10% concentrations respectively

Infusion with IBA resulted in maximum germination percentage of 88.2, 84.2 and 84.2 and V.I 1480, 1338 and 1339 at 2%,5% and 10% concentrations respectively. After 6 months of controlled ageing ,the treatments with the same concentrations the G% was observed to be 53, 48 and 48 respectively. After 12 months of ageing G% recorded was 25.4, 23.2 and 23.1 at 2%,5% and 10% concentrations respectively. After 18 months of ageing , G% recorded was 15.4, 16 and 15.2 and V.I 215, 237.3and 220.1 at 2%,5% and 10% concentrations respectively

Among all the treatments GA3 (50ppm) is the most effective in maintaining best germination and VI over control at 5% level of significance as shown in Table 3

TABLE 3:

Effect of seed infusion (Pre-sowing) on ageing *Dendrocalamus strictus* seeds

S.No.			Fresh		6 Monthly		12 Monthly		18 Monthly	
	Treatment	Conc.	G%	V.I	G%	V.I	G%	V.I	G%	V.I
1.	GA_3	10 ppm	82.2	1274	56.4*	854.1	34.7	609	23.3	341
		20 ppm	84.3*	1309	56.3*	868.2	34.8	594	23.3	360
		50ppm	86*	1447	60*	984	40*	704	26*	443
2.	IAA	10 ppm	83.1	1291.15	54.3*	798	25.4	390.2	16.4	234.5
		20ppm	83.1	1264	53.1	790	25.2	395	20*	282
		50ppm	85.2*	1312	54.0*	795.2	27.4*	413	16.4	244.4
3.	IBA									
		10ppm	88.2*	1480	53*	826.15	25.4*	405	15.4	215
		20 ppm	84.2*	1338	48	780	23.2	349	16*	237.38
		50 ppm	84.2*	1339.2	48	785	23.1	352	15.2	220.1
4.	Control		80.2	1014	20	108	0	0	0	0
		LSD#	Treat 4.12	Treat x 7.13	Treat 3.2	Treat x 5.12	Treat 1.03	Treat x 3.09	Treat 0.86	Treat x 1.23

LSD# represents least significant difference at 5% level of significance.
*Significant figures

Conclusion :

Infusion is the best method among all the three in enhancing the viability of dendrocalamus seeds. In fortified and infused seeds among all the treatments GA_3 (50ppm) could be recommended for bamboo seeds as a pre- sowing invigouration treatments and in maintaining best germination and VI over control at 5% level of significance. Seed viability can be recovered to major extent by the application of seed invigouration treatments such as osmopriming , fortification and infusion. Among all the treatments, priming with 10% KCl could be recommended most effective in maintaining best germination and VI over control at 5% level of significance These techniques of infusion, osmopriming and fortification can prove commercially important to increase the longevity of dendrocalamus seeds so that these could be used for longer period of time for raising plantations.

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