Mid–Storage Treatment and Its Effect on Bamboo (Bambusa bambos L.) Voss) Seeds

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A B S T R A C T

Bamboo set seeds once in life time, and the seeds are poor storer, necessitates the preservation of seeds until net availability. Experiments were conducted with one year refrigerated stored medium vigour (78% germination and vigour index of 1522) seeds of Bambusa bambos to extend the storage life. The seeds were soaked in 0.25 and 0.5% of Para Amino Benzoic Acid, 0.5 and 0.75% of Para Hydro Benzoic Acid, 0.1 and 0.2% of KH\(_2\)PO\(_4\), 500, 600 ppm of \(\alpha\)–tocopherol solutions and water for a duration of 30 min, 1, 2, 4, 6, and 12h as a mid-storage seed treatment to maintain the viability and vigour. The experiment results revealed that mere water soaking for 4h and drying could able to improve the germination (91%) and vigour (1738) immediately after treatment when compared to chemical and vitamin solutions. From the observations, water soaking for 4h and drying can be recommended as NO COST mid storage seed treatment for better performance of B. bambos seeds.

Keywords

Medium vigour, Mid storage, Soaking in water, Vigour.

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Introduction

Irrespective of agricultural or forestry, all seeds suffer a degree of deterioration after attainment of maturity. Particularly in forestry species, the deterioration may incur during delays between collection and processing, if seeds are held under inappropriate conditions, either during processing or in storage. Even under dry state, slow and normal metabolism essential to keep the seeds alive also may lead to some damage. Up to certain level of damage, repair will be possible through rehydration. On rehydration, metabolic activity are reactivated and cellular integrity is restored by the synthesis of Macromolecules and repair of cellular lesions and DNA (Cheah and Osborne, 1978; Elder and Osborne, 1993 and Onelli et al., 2000). The critical moisture content for reactivation of repair mechanisms varies between species and ranged from 15% (Lactuca sativa) to 30% (Triticum durum) (Ibrahim et al., 1983; Petruzelli, 1986), seed longevity also increases under this range (Roberts and Ellis, 1989), the repair processes are start to function when the seeds are rehydrated sufficient for the metabolic activities until then the processes are not fully
The repair mechanism of hydrated seed were reported in lettuce (Villiers and Edgcumbe, 1975); Maize, oat and rye (Zlatanova et al., 1987; Elder and Osborne, 1993 and Boubriak et al., 1997).

The hydration treatments either with water or dilute salt solutions or PEG may be given prior to storage or during storage (mid storage) or after storage as pre sowing (Basu, 1994) seed treatment. However number of conflicts on performance of seeds after hydration also exists. Differences in the effect of treatment between seed lots with differential vigour and maturity have been described (Powell et al., 2000; Demir, 2003, Butler et al., 2009). The treatment effect was more apparent in the medium vigour seeds than high and low vigour (Powell et al., 2000).

The magnitude of hydration is most effective on subsequent drying (Gurusinghe and Bradford, 2001). Gurusinghe et al., 2002, reported that slow drying of hydrated seeds may induce the LEA protein synthesis. Hydration-dehydration (H-DH) treatments of stored orthodox seeds of wheat, soybean and sesamum have been found to be very effective for the maintenance of vigour, viability and productivity (Mandal et al., 1989; Mandal et al., 2000 and De et al., 2003). H-DH is able to control the generation of free radical and damage already occurred due to free radicals (De et al., 2003).

Dilute solutions of chemicals such as sodium or potassium phosphate (di and mono basic), sodium chloride, p-hydroxy benzoic acid, p-amino benzoic acid, oxalic acid, potassium iodide, etc are effective against the age related problems in number of crops (Kundagrami et al., 2008 and Mandal et al., 2010). An investigation on potential of hydration and dehydration on seed performance of one year refrigerated stored seeds of B. bambus carried out and findings were presented.

Materials and Methods

One year refrigerated stored seeds of B.bambus were soaked in 0.25 and 0.5% of Para Amino Benzoic Acid, 0.5 and 0.75% of Para Hydro Benzoic Acid, 0.1 and 0.2% of KH$_2$PO$_4$, 500, 600 ppm of α – tocopherol solutions and water for a duration of 30 min, 1, 2, 4, 6, and 12h. After soaking, the seeds were dried back to original moisture content of 8%.

The performance of the treatments was evaluated through germination test (ISTA, 2010) in an inclined paper method along with control and observed for seedling length in cm (root and shoot) by measuring all normal seedlings after 21 days of test, vigour index (Abdul Baki and Anderson, 1973) and dry matter production in mg-seedling by drying all normal seedlings. Moisture content was estimated by sieving the grounded seeds in 0.5mm sieve and placed in an oven maintained high constant (130ºC±1) for 2h.

Results and Discussion

Both duration of soaking and the chemicals influenced the germination, seedling length, dry weight and vigour index. Among the four chemicals, the seeds soaked in KH$_2$PO$_4$ performed better with germination of 84% in both the concentrations (0.1and 02%) followed by water and 0.25% of Para Amino Benzoic Acid (83%), both the values were statistically different from each other. The poorest performer was α – tocopherol at all two concentrations. It produces only 9 and 11% of normal seedlings at 500 and 600ppm respectively (Plate 1).

The highest germination percentage varied with chemicals and duration of soaking. Germination percentage increased along with duration of soaking in water. It reached a maximum of 91% in water soaking for 4h,
thereafter started to decline, at the end of 12h the germination % was 82. However 0.2% KH$_2$PO$_4$ soaked seeds registered higher germination 89% at short period of 2h of soaking. The long durations were not beneficial. The potential of chemicals on influencing germination varied with duration of soaking (Table 1). Length of seedlings measured in root and shoot were not much influenced by the treatments. The seeds of KH$_2$PO$_4$ and water soaking produced longer seedlings with mean root and shoot length of 9.2 and 8.6cm followed by water soaking (8.8 and 8.2) respectively (Table 2). Vigour index computed using germination % and seedling length registered higher mean value for KH$_2$PO$_4$ soaked seeds (1485) followed by water soaking (1430). Irrespective of chemical and duration, water soaking for 4h and 0.2% KH$_2$PO$_4$ for 2 h produced vigorous seedlings with vigour index of 1738 and 1647 respectively (Table 3).

Short hydration of stored seeds are effective immediately after drying, in the present study a 12% increase in germination was observed, confirms the earlier findings by Basu (1976) and Rudrapal and Basu (1982).

Plate.1 Effect of mid storage correction treatment on seedling performance

4h water soaking 2h 500 ppm of α-tocopherol
Table.1 Effect of mid-storage H-DH seed treatments on seed germination %

| Chemicals (T)/ Duration of soaking (D) | Germination |       |       |       |       |       | Mean   |
|--------------------------------------|-------------|-------|-------|-------|-------|-------|--------|
| Control                              | 71(57.42)   |       |       |       |       |       |        |
| Water                                | 79 (62.73)  | 79 (62.73) | 80 (63.44) | 91 (72.54) | 88 (69.73) | 82 (64.90) | 83 (65.65) |
| 0.25% Para Amino Benzoic Acid        | 78 (62.03)  | 88 (69.73) | 87 (68.87) | 84 (66.42) | 82 (64.90) | 80 (63.44) | 83 (65.65) |
| 0.5% Para Amino Benzoic Acid         | 78 (62.03)  | 82 (64.90) | 84 (66.42) | 83 (65.65) | 79 (62.73) | 72 (58.05) | 80 (63.44) |
| 0.5% Para Hydro Benzoic Acid         | 77 (61.34)  | 80 (63.44) | 82 (64.90) | 84 (66.42) | 84 (66.42) | 68 (20.27) | 76 (56.79) |
| 0.75% Para Hydro Benzoic Acid        | 78 (62.03)  | 85 (67.21) | 83 (65.65) | 75 (60.00) | 71 (57.42) | 71 (57.42) | 77 (61.34) |
| 0.1% KH₂PO₄                           | 79 (62.73)  | 80 (63.44) | 83 (65.65) | 84 (66.42) | 88 (69.73) | 87 (68.87) | 84 (66.42) |
| 0.2% KH₂PO₄                           | 79 (62.73)  | 80 (63.44) | 89 (70.63) | 86 (68.03) | 84 (66.42) | 83 (65.65) | 84 (66.42) |
| 500ppm α – tocopherol                 | 45 (42.13)  | 6 (14.18)  | 2 (8.13)   | 0 (0.29)   | 0 (0.29)   | 0 (0.29)   | 9 (17.46)  |
| 600ppm α – tocopherol                 | 53 (46.72)  | 11 (19.37) | 3 (9.97)   | 0 (0.29)   | 0 (0.29)   | 0 (0.29)   | 11 (19.37) |
| Mean                                 | 72 (58.05)  | 66 (54.33) | 66 (54.33) | 65 (53.73) | 64 (53.13) | 54 (47.29) | 64 (53.13) |

|   | D  |   | T  |   | DxT |
|---|----|---|----|---|-----|
| SEd| 0.424 | 0.548 | 1.342 |
| CD (P=0.05) | 0.849** | 1.096** | 2.684** |

** Significant at 1% level (Figures in parenthesis are arc sine values)
## Table 2: Effect of mid-storage H-DH seed treatments on root and shoot length (cm)

| Chemicals (T) / Duration of soaking (D) | Root length (cm) | Shoot length (cm) | Mean | D | T | DxT |
|----------------------------------------|------------------|-------------------|------|---|---|-----|
| Control                                | 8.2              | 8.7               |      |   |   |     |
| Water                                  | 8.2              | 8.6               | 9.0  | 9.6| 9.1| 8.4 |
| 0.25% Para Amino Benzoic Acid          | 8.6              | 8.6               | 8.4  | 8.3| 8.0| 8.0 |
| 0.5% Para Amino Benzoic Acid           | 8.0              | 8.4               | 8.5  | 7.8| 7.8| 7.7 |
| 0.5% Para Hydro Benzoic Acid           | 8.7              | 8.8               | 8.9  | 8.9| 9.0| 9.3 |
| 0.75% Para Hydro Benzoic Acid          | 8.6              | 8.8               | 9.1  | 9.0| 8.9| 8.8 |
| 0.1% KH$_2$PO$_4$                      | 8.6              | 8.4               | 8.4  | 8.5| 7.7| 7.3 |
| 0.2% KH$_2$PO$_4$                      | 10.3             | 9.3               | 9.6  | 9.0| 8.6| 8.4 |
| 500ppm α – tocopherol                   | 9.0              | 8.7               | 8.7  | 0.0| 0.0| 0.0 |
| 600ppm α – tocopherol                   | 9.2              | 8.3               | 8.3  | 0.0| 0.0| 0.0 |
| Mean                                   | 8.8              | 8.7               | 8.8  | 6.8| 6.6| 6.4 |
| SED                                    | 0.042            | 0.055             | 0.134|   |   |     |
| CD (P=0.05)                            | 0.085**          | 0.110**           | 0.268**|   |   |     |
**Table 3** Effect of mid-storage H-DH seed treatments on dry-matter production (mg/seedling) and vigour index

| Chemicals (T)/ Duration of soaking (D) | Dry-matter production (mg/seedling) | Vigour index |  |
|--------------------------------------|------------------------------------|--------------|---|
|                                      | 30 min    | 1h    | 2h    | 4h    | 6h    | 12h  | Mean | 30 min | 1h    | 2h    | 4h    | 6h    | 12h  | Mean |  |
| Control                              | 8.5       |       |       |       |       |      |      | 1278   |       |       |       |       |      |      |   |
| Water                                | 8.5       | 8.8   | 8.9   | 9.5   | 9.0   | 8.9  | 8.9  | 1280   | 1335 | 1392  | 1738  | 1496 | 1337 | 1430 |
| 0.25% Para Amino Benzoic Acid        | 9.0       | 8.9   | 9.0   | 9.0   | 8.9   | 8.6  | 8.9  | 1287   | 1426 | 1392  | 1319  | 1246 | 1208 | 1313 |
| 0.5% Para Amino Benzoic Acid        | 9.2       | 9.5   | 10.2  | 10.0  | 9.4   | 9.2  | 9.6  | 1217   | 1337 | 1386  | 1303  | 1201 | 1087 | 1255 |
| 0.5% Para Hydro Benzoic Acid        | 9.1       | 9.1   | 8.9   | 8.7   | 7.9   | 7.9  | 8.6  | 1263   | 1320 | 1328  | 1361  | 1361 | 1196 | 1304 |
| 0.75% Para Hydro Benzoic Acid       | 8.0       | 10.3  | 8.8   | 8.8   | 8.6   | 8.5  | 8.8  | 1240   | 1437 | 1394  | 1230  | 1150 | 1143 | 1266 |
| 0.1% KH2PO4                          | 8.5       | 8.8   | 8.8   | 9.2   | 9.7   | 8.8  | 9.0  | 1319   | 1344 | 1403  | 1428  | 1434 | 1349 | 1380 |
| 0.2% KH2PO4                          | 8.7       | 8.8   | 8.8   | 8.7   | 8.8   | 8.8  | 8.8  | 1485   | 1424 | 1647  | 1514  | 1436 | 1403 | 1485 |
| 500ppm α – tocopherol                | 8.9       | 8.0   | 7.8   | 0.0   | 0.0   | 0.0  | 4.1  | 792    | 103  | 34    | 0     | 0    | 0    | 155  |
| 600ppm α – tocopherol                | 8.5       | 7.9   | 7.5   | 0.0   | 0.0   | 0.0  | 4.0  | 954    | 183  | 50    | 0     | 0    | 0    | 198  |
| Mean                                 | 8.7       | 8.9   | 8.7   | 7.1   | 6.9   | 6.7  | 7.9  | 1204   | 1101 | 1114  | 1099  | 1036 | 858  | 1069 |

|                  | D         | T         | DxT       | D         | T         | DxT       |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| SEd              | 0.042     | 0.055     | 0.134     | 0.849     | 1.096     | 2.683     |
| CD (P=0.05)      | 0.085**   | 0.110**   | 0.268**   | 1.698**   | 2.191**   | 5.367**   |
Hydration-dehydration removes the age accumulated toxic substances (Powell et al., 2000) and drying allows the seed to exclude the free radicals generated during storage (Gurusinghe and Bradford, 2001) thus improved the performance of seed. Proper drying is much essential to keep the respiration at lower rates. The activation of enzymes like superoxide dismutase (SOD) might have involved in removal of free radicals (Wilson and McDonald, 1986). However, the extent of damage due to free radical needs to be considered for a decision on strength of chemicals required or the soaking duration.

In the present study, the seeds were stored under refrigerated condition and were able to produce 71% normal seedlings after one year of storage. By the experience it is suggested that the seeds were occurred with a minimum loss in vigour, sufficient repair during rehydration might have resulted in increased germination and vigour. The chemicals except KH$_2$PO$_4$ at all concentrations and duration failed to produce the effect of water but improvement over control might be due to shallow depth of damage due to free radicals, which can be removed by mere water soaking, upon further damage, the seeds may require chemical solutions to rectify the damage occurred due to storage. Though KH$_2$PO$_4$ equally performing with water, economic point water soaking serves as best one with nil expense.

However, the storability of hydrated dehydrated seeds needs to be investigated.

From the study it can be concluded that the performance of B. bambus seeds with medium vigour and viability can be improved by water soaking for 4h, as a NO COST treatment it can be recommended.

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