PRE-SEED GERMINATION BY OSMOPRIMING METHOD ON QUALITY AND VIGOUR OF RICE SEEDS

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Abstract—Although more than half of the world’s population grown rice as a main crop, they still face many problems such as, in grown crop, too slow growth, etc. Due to the said problems, productivity of rice became lower, so they try to resolve the problems about its quality by using “seed priming” method to get our rice productivity better. The main purposes of this research were to find out about how rice quality get changed after pre-seed germination by osmopriming method and to study about the vigour of the primed seeds by accelerated aging method. The experiments were conducted at seed technology laboratory, Faculty of Agricultural Technology, King Mongkut’s Institute of Technology Ladkrabang. Firstly, the 10 months stored of rice seeds were soaked into IBA solution (Indole-3-butyric acid) at 1, 2, 3, 4 and 5 ppm I. concentrate and left it in room temperature condition for 3 and 6 hours. Then, the primed seeds were dried by keeping it the hot air oven at 40 Degrees Celsius until its moisture content came back to initial level. Subsequently, observed the change of seed quality from its moisture content, seed germination in laboratory condition and germination index. The results found that seed quality was improved after we did seed priming. The best method was soaked seed into IBA solution at 1 ppm concentrate for 3 hours. It made the result of germination index was higher than the other methods. And when the primed seeds were accelerated aging at 43 Degrees Celsius with relative humidity 100% for 72 hours to observe their vigour. The result found that the primed seeds were vigour than non-primed seeds.

Keywords—seed priming, osmopriming, rice seed, seed quality, seed vigour, Indole-3-butyric acid

INTRODUCTION

Rice (Oryza sativa L.) is a cereal crop as a main food for more than half of the world’s population. It is grow
on wide planting area cover approximately 11% of arable land in the world [1]. Currently, there may be problems, especially in transplanted rice cultures such as poor germination, germinate slowly and un-uniform emergence. That all the problem resulting un-synchronization and un-vigour of seedling resulting rice cultivation had poor or slow growth and finally gives low yields.

Different seed priming techniques including hydropriming, osmopriming and matric priming are used in rice. There provides a high germination, germinate faster, uniform emergence and gives high yields [2]. Therefore, pre-germination of seed (seed priming) before planting getting very interesting.

Seed priming is the pre-seed germination before planting process by soaking the seed into water or some chemical at optimum temperature and time for activate germination process occur, then stop the process before radicle emergence by dry them until seed moisture content is reduce to initial moisture content [3] to provides synchronization of seed germination [4]. In addition, the primed seed can be storage for some period of time.

Therefore, pre-seed germination by using IBA solution as an osmopriming solution; it is the one method that great for rice seed. The aim of this study were to find out about how rice quality get changed after pre-seed germination by osmopriming method and to study about the vigour of the primed seeds by accelerated aging method.

II. MATERIALS AND METHODS

A. Seed Priming Materials

The 10 month stored of rice (Oryza sativa L.) seeds used for seed priming in this study were obtained from Oryza World Company, Khon Kaen, Thailand. Indole-3-butyric acid (IBA) from Sigma-Aldrich, St. Louis, MO, USA was used as a seed priming solution.

B. Pre-Seed Germination by Osmopriming Method

Rice seeds were soaked into IBA solution (Indole-3-butyric acid) at 1, 2, 3, 4 and 5 ppm concentrate and left it in room temperature condition for 3 and 6 hours. Then, the primed seeds were dried by keeping it in the hot air oven at 40 Degrees Celsius until seed moisture content was reduced to initial moisture content of 10%. A non-primed treatment was included as a control. The primed seed were divided into two parts. The first part was tested for initial primed seed after priming. The second part was tested for seed vigour by using accelerated aging method. All the parts were tested for seed germination and germination index.

C. Seed Germination Test under Laboratory Condition

Four replicates of 100 rice seeds from each treatment were incubated on moist paper towels in germinator at 20-30 Degrees Celsius. The first count was carried out after 5 days and the second one after 14 days following the rules of rice seed germination protocol according to [5]. Percentage of seed germination was calculated by following formula:

\[
\text{Seed germination} (\%) = \left( \frac{\text{No. of normal seedling}}{\text{Total of seed used in germination}} \right) \times 100
\]

D. Germination Index

The germination index as following to seed germination under laboratory condition was calculated as described in [5] by following formula:

\[
\text{Germination index} = \left( \frac{\text{No. of seedlings}}{\text{Days of first count}} - \frac{\text{No. of seedlings}}{\text{Days of final count}} \right)
\]

E. Accelerated Aging Testing

The non-primed seeds and primed seeds were accelerated aging. Accelerated aging technique was performed as described by [6]. Seeds were artificially aged for 3 days in an accelerated aging chamber and incubated in plastic boxes with 100% (R.H.) at 43
Degrees Celsius. Subsequently, a sample of aged seeds were tested immediately for seed germination and germination index.

F. Statistical Analysis
The design was completely randomized with four replications. Data were analysed by 1-way ANOVA. The difference between treatments was tested by Duncan’s new multiple range test (DMRT).

I. RESULTS
A. Seed Quality after Priming with IBA
After, the 10 month stored of rice seeds were soaked into IBA solution (Indole-3-butyric acid) at 1, 2, 3, 4 and 5 ppm concentrate and left it in room temperature condition for 3 and 6 hours. Then, the primed seeds were dried by keeping it the hot air oven at 40 Degrees Celsius until seed moisture content was reduced to initial moisture content of 10%. Then the seed qualities including seed germination and germination index were tested. The result showed that the germination percentage of the primed seed with IBA for all treatments were significantly difference from the non-primed seed, the primed seed for all treatments were higher than the non-primed seed, especially the primed seed with 1 ppm IBA for 3 hours had highest seed germination. Similarly, the germination index also were significantly different among treatments and the best one also were the primed seeds with 1 ppm IBA for 3 hours (TABLE 1).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seed Germination (%)</th>
<th>Germination Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-primed seed</td>
<td>85.50</td>
<td>16.43</td>
</tr>
<tr>
<td>Primed seed with 1 ppm IBA 3 hr</td>
<td>95.50</td>
<td>17.13</td>
</tr>
<tr>
<td>Primed seed with 1 ppm IBA 6 hr</td>
<td>94.00</td>
<td>15.23</td>
</tr>
<tr>
<td>Primed seed with 2 ppm IBA 3 hr</td>
<td>93.00</td>
<td>12.22</td>
</tr>
<tr>
<td>Primed seed with 2 ppm IBA 6 hr</td>
<td>91.75</td>
<td>15.33</td>
</tr>
<tr>
<td>Primed seed with 3 ppm IBA 3 hr</td>
<td>92.50</td>
<td>15.35</td>
</tr>
<tr>
<td>Primed seed with 3 ppm IBA 6 hr</td>
<td>91.60</td>
<td>16.71</td>
</tr>
<tr>
<td>Primed seed with 4 ppm IBA 3 hr</td>
<td>94.60</td>
<td>16.78</td>
</tr>
<tr>
<td>Primed seed with 4 ppm IBA 6 hr</td>
<td>93.50</td>
<td>15.34</td>
</tr>
<tr>
<td>Primed seed with 5 ppm IBA 3 hr</td>
<td>93.25</td>
<td>16.78</td>
</tr>
<tr>
<td>Primed seed with 5 ppm IBA 6 hr</td>
<td>82.22</td>
<td>15.33</td>
</tr>
</tbody>
</table>

** Means within a columns with different letters are significantly different (P ≤ 0.05) according to DMRT.

** Treatments significantly different at P≤0.01.

In addition, the primed seed with IBA (below) had speed and uniformity of germination higher than the non-primed seed (above) when incubated them on moist paper towels in germinator for 5 days (Fig. 1).

B. Seed Vigour after Priming with IBA
After, the non-primed seeds and primed seeds were artificially aged for 3 days in an accelerated aging chamber and incubated in plastic boxes with 100% (R.H.) at 43 Degrees Celsius. Then, a sample of aged seeds were tested immediately for seed germination and germination index. The results showed that the germination percentage of the primed seed with IBA for all treatments were higher than the non-primed
seed and found the highly significantly difference, the primed seed with 4 ppm IBA for 3 hours had highest seed germination. Similarly, the germination index also were highly significantly difference and the best one were the primed seeds with 3 ppm IBA for 3 hours, these treatments were not significantly difference from all treatments of primed seed (TABLE 2).

**TABLE II**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seed germination (%)</th>
<th>Germination index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-primed seed</td>
<td>50.50</td>
<td>0.90b</td>
</tr>
<tr>
<td>Primed seed with 1 ppm IBA 6 hrs</td>
<td>80.50 ab</td>
<td>7.94 a</td>
</tr>
<tr>
<td>Primed seed with 2 ppm IBA 6 hrs</td>
<td>79.25 ab</td>
<td>9.91 a</td>
</tr>
<tr>
<td>Primed seed with 3 ppm IBA 6 hrs</td>
<td>75.50 ab</td>
<td>9.93 a</td>
</tr>
<tr>
<td>Primed seed with 4 ppm IBA 6 hrs</td>
<td>84.73 a</td>
<td>10.10 a</td>
</tr>
<tr>
<td>Primed seed with 5 ppm IBA 6 hrs</td>
<td>81.73 a</td>
<td>10.21 a</td>
</tr>
<tr>
<td>Primed seed with 6 ppm IBA 6 hrs</td>
<td>81.00 ab</td>
<td>9.07 a</td>
</tr>
<tr>
<td>Primed seed with 7 ppm IBA 6 hrs</td>
<td>85.00 a</td>
<td>9.83 a</td>
</tr>
<tr>
<td>Primed seed with 8 ppm IBA 6 hrs</td>
<td>80.36 c</td>
<td>7.71 a</td>
</tr>
<tr>
<td>Primed seed with 9 ppm IBA 6 hrs</td>
<td>72.30 bc</td>
<td>7.56 a</td>
</tr>
<tr>
<td>Primed seed with 10 ppm IBA 6 hrs</td>
<td>82.25 ab</td>
<td>10.02 a</td>
</tr>
<tr>
<td>F test</td>
<td><strong>9.32</strong></td>
<td><strong>3.78</strong></td>
</tr>
</tbody>
</table>

**Means within a columns with different letters are significantly different (P ≤ 0.05) according to DMRT.**

II. DISCUSSION

According to the result that pre-seed germination by osmopriming method by soaked the 10 month stored of rice seeds into IBA solution (Indole-3-butyric acid) at 1, 2, 3, 4 and 5 ppm concentrate and left it in room temperature condition for 3 and 6 hours. Then, the primed seeds were dried by keeping it the hot air oven at 40 Degrees Celsius until seed moisture content was reduced to initial moisture content of 10%. Based on the above results, the 10 month stored of rice seeds had seed quality changed in seed germination and germination index, there were higher than the non-primed seed. Due to the fact that seed priming can be promote the germination of seed by let the seed imbibe the moisture for some period of time, this could be activate for germination process [7]. Similarly, [8] said that seed priming has appear as a productive and useful access for increasing seed vigour and concomitant germination. In addition, the IBA solution that were used for osmopriming solution had the property that can be activate a radicle emergence. Vigour testing has become a critical component of a seed producer’s quality assurance program because it provides information on individual and seed lots that may not be apparent in the warm germination test [9]. Accelerated aging test is also another one of the methods that recommended to use for rice seed vigour measurement [6]. Accelerated aging test was then applied to use for measure vigour of the primed seed in this research by maintained at very high relative humidity and high temperature for a defined period of time (43 °C, 100%RH for 3 days). This was following the previously described condition [6]. Accelerated aging test effected on seed quality. These included seed germination and germination index were clearly decreased upon the aging time. The explanation for seed deterioration was that high temperature and moisture content reduce the seed quality and these parameters were the factors to predict the life spans of seeds [10] Moreover, the reactions involved in seed aging were controlled by the thermodynamic status of water [6]. High seed moisture content and high temperature also accelerated the seed deterioration [11]. In theory, seed deterioration is started from the deterioration of membranes which probably involves lipid peroxidation and associates free radicle oxidation stresses, leading to membrane leakage. The leakage of ions, amino acids and sugars are a clear sign of membrane deterioration that results in greatly increased permeability [12]. This free radicle included non-enzymatic peroxidation has the potential to damage the membrane. It is also the major cause of
electrolyte leakage and decrease in seed germination [13]. In order to prove this, further experiments on the analysis of peroxidation on seed during germination are needed. Additionally, seed deterioration revealed by delayed germination, slower seedling growth rates, abnormal growth, decreased tolerance to adverse conditions and finally loss of germinability. Overall, the primed seed showed germination percentage and germination index higher than the non-primed seed. This is due to IBA can be benefit of rice seed priming. No such a delayed germination, a slower seedling growth rate, an abnormal growth were observed in the experiment. The present study agrees with the research by [14] that tomato seed coating with coating substances mixed with 2 types of plant hormones; Gibberellins (GA) rates of 1, 1.5 and 2 % Indole-3-butyric acid (IBA) rates of 0.1, 0.2 and 0.3 %, revealed that coated seed with IBA 0.2 % had the highest germination, the seedling of coated seeds with both plant hormones had longer of root length than that of the non-coated. Especially, the primed seed with 4 ppm IBA solution provided seed vigour higher than non-primed seed. IBA is the plant growth promotion [15], [16], [17] reported the coating of seed with plant growth promoter has increased both the germination percentage, seedling vigor and emergence. Furthermore, IBA treatment in this study also provided higher seed vigour than that of other treatments. This finding supported the idea that IBA could be activate radicle emergence [14].

III. Conclusions
The pre-seed germination by osmopriming for all treatments had seed germination in laboratory condition and germination index higher than the non-primed seed. Especially, soaking the seed into 1 ppm IBA solution for 3 hours. In addition, the primed rice seed for all treatments had seed vigour than the non-primed seed.

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