OSMOCONDITIONING SEEDS OF FOUR CROP SPECIES USING BOTANICAL EXTRACTS

McWinner Yawman1* and Danilo P. Padua2

1University of Southeastern Philippines, Tagum Philippines
2Benguet State University, La Trinidad, Benguet Philippines

ABSTRACT

Corn, peanut, millet and field bean seeds were subjected to osmoconditioning using extracts of moringa (Moringa oleifera), papaya (Carica papaya), golden bush (Haplopapus linearifolius), mushroom (Pleurotus ostreatus) and coconut (Cocos nucifera) water. The osmoconditioned seeds of corn, millet and peanut germinated 1-2 days earlier than the counterpart seeds conditioned only with water. With respect to the different parameters measured, the extracts seem to have varying but specific effects on certain crop seeds. The root dry matter yield in field bean was enhanced by all the extracts. Coconut water and papaya extracts produced longer shoots only in field bean and peanut respectively. On the dry matter of seedlings, only coconut water, papaya and moringa tend to increase it. All the botanical extracts however, greatly enhanced the seedling vigor in corn peanut and millet. The extracts, specially, papaya and coconut water, have also shown a possible natural fungicidal effect as they prevented or at least reduced rotting of roots in seedlings of all the test crops. It seems prudent to have laboratory tests to determine the chemical content of the extracts used that is responsible for the positive effect of osmoconditioning seeds.

INTRODUCTION

One of the most important problems facing farmers in developing countries is the heterogeneity and lack of suitable condition in soil that causes decrease in germination percentage, heterogeneous emergence, unbalanced seedling growth and competition for environmental resources such as light, nutrients and water. Subsequently, this makes a difference in biomass and performance of species of crops. One of the methods that can overcome the problem is seed pre-planting treatments like osmoconditioning. Seed osmoconditioning is pre-sowing imbibition treatment which is widely used to enhance seed performance with respect to rate and uniformity of germination (Ghiyasi et al., 2008). This treatment is based upon controlled hydration of the seeds; during priming; seeds are brought up to, and eventually held at the end of phase II of water uptake of the germination process without entering the initial growth phase characterized by radicle protrusion through the seed coat. Since most embryos of seeds are desiccation tolerant up to this developmental stage, the advancement of the seeds in the germination process during osmoconditioning can be arrested by drying (Hassanpouraghdam, Pardaz and Akhtar, 2009). Optimum crop stand establishment is considered to be important for the efficient use of resources like water and light. In the rain fed semi-arid tropics, however, the balance between water supply and demand is critical and more conservative crop densities are often required.

Nevertheless, uniform stand establishment is still a requirement for cropping success because, under adverse conditions, crowding should be avoided in order to allow each plant maximum access to limited soil water (Kausar, Mahmood, Basra and Arshad, 2009). Good crop establishment is especially difficult in marginal, rain-fed environments where many poor farmers live. The effect of which often manifest as sparse stands of stressed seedlings. Such stands seldom recover and can never fulfill their genetic potential (Moradi, Sharifzadeh & Jamnoohamadi 2008). Good germination and emergence is the key to controlling stand establishment. Similarly, vigorous early growth is often associated with better yields. In general, healthy plants with well-developed root systems can withstand adverse conditions better than plants whose development and growth have been interrupted at an early stage (Talebian et al., 2008). Seed osmoconditioning is a generic technology that addresses a fundamental requirement for crop production - the need to have a field full of vigorous plants. Thus it can be incorporated with almost any other technology or process that can be used to improve crop performance. Heydecker and associates developed the priming system and used the term osmoconditioning for osmotic priming and related procedures (Yari, Aghaalikhani and Khazaei, 2010). According to Benitez-Rodriguez et. al, (2014) on-farm seed osmoconditioning is a simple, proven technology that has been developed, tested, and refined in laboratories, in experimental plots, and by farmers themselves in their fields. It’s easy to use with a wide range of crops in many different
farming conditions (Cendan, Sampedro, & Zas, 2013). Osmoconditioning seeds of six cultivars of finger millet with water for 8 hr in eastern India resulted in taller, earlier-maturing plants that produced more yield than plants from non-primed seed in two on-station trials in 2000 and 2001. It’s reported that higher yields of crops per unit area as a result of osmoconditioning seeds reduced pressure on more marginal land. Increased straw production can reduce pressure on natural environments for feeding livestock (Mondal & Bose, 2014). The central objective of this study to determine the effect of extracts of mushroom, moringa, papaya, golden bush and coconut water on germination, vigor, crop establishment and early growth of maize, peanut, millet and field bean.

**MATERIALS AND METHODS**

The botanical extracts used for the experiment are the following: Papaya extracts (Carica papaya), Moringa Extract (Moringa oleifera), Coconut Water (Cocos nucifera), Golden Bush Extract (Haplopapus linearifolius), and Oyster Mushroom Extract (Pleurotus ostreatus). They were obtained from the Benguet State University campus and surrounding community. Good quality seeds of corn (Zea mays), peanut (Arachis hypogaea), millet (Pennisetum glaucum), and field bean (Phaseolus vulgaris) were used as test crops in this experiment. They were bought from certified seed sellers from the municipality of La Trinidad. Sterilized plastic trays measuring 50cm x 35cm x 15cm were used for the experiment. Oven was used to dry seedling samples, and electronic balance used to weigh them. The plastic trays were thoroughly washed and rinsed with purified water to reduce the incidence of microorganisms.

Botanical extracts of papaya, moringa, mushroom, golden bush, and Coconut water were used to osmocondition the seeds. These botanicals are rich in growth hormones and vitamins and have the tendency to enhance growth and repairs in plants. The botanicals were initially washed in running water, then with purified water. They were kept in shade for air-drying for 12 hrs, and then oven dried at 40°C for 48 hrs to gain constant weight. Powdered samples were prepared by pulverizing the dried leaves using wiley mill as described by Chivasa, et al. (2000b). The ground samples were passed through a 25-mesh sieve to obtain a fine and uniform powder. One hundred (100g) sample of each powdered botanical extract was placed in 500 ml beaker and mixed separately with 110 ml of water to give 90% solution. The mixtures were stirred for 15 minutes with stirrer and left to stand for next 24 hours. They were filtered through a filter paper (Ederol 610 mm X 610 mm). Same volume of plant extracts was used for osmoconditioning all the seeds of the test crops.

The fresh coconut water was collected on the day of the experiment. Two hundred (200) ml of fresh coconut water was diluted with 220 ml of purified water to give 90% solution. Seeds were fully immersed in osmoconditioning media at room temperature for 8 hrs before planting. Sterilized sandy soil was used for the experiment. They were filled with sterilized sandy soil up to 2 cm to the brim. The osmoconditioned seeds were sown in plastic trays at one seed per hill at a distance of 3 cm between hills by 5 cm between rows. There were 54 seeds per replication or per tray. Three trays were planted per extract per replication. Watering was done as needed. Seeds of maize, peanut and field bean were planted at a depth 2.0 cm in the soil, and 1 cm depth for millet. Seeds were considered germinated when the plumule emerged from the soil. Germination progress was monitored at 12 hr interval for 10 days. The experiment was carried out for duration of 10 weeks. The experiment was laid out in a Completely Randomized Design with three replications. The following treatments were used for osmoconditioning each test crop.

\[
\begin{align*}
T_0 & = \text{distilled water} \\
T_1 & = \text{Oyster mushroom extract} \\
T_2 & = \text{Moringa extract} \\
T_3 & = \text{Papaya extract} \\
T_4 & = \text{Golden bush extract} \\
T_5 & = \text{Coconut water}
\end{align*}
\]

All quantitative data were analyzed using the Analysis of Variance (ANOVA) for Completely Randomized Design. The significance of differences among treatments was tested using the Duncan’s Multiple Range Test.

**RESULTS AND DISCUSSION**

Seeds osmoconditioned with botanical extracts germinated 1-2 days earlier than seeds osmoconditioned with water (Table 1,2&3; figure 1,2&3). Faster emergence of seeds treated with botanical extracts could be attributed to metabolic repair processes, a build-up of germination metabolites or osmotic adjustments during osmoconditioning. This has the tendency to enhance faster germination. In sorghum, Di Girolamo and Barbanti (2012) found priming conditions had a large influence on emergence and seedling vigor that germination was an important determinant of successful seedling establishment. In figure 2&3, peanut and millet osmoconditioned seeds germinated a day earlier. These findings agree with Dursun and Ekinci (2010) who reported faster emergence of osmoconditioned seeds. Observed improvements in emergence of osmoconditioned seeds may be attributed to the extracts that induces quantitative changes in biochemical content of the seed and improves membrane integrity and enhances physiological activities at seed germination. These results are also in conformity with an earlier finding that seed priming was beneficial in reducing the days to emergence of seeds of several species. It was concluded that osmopriming of a slowly germinating stock improved the percentage seedling emergence compared with un-treated seeds.

It is generally accepted that repair of seeds deteriorated by lipid peroxidation occurs during hydration, mainly via production of antioxidants and repair enzymes (Nawaz et al. 2013). In corn, peanut, and millet, all the extracts were found to enhance 50% germination by 1-2 days (figure 1,2&3). In agreement with these findings, several other reports showed improved and early seedling emergence in sorghum, millet, cotton, beans and maize as a result of osmoconditioning. In corn, coconut water was observed to have the greatest effect in enhancing shoot development (figure 1). The control had the shortest shoots (62.79 cm), but did not markedly differ from of the moringa extract. This is in conformity with Dehghanpour et. al., (2011) that osmopriming of morgina seeds for 8, 16 and 24 hours enhanced seedling vegetative growth. Similar to this, it was reported later that presoaking seeds before sowing slightly enhanced vegetative crop growth. This finding corroborates the positive effects of osmoconditioning on emergence and crop growth as reported in previous studies. Coconut water was observed to enhance the longest shoots in millet (figure 3).
Table 1. Effect of osmoconditioning with distilled water (T0), mushroom (T1), moringa (T2), papaya (T3), golden bush (T4), coconut water (T5) on corn

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of days to germination</th>
<th>Days to 50% germination</th>
<th>50% Shoot Length</th>
<th>Root Length</th>
<th>Shoot Dry matter yield</th>
<th>Root Dry matter yield</th>
<th>% Normal seedlings</th>
<th>% Root rot infection</th>
<th>Seedling vigor</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>95.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.67&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.85</td>
</tr>
<tr>
<td>T1</td>
<td>5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>48.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.97&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>97.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.33&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.05</td>
</tr>
<tr>
<td>T2</td>
<td>5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7&lt;sup&gt;c&lt;/sup&gt;</td>
<td>51.88&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.47&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.23&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.55&lt;sup&gt;b&lt;/sup&gt;</td>
<td>96.67&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.22</td>
</tr>
<tr>
<td>T3</td>
<td>5&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7&lt;sup&gt;d&lt;/sup&gt;</td>
<td>54.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.41&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.53&lt;sup&gt;c&lt;/sup&gt;</td>
<td>97.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.32</td>
</tr>
<tr>
<td>T4</td>
<td>5&lt;sup&gt;e&lt;/sup&gt;</td>
<td>7&lt;sup&gt;e&lt;/sup&gt;</td>
<td>50.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.87&lt;sup&gt;e&lt;/sup&gt;</td>
<td>3.33&lt;sup&gt;d&lt;/sup&gt;</td>
<td>97.67&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.49</td>
</tr>
<tr>
<td>T5</td>
<td>5&lt;sup&gt;f&lt;/sup&gt;</td>
<td>7&lt;sup&gt;f&lt;/sup&gt;</td>
<td>57.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.26&lt;sup&gt;f&lt;/sup&gt;</td>
<td>4.60&lt;sup&gt;a&lt;/sup&gt;</td>
<td>97.33&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.55</td>
</tr>
<tr>
<td>CV%</td>
<td>0.0</td>
<td>46.29</td>
<td>5.18</td>
<td>10.83</td>
<td>6.98</td>
<td>15.55</td>
<td>35.50</td>
<td>33.50</td>
<td>11.85</td>
</tr>
</tbody>
</table>

Means with same letters are not significantly different at 5% level of significance, DMRT

Parameters = Number of days to germination, days to 50% germination, shoot length, root length, shoot dry matter yield, root dry matter yield, percent normal seedlings, percent root rot infection, seedling vigor

Table 2. Effect of osmoconditioning with distilled water (T0), mushroom (T1), moringa (T2), papaya (T3), golden bush (T4), coconut water (T5) on peanut

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of days to germination</th>
<th>Days to 50% germination</th>
<th>50% Shoot Length</th>
<th>Root Length</th>
<th>Shoot Dry matter yield</th>
<th>Root Dry matter yield</th>
<th>% Normal seedlings</th>
<th>% Root rot infection</th>
<th>Seedling vigor</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>34.57&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16.42&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.70</td>
<td>96.67&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.64&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>T1</td>
<td>7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31.57&lt;sup&gt;a&lt;/sup&gt;</td>
<td>18.31&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.82&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.80</td>
<td>98.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.33&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.26&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>T2</td>
<td>7&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9&lt;sup&gt;c&lt;/sup&gt;</td>
<td>37.55&lt;sup&gt;c&lt;/sup&gt;</td>
<td>15.55&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.72&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.80</td>
<td>98.67&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.81&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>T3</td>
<td>7&lt;sup&gt;d&lt;/sup&gt;</td>
<td>9&lt;sup&gt;d&lt;/sup&gt;</td>
<td>40.52&lt;sup&gt;d&lt;/sup&gt;</td>
<td>15.21&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.76&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.60</td>
<td>98.00&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.67&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.23&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>T4</td>
<td>7&lt;sup&gt;e&lt;/sup&gt;</td>
<td>9&lt;sup&gt;e&lt;/sup&gt;</td>
<td>36.19&lt;sup&gt;d&lt;/sup&gt;</td>
<td>19.49&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.14&lt;sup&gt;e&lt;/sup&gt;</td>
<td>1.60</td>
<td>97.67&lt;sup&gt;e&lt;/sup&gt;</td>
<td>4.33&lt;sup&gt;e&lt;/sup&gt;</td>
<td>5.00&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>T5</td>
<td>7&lt;sup&gt;f&lt;/sup&gt;</td>
<td>9&lt;sup&gt;f&lt;/sup&gt;</td>
<td>43.81&lt;sup&gt;f&lt;/sup&gt;</td>
<td>19.57&lt;sup&gt;f&lt;/sup&gt;</td>
<td>4.77&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1.60</td>
<td>99.00&lt;sup&gt;f&lt;/sup&gt;</td>
<td>2.33&lt;sup&gt;f&lt;/sup&gt;</td>
<td>5.19&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>CV%</td>
<td>3.32</td>
<td>6.37</td>
<td>7.75</td>
<td>3.43</td>
<td>2.71</td>
<td>14.57</td>
<td>48.48</td>
<td>39.90</td>
<td>5.19</td>
</tr>
</tbody>
</table>

Means with same letters are not significantly different at 5% level of significance, DMRT

Parameters = Number of days to germination, days to 50% germination, shoot length, root length, shoot dry matter yield, root dry matter yield, percent normal seedlings, percent root rot infection, seedling vigor
Table 3: Effect of osmoconditioning with distilled water (T0), mushroom (T1), moringa (T2), papaya (T3), golden bush (T4), coconut water (T5) on millet

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of days to germination</th>
<th>Days to 50% germination</th>
<th>50% Shoot Length</th>
<th>Root Length</th>
<th>Shoot Dry matter yield</th>
<th>Root dry matter yield</th>
<th>% normal seedlings</th>
<th>% root rot infection</th>
<th>Seedling vigor</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>6a</td>
<td>7</td>
<td>21.71</td>
<td>4.90</td>
<td>0.03</td>
<td>0.16</td>
<td>94.00</td>
<td>8.33</td>
<td>5.28</td>
</tr>
<tr>
<td>T1</td>
<td>5b</td>
<td>7</td>
<td>15.61</td>
<td>6.67</td>
<td>0.03</td>
<td>0.19</td>
<td>95.33</td>
<td>6.00</td>
<td>4.56</td>
</tr>
<tr>
<td>T2</td>
<td>5b</td>
<td>6</td>
<td>15.36</td>
<td>5.95</td>
<td>0.02</td>
<td>0.23</td>
<td>95.00</td>
<td>5.67</td>
<td>5.38</td>
</tr>
<tr>
<td>T3</td>
<td>5b</td>
<td>6</td>
<td>21.53</td>
<td>8.79</td>
<td>0.02</td>
<td>0.22</td>
<td>95.33</td>
<td>4.67</td>
<td>5.53</td>
</tr>
<tr>
<td>T4</td>
<td>5b</td>
<td>6</td>
<td>16.82</td>
<td>6.18</td>
<td>0.03</td>
<td>0.18</td>
<td>95.33</td>
<td>6.33</td>
<td>4.99</td>
</tr>
<tr>
<td>T5</td>
<td>5b</td>
<td>6</td>
<td>25.23</td>
<td>5.69</td>
<td>0.03</td>
<td>0.23</td>
<td>95.67</td>
<td>3.67</td>
<td>5.53</td>
</tr>
<tr>
<td>C.V.</td>
<td>4.61</td>
<td>9.60</td>
<td>8.78</td>
<td>9.80</td>
<td>15.10</td>
<td>7.62</td>
<td>22.61</td>
<td>21.97</td>
<td>5.53</td>
</tr>
</tbody>
</table>

Means with same letters are not significantly different at 5% level of significance, DMRT

In contrast, mushroom, moringa and golden bush extracts appear to have a depression effect. Coconut water seem to contain substances that could promote faster growth of seedlings. Rapid emergence of seedlings has also been mentioned to lead to the production of vigorous plants. The efficiency of seed osmo-priming for better seedling emergence and vegetative growth is reported in barley and chickpea. Coconut water enhanced the longest shoots in peanut (Table 2) which was remarkably longer than the other extracts except papaya. The higher values of osmoconditioned seeds may be due to early and improved emergence that ultimately resulted in better roots and shoots development. Similar arguments were made by Nawaz et al. (2013) who attributed good length of roots and shoots to early emergence of seeds. It’s further reported that osmoconditioned crops produced better shoots and roots than non osmoconditioned crops. These results are also in conformity with Song (2011) who reported that seed priming increased vegetative growth. The effect of coconut water on peanut shoot length is similar to that of millet. The effect of moringa on root length was very evident in corn (Table 1).

Beneficial effects of osmoconditioning on vegetative growth were reported in wheat and rice. The dry matter yield of roots of millet seedlings was substantially greater when osmoconditioned with coconut water and moringa extract (figure 3). An earlier report found that earlier emergence after priming gave rise to higher mean plant weights ten weeks after sowing. In contrary, it’s reported that seed soaking with 20 ppm GA3 significantly reduced the stem dry weight, and whole-plant dry weight. All the botanical extracts did not differ significantly on the root dry matter yield of field bean (table 4), but were found to be higher, indicating that the plant extracts used were very effective for osmoconditioning. In a study, Moon & Soon (2004) reported that priming reduced time to 50% emergence and increased plumule weight. Papaya extract, coconut water, and moringa proved to be superior in enhancing dry matter yield of shoot of corn seedling (Table 1). These results are also in line with those reported earlier that heavier grains and greater amount of dry matter for primed seeds and dry matter weight. They endorse the findings in 2002 that plant extract significantly increased total biomass when compared with unprimed seeds.
In peanut higher dry matter yield of seedling were obtained from mushroom, moringa, papaya, and coconut water (Figure 2). Beneficial effects of hydro-priming on grain yield were reported in wheat earlier. Papaya gave the highest dry matter yield of shoots of field bean seedling (2.85g) followed by moringa (2.70g) while control had the least effect on dry matter yield of field bean seedling (Table 4). This indicates that all the extracts used could be useful in improving the dry matter yield of field bean seedling. The results agree with the findings of Basra et al. (2003). A normal seedling will have all of the essential structures present for normal growth, often some structures may be slow to develop or they may be missing as well. The control was observed to have the lowest percentage normality with seedlings. In field bean, coconut water, papaya and moringa enhanced the highest percentage of normal seedlings. It was reported that the type and severity of seed abnormality may be dependent on the type and pathogenic potential of the associated fungi as well as the prevailing weather conditions. It was very evident in (Table 1, 2, 3 & 4) that the control had the highest root rot incidence (5.67%), and was significantly different from mushroom, moringa, papaya, golden bush, and coconut water extracts. The highest root rot incidence was observed on the control (8%). Obviously, significant difference was found between the control and the effect of mushroom, moringa, papaya, golden bush extracts and coconut water All the botanical extracts used probably contain chemicals that could be isolated and used to control diseases in peanut (figure 2). In relation to this, it is reported that seed priming in chickpea significantly reduced the damage caused by collar rot (Sclerotium rolfsii) in Bangladesh in two contrasting seasons, Rashid et al. (2004b) also observed similar differences in MYMV infection in other mungbean priming trials. Coconut water was observed to have the least disease infection of 3.67% in millet seedlings (Table 3). The control was found to have the highest incidence of disease infection (8.33%). Invasion of seed by fungi may also result in biochemical deterioration and change in quality of nutrients. The root rot of seedlings produced by Fusarium spp has also been reported by Khan et al. (2013). All botanical extracts also appear effective in controlling some seedling diseases of millet (Figure 3).

Like in corn, peanut and millet, the botanical extracts seem effective reducing the occurrence of seedling diseases in field bean. Coconut water, papaya, moringa, and mushroom extracts had the least incidence of Fusarium spp disease. There was no significant difference among the seedling vigor in peanut among mushroom, papaya and coconut water. However they were found to have the highest vigor levels. The control was observed to have the least seedling vigor, but not significantly different from the effect of moringa and golden bush extract. Osmoconditioning presumably allowed some repairs of damage to membrane caused by deterioration. It has been reported that primed seeds showed better germination pattern and higher vigor level than non-primed. Many workers have attempted to increase the seed germination capacity and vigor by using different priming extracts in various field crops. On the other hand it’s reported that none of the seed-priming extracts showed beneficial effects on grain yield of corn; some positive effects of seed priming on seedling vigor and stand establishment.

The results suggest that millet seedling vigor can be enhanced to some extent when treated with different botanical extracts. Primed seeds had higher vigor levels, which resulted in earlier start of emergence. Positive correlation between seed vigor and field performance had also been found in rice. Osmoconditioning resulted in enhanced seedling vigor, as indicated by high energy of emergence and emergence percentage. It has been verified that priming increased germination performance of low vigor seeds. For lettuce, ISTA (2012) observed beneficial effects of priming only for non-aged seeds. In addition, high seed vigor is necessary for tolerance to environmental stress. The improvement in germination performance resulting from osmoconditioning extracts has also been suggested as a result of repair mechanisms that occur during soaking; the seeds during the maturation process and/or during storage deteriorate and need repair during imbibition in order to germinate. Thus, aged (more deteriorated) seeds could benefit more from osmoconditioning extracts.

Conclusion and recommendation

Conclusion

Botanical extracts of mushroom, moringa, papaya, and golden bush were able to enhance germination of corn, peanut, millet and golden bush 1-2 earlier than the control. Shoot length of millet, peanut, and corn was greatly enhanced by coconut water; peanut was enhanced by mushroom, papaya and moringa extracts. For root length enhancement in corn, moringa extract was the most appropriate. Coconut water and golden bush extracts were ideal for better root development in peanut; for millet and field bean, papaya extract was promising.

For dry matter yield of roots in corn and millet, coconut water, moringa and papaya extracts gave higher yield. The botanical extracts did not have effect on the root dry matter yield of peanut. In field bean, coconut water, mushroom, moringa, papaya, and golden bush extracts could all be used to enhance root dry matter yield. Root rot in corn seedlings could be reduced by osmoconditioning seeds with extracts of papaya, moringa or coconut water. In peanut, it could be reduced by osmoconditioning with coconut water, papaya, moringa, or mushroom extract. Coconut water and papaya extract were ideal for millet, and any of the extracts mentioned above could equally reduce root rot in field bean. The botanical extracts had no significant effect on seedling vigor in corn and field bean but in peanut higher seedling vigor could be achieved by coconut water, papaya or mushroom osmoconditioning. In millet, coconut water, papaya, moringa or coconut extract is ideal.

Recommendation

Coconut water and papaya, moringa and mushroom extract are recommended for enhancing germination in corn, peanut, millet, and field bean. Coconut water, papaya and moringa extracts are recommended for better root and shoot development as well a higher dry matter yield in corn, peanut and millet. Mushroom, papaya and coconut water are recommended for the reduction of root rot in corn, peanut, millet and field bean seedlings. It is recommended that further studies be conducted in the future to determine the chemical composition of these botanical extracts.
REFERENCES


******