Influence of Seed Priming Agents on the Germination and Field Performance of Pepper (Capsicum spp) in Guinea Savanah Region of Nigeria

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Abstract: Insufficient seedling emergence and inappropriate stand establishment are the main constraints in the production of crops particularly seeds of vegetables and small seeded grasses. Various studies have been carried out to reduce the period between sowing to emergence as this play a key role in crop production. One of the important developments in this area has been the use of seed priming technique. A field and screen house studies was carried out at the University of Abuja Research Farm to evaluate the influence of different priming agents on the establishment and performance of soybean in the Guinea Savanna region of Nigeria. Five treatments were used in the study, four priming agents (gibberellic acid, sodium chloride (NaCl), coconut water and warm water) and the control. The study was arranged in randomized complete block design (RCBD) with three replicates. Seed priming improved germination percentage of pepper. The pepper primed with gibberellic acid significantly increased growth and yield components (number of leaves, number of flowers length of main vine etc.) of both experiments.

Keywords: Priming, Gibberellic Acid, Coconut Water, Warm Water, Pepper

1. Introduction

In field crops, crop emergence and stand count which closely relates to plant population density determines to a very large extent, the yield of the said crop. The stand count and plant population density is mainly attributed to seed germination and emergence.

The emergence and stand establishment of pepper seeds are often slow and extremely erratic, particularly under cool stress conditions. Small seeded seeds like pepper seeds have been reported to lose viability under ambient conditions (Mohamed-Yassen et al., 1994). One other significant factor responsible for low viability of pepper seed may be the very thin and weak seed coat which provides very limited resistance to attacks from well-defined external agencies like microbes and absorption of atmospheric moisture (Mohammed-Yassen et al., 1994). It has become clear in recent years that the endospermic tissue enclosing the radicle tip of the embryo offers a mechanical barrier to the growing embryo, thus affecting germination (Andreoli & Khan, 1993). It has been reported that one of the major obstacles to high yield and production of crop plants is the lack of synchronized crop establishment due to poor weather and soil conditions (Mwale et al., 2003).

Seed Priming is a process which increases the germination percentage and reduces the time of emergence; because the primed seeds of plants completed their chitting period (seed absorb maximum water and complete all processes before germination during priming). Seed priming is mainly used to increase germination and uniformity of different crops under non-supporting conditions. Mostly priming is used to get uniform and healthy crop stand and it increase the vigour of seed (Draganic and Lekic, 2012). During priming process, seeds are soaked in different solutions with high osmotic potential. Different type of solutions according to the seed requirement was used for seed priming. The purpose of soaking of seed in the solution is to prevent the enough water absorption for radical emergence and expand the seed in lag phase. Seed priming protects the disease attack by applying the coating of fungicides, bactericides and nematicides. Seed priming is used to increase the germination percentage and seed vigor (Nawaz et al., 2013). Primed seeds have great potential to grow under stressful conditions. It has strong resistance against disease and insect attack. Primed seeds have much growth potential and give more production as compared to non-primed seeds. It showed that more yield and uniformity as compare to non-primed seeds. Seed germination process occurs in the three phases. First phase in which seed uptake the water rapidly is called the Imbibitional phase, second phase which just change in the water content and third or last phase is radical emergence. Primed seeds completed first two phases during priming process so immediately germinate after sowing (Aymen and Hannachi, 2012).

This study was conducted to monitor the ease of seed germination under different seed treatment methods. It was also carried out to assess the influence of seed priming agents on seed germination and some field crops performance indicators like plant height, leaf count and the flowering of pepper in the southern Guinea Savanna region of Abuja, Nigeria.
2. Materials and Method

Study Location: The research was carried out at the Teaching and Research Farm and the Crop Science Laboratory of the University of Abuja, Nigeria during the 2017 cropping season. The location which lies on Latitude 8°45’ and Longitude 6°04° and is characterized by a bimodal rainfall pattern. The mean annual rainfall is about 1500 mm, the soils are sandy loams and classified as Ferric Acrisol (FAO, 2017).

Experimental Materials: The materials used include the seeds of soybean, sourced from the International Institute of Tropical Agriculture (IITA) and Institute of Agriculture (IAR) Samaru, Zaria, Giberrelic Acid (a growth Hormone), Coconut water, NaCl, Distilled Water and Warm water.

Soil Sampling and Analysis: Prior to land preparation and sowing, soil samples were taken across the fields with an auger at the depth of 0-30 cm and bulked in a polythene bag to form a composite Sample. The samples were later taken to the laboratory for physico-chemical analysis using standard laboratory procedures.

Seed Priming Treatments includes;

1. The seeds of pepper were soaked with coconut water for 12 hours, after which the seeds was removed and placed on top of a clean filter paper to air dry to its normal moisture content.
2. The seeds were soaked in warm water at 25 °C for one minute after which the seeds were removed and placed on top of a clean filter paper to air dry to its normal moisture content.
3. The seed were soaked with a solution of Giberrelic Acid (GA) at the concentration of 3g/ litre of water for four hours after which the seeds were later removed and placed on top of a clean filter paper to air dry to its normal moisture content.
4. The seeds were planted without any treatment application (Control).
5. The seeds were soaked with a solution of sodium chloride (NC) at the concentration of 12g/litre for 24 hours after which the seeds were removed and placed on top of a clean filter paper to air dry to its normal moisture content.

Experimental Design and Field Lay Out: The experimental design adopted had treatments arranged in a Randomized Complete Blocks Design (RCBD) with two (2) varieties of soybeans and Five (5) - Priming Agents No Primers, Giberrelic Acid(GA), Coconut water(CW), Warm water(WW), and NaCl (NC) making up 10 treatments replicated three (3) times. The plot size measured 3 M by 4 M with inter – row spacing of 0.75 and intra - row spacing 0.1m. Plots measured 0.5m apart while blocks were 1m apart.

Crop Husbandry: The field was disc-ploughed and harrowed twice, to a fine seed-bed, before the layout was done to produce plots measuring 3M wide and 4M long spaced 0.5M within the rows that were 0.75M apart. Two seeds were sown along the rows at 10cm to produce 40 stands along the rows and 160 stands within a plot and 320 plants per plot. All agronomic appropriate practices (weeding, disease and pest control etc) were carried out as and when due.

Data Collection/Observations: Germination count, seedling emergence, plant height, number of leaves and days taking to attain 50% flowering by all the plants in the plot were carried out as described below-

i. Percentage emergence = \( \frac{\text{Expected number of plants (no of seed sown)}}{\text{Number of emerged seedlings}} \times 100 \)

ii. Plant height (cm) will be measured at 2, 4and 6 WAS using a measuring tape from randomly selected and marked plants from which an average was calculated per plant.

iii. Number of leaves: was counted at 2, 4 and 6 WAS from randomly selected and marked plants from which an average was calculated per plant.

iv. Number of flowers: was determined by carefully observing and counting the numbers of flowers daily until about half of the total plants in the field have flowered.

Data analysis: Data collected were subjected to analysis of variance (ANOVA) using GENSTAT 11th edition (GenStat, 2009). Fischer’s least significant difference (LSD) was used to separate means.

3. Results

The Effect of Priming Agents on Pepper Germination %: GA induced the highest germination % on seeds of pepper though it was not significantly different from the effect of CW. The control caused the lowest pepper germination % (Table 1).

The effect of the priming agents on the leave count of pepper: In table 2 the number of leaves counted on the pepper plants is presented. The number of pepper leaves due to the different priming agents was not significantly different at 2 and 6 WAS but at 4WAS, the pepper seeds treated with GA produced the highest number of leaves and there was no significant difference among the control, NC and WW.

<table>
<thead>
<tr>
<th>Priming Agent</th>
<th>5 DAS</th>
<th>10 DAS</th>
<th>15 DAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>42.80d</td>
<td>47.10c</td>
<td>56.57c</td>
</tr>
<tr>
<td>NaCl</td>
<td>58.77bc</td>
<td>65.07b</td>
<td>71.93b</td>
</tr>
<tr>
<td>Giberrelic Acid</td>
<td>78.00a</td>
<td>73.93ab</td>
<td>86.93a</td>
</tr>
<tr>
<td>Coconut Water</td>
<td>69.00ab</td>
<td>83.60a</td>
<td>81.60ab</td>
</tr>
<tr>
<td>Warm Water</td>
<td>49.00cd</td>
<td>53.47c</td>
<td>59.47c</td>
</tr>
<tr>
<td>S.E.</td>
<td>5.11</td>
<td>4.41</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Means with the same letter in a column are not significantly different (P ≤ 0.05). S.E = standard error.
Effect of priming agents on pepper plant height: From the results presented in Table 3, there was no significant difference among all the priming agents including the control in respect to pepper plant height at 2 and 6 WAS. However, at 4 WAS, the plant height was not significantly different between GA and CW. The control and NC had the shortest plants that were not significantly different.

Effect of priming agents on the number of Pepper flowers: As presented in Table 4, pepper seeds treated with GA produced the highest number of flowers compared to other priming agents at 50, 60 and 70 DAS. At 70 DAS the number of pepper flowers counted was not significantly different among the priming agents including the control.

Table 3: Effect of priming agents on pepper plant height (cm) at 2, 4 and 6 weeks after sowing (WAS).

<table>
<thead>
<tr>
<th>Priming Agent</th>
<th>2 WAS</th>
<th>4 WAS</th>
<th>6 WAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.91</td>
<td>46.56c</td>
<td>71.53</td>
</tr>
<tr>
<td>NaCl</td>
<td>1.84</td>
<td>54.51bc</td>
<td>78.75</td>
</tr>
<tr>
<td>Gibberellic Acid</td>
<td>1.98</td>
<td>69.30a</td>
<td>79.03</td>
</tr>
<tr>
<td>Coconut Water</td>
<td>1.88</td>
<td>62.36ab</td>
<td>74.87</td>
</tr>
<tr>
<td>Warm Water</td>
<td>1.49</td>
<td>58.12b</td>
<td>73.94</td>
</tr>
<tr>
<td>S.E.</td>
<td>0.31</td>
<td>4.79</td>
<td>9.41</td>
</tr>
</tbody>
</table>

Means with the same letter in a column are not significantly different (P ≤ 0.05). S.E. = standard error

Table 4: Effect of Priming Agents on the Number of Pepper flowers of peppers at 50, 60 and 70 Days after sowing (DAS)

<table>
<thead>
<tr>
<th>Priming Agent</th>
<th>50 DAS</th>
<th>60 DAS</th>
<th>70 DAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>76.70abc</td>
<td>78.07ab</td>
<td>75.80</td>
</tr>
<tr>
<td>NaCl</td>
<td>72.80bc</td>
<td>75.83ab</td>
<td>73.10</td>
</tr>
<tr>
<td>Gibberellic Acid</td>
<td>84.50a</td>
<td>86.43a</td>
<td>91.70</td>
</tr>
<tr>
<td>Coconut Water</td>
<td>83.23ab</td>
<td>85.70a</td>
<td>88.00</td>
</tr>
<tr>
<td>Warm Water</td>
<td>67.97c</td>
<td>70.37b</td>
<td>71.50</td>
</tr>
<tr>
<td>S.E.D</td>
<td>4.78</td>
<td>4.81</td>
<td>156.30</td>
</tr>
</tbody>
</table>

Means with the same letter in a column are not significantly different (P ≤ 0.05). S.E. = standard error

4. Discussion

Effect of priming agents on germination % on pepper: Under normal field conditions depicted here by the control, the germination of peppers is poor. It was observed that less than half (50%) of the seeds germinated by 10DAS and just barely attained 56.7% germination at 15DAS. On the other hand some primers like GA and CW had stimulated 69% and 78% of the seeds respectively germinated in just five days. At 15 DAS over 80% of the seeds treated with GA and CW had germinated. This slow and poor germination/emergence of the unprimed seed and the enhanced germination rate and volume agrees with observations reported by other workers who asserted that priming improved seed vigour capacity and rate (Cokkizgin and Bolek, 2015). These findings are also in agreement with findings of Dezfuli et al. (2008) who reported that primed seeds completed their germination processes early as compared to non-primed seeds.

The effects of this priming agent did not only stop at germination but continues in the field in the form of number of leaves counted, plant height and flowering. The trend followed a similar pattern where plants resulting from seeds primed with GA and CW showed superiority in these traits over the plants that developed from seeds primed with WW, NC and the control which also agrees with other reports (Rezaee and Amir 2015).

5. Conclusion

Plants primed with GA and CW recorded the highest germination percentage, number of leaves and plant height while the control (no-priming) had the lowest. Gibberellic acid and coconut water have high capacity to improve seed vigour which resulted in high germination percentage and growth of pepper. In view of the relative availability and affordability of coconut water and its superior performance, it will be advisable for pepper farmers to adopt it as a seed priming agent.

References

