Enhancement of seed quality of chilli by seed invigoration treatments

K. VISHWANATH, H.M. PALLAVI, B.N. RADHA, J.B. MARUTHI AND VENKATA CHALAPATHY

SUMMARY
Loss of seed vigour and viability was said to be associated with the ageing phenomenon and results in poor stand and performance in the field, but many researchers advocated seed invigoration in promoting vigour, viability, storability and performance. Chilli cv. Byadgi seeds with initial germination of 76 per cent were invigorated with different chemicals. Significant improvement in germination, root length, shoot length, seedling dry weight, vigour index, speed of emergence and germination after accelerated gaining, was observed in invigorated seeds over the control seeds. Germination was enhanced to 88 per cent in KNO₃ (1%), hydration-dehydration alone enhances the germination from 76 to 83 per cent and field emergence from 72 to 78 per cent. The study suggests that KNO₃ (1%) could improve rapid and uniform seedling emergence.

Key Words: Vigour, Viability, Seed invigoration


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Hot pepper (Capsicum annuum L.), commonly known as chilli, is an important vegetable as well as spice crop of India. The yield of chilli is much lower in third world countries. Rapid and uniform emergence are two essential pre requisites to increase yield, quality and ultimately profit in crops. In chilli crop its quality is a major factor which determines the economic success of the crop. One of the main causes for this poor yield is lack of a good stand establishment and reduced early growth as stressed by adverse environment. Germination and emergence of chilli seeds is often slow and non-uniform under normal as well as stress conditions (Wein, 1999; Demir and Okcu, 2004). Similarly, Andreoli and Khan (1999) found slow and erratic emergence and establishment of chili seeds, especially under cool conditions. Chilli and tomato have non-starchy endosperm and this offered a mechanical barrier to the growing embryo resulting in poor germination (Andreoli and Khan, 1999). High germination and uniform stand establishment for chili production is essential to maintaining profitable yields. Improvement in stand establishment can be obtained by advancements in seed quality and seed enhancements, genetic improvement, as well as improved seeding techniques. Seed invigoration is a technique of seed enhancement, it includes pre-soaking of seeds that improves seed performance by rapid and uniform germination, normal and vigorous seedlings, which resulted in faster and higher rate of germination and emergence in different crops (Farooq et al., 2007), which also helps seedlings to grow in biotic or abiotic stress conditions (Ashraf and Foolad, 2005; Khan et al., 2009a and 2009b). Such seed treatments result in synchronized emergence and uniform stand establishment leading to improved yield.

Now-a-days, various seed priming techniques have been...
developed, including hydropriming (soaking in water), halopriming (soaking in inorganic salt solutions), osmopriming (soaking in solutions of different organic osmotica), thermopriming (treatment of seed with low or high temperatures), solid matrix priming (treatment of seed with solid matrices) and biopriming (hydration using biological compounds) (Ashraf and Foolad, 2005). Each treatment has advantages and disadvantages and may have varying effects depending upon plant species, stage of plant development, concentration/dose of priming agent and incubation. Keeping in view of the above facts an experiment was designed to evaluate the impact of different chemicals on improvement of seed germination and vigour in chilli.

MATERIAL AND METHODS

Hand cleaned seeds with initial germination of 76 per cent were subjected for several seed invigoration treatments such as hydration-dehydration and soaking of seeds in aqueous solutions of KNO$_3$ (1%), sodium phosphate NaH$_2$PO$_4$(1%), NaCl (1.75%), potassium diphosphate KH$_2$PO$_4$ (0.5%), potassium chloride KCl (1%), calcium chloride CaCl$_2$(1%) and PEG-6000 (-8 bars) for 6h. With a seed to solution ratio of 1:2 by volume except for polyethylene glycol in which seeds were soaked for 144 hours (6 days) and dried back to original moisture, beside a dry treatment involving hedran 3 g/kg seed and stored for 7 days was tried.

Seeds were soaked in aqueous solutions of the above chemicals and then dried under shade to the original moisture content, except hedran which was used for dry treatment of seeds control seeds did not receive any treatment. Then seeds were tested for following seed quality parameters.

Germination percentage:

It was determined as per ISTA rules for seed testing (Anonymous, 1996). The seeds were placed in rolled paper towels. Hundred seeds of four replications were tested at a constant temperature of 25°C. The germination first and second counts were recorded on fourth and tenth day, respectively and per cent germination was expressed on normal seedling basis.

Root length, shoot length and seedling dry weight:

From the standard germination test, ten normal seedlings were selected at random in each replication on final count. The shoot length was measured from collar region to the point of attachment of cotyledons and root length from the collar region to the tip of the primary root, sum of shoot and root length constitute the seedling length and mean was calculated and expressed in centimeters. The seedlings used for seedling length measurement was used for estimating dry weight. They were dried in a hot air oven maintained at 80 ± 2°C for 24 hours. After drying, the weight of dry seedlings was recorded and the mean seedling dry weight was calculated and expressed in milligrams.

Seedling vigour index:

It was computed by adopting the formula as suggested by Abdul-Baki and Anderson (1973) and expressed in whole number:

Seedling vigour index-I = Germination (%) x mean seedling length (cm)

Or

Seedling vigour index-II = Germination (%) x mean seedling dry weight (mg)

Seed germination test was conducted as described above daily germination counts were recorded and the only normal seedlings were considered.

Speed of germination:

It was calculated by using formula suggested by Maguire (1962).

\[
\text{Speed of germination} = \frac{\text{No. of normal seedling at first count} + \ldots + \text{No. of normal seedling at final count}}{\text{Days to first count} + \ldots + \text{Days to final count}}
\]

Field emergence:

It was calculated by sowing one hundred seeds from each treatment in four replications in the field. The emergence counts were made on 14th day after sowing and expressed in per cent.

RESULTS AND DISCUSSION

Loss of seed vigour and viability was said to be associated with the ageing phenomenon and results in poor stand and performance in the field, but many researchers advocated seed invigoration in promoting vigour, viability, storability and performance (Zhang and Maun, 1990 and Tiryaki, 2006). Pre-sowing soaking seed treatment with various chemicals is being reported for improving the physiological stamina of the seed, achieving uniform crop stand and further improving quality of seed by minimizing the variation of seed quality within the seed lots. In the present study Chilli cv. Byadgi seeds were invigorated with different chemicals besides, hydration-dehydration and PEG-6000. Germination percentage, field emergence and other seed quality parameters such as speed of emergence root length, shoot length, seedling dry weight, vigour index and germination after accelerated ageing were found to differ significantly due to invigoration treatments. Maximum germination (88%) was observed in KNO$_3$ (1%). Invigoration with NaH$_2$PO$_4$(1%), KH$_2$PO$_4$(0.5%), CaCl$_2$(1%) and harden (3g/kg) recorded 86 per cent, NaCl (1.75%) and KCl (1%) recorded 85 per cent and PEG-6000 recorded 84 per cent germination and they did not differ among each other (Table 1). Enhancement of germination by KNO$_3$ was reported by Rivas et al. (1984), Jones and Sanders (1987) in hot pepper and Tzortzakis and Economakis (2005) in chicory. The result
of seed quality parameters in chilli cv. Bradagd

<table>
<thead>
<tr>
<th>Seed invigoration treatment</th>
<th>Field emergence (9%)</th>
<th>Germination (%)</th>
<th>Root length (cm)</th>
<th>Shoot length (cm)</th>
<th>Seedling dry weight (g/100)</th>
<th>Vigour index</th>
<th>Speed of emergence (cm/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>77</td>
<td>77</td>
<td>3.60</td>
<td>6.75</td>
<td>0.11</td>
<td>0.21</td>
<td>2</td>
</tr>
<tr>
<td>Hydration-dehydration</td>
<td>82</td>
<td>82</td>
<td>4.92</td>
<td>8.66</td>
<td>0.23</td>
<td>0.54</td>
<td>3</td>
</tr>
<tr>
<td>KNO$_3$ (1%)</td>
<td>85</td>
<td>85</td>
<td>5.28</td>
<td>9.97</td>
<td>0.33</td>
<td>0.71</td>
<td>5</td>
</tr>
<tr>
<td>NaH$_2$PO$_4$ (1%)</td>
<td>86</td>
<td>86</td>
<td>5.78</td>
<td>10.90</td>
<td>0.43</td>
<td>0.82</td>
<td>6</td>
</tr>
<tr>
<td>KH$_2$PO$_4$ (0.5%)</td>
<td>87</td>
<td>87</td>
<td>6.29</td>
<td>11.97</td>
<td>0.49</td>
<td>0.85</td>
<td>7</td>
</tr>
<tr>
<td>CaCl$_2$ (1%)</td>
<td>88</td>
<td>88</td>
<td>6.80</td>
<td>13.00</td>
<td>0.54</td>
<td>0.88</td>
<td>8</td>
</tr>
<tr>
<td>Hedran (3g/kg)</td>
<td>89</td>
<td>89</td>
<td>7.31</td>
<td>14.00</td>
<td>0.60</td>
<td>0.91</td>
<td>9</td>
</tr>
<tr>
<td>Neem</td>
<td>90</td>
<td>90</td>
<td>7.82</td>
<td>15.00</td>
<td>0.64</td>
<td>0.94</td>
<td>10</td>
</tr>
<tr>
<td>S.E.</td>
<td>0.79</td>
<td>0.79</td>
<td>0.27</td>
<td>0.51</td>
<td></td>
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<tr>
<td>C.I. (p=0.05)</td>
<td>2</td>
<td>2</td>
<td>0.29</td>
<td>0.54</td>
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</tbody>
</table>

The present study suggests that KNO$_3$ (1%) improves rapid and uniform seedling germination, emergence and plant development. They are economical and can be easily adopted by nursery men in developing mass planting stocks.

REFERENCES


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