Plant growth regulators priming enhances seed quality and enzymes activity in mungbean (*Vigna radiata* L.)


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**ABSTRACT**

Field experiments were conducted at the research farm of Directorate of Seed Research, Mau to improve the germination, stand establishment, and growth of mungbean employing the seed priming techniques. Seeds of two mungbean varieties viz: Samrat and Pusa Vishal were sand primed with 50 ppm and 100 ppm solution of growth regulators viz. Gibberellic Acid (GA$_3$), Indol Acetic Acid (IAA), Indol butyric acid (IBA) and Kinetin separately for 8 hours. Experiments were conducted in laboratory as well as in the cemented pots of 15 kg capacity. The results revealed that PGR priming showed significant enhancement in the seed quality parameters, growth, nitrate assimilatory enzymes and alpha amylase activity over unprimed control. Among treatments performance of GA$_3$ @ 100 ppm was superior over others in respect of seed germination, field emergence, seedling growth, vigour index 1 & 2, nitrate assimilatory enzymes including nitrate reductase and nitrite reductase and germination enzyme alpha amylase.

**Key words**: Mungbean, sand priming, plant growth regulator, seed quality, enzyme activity.

Pulses constitute an integral part of Indian agriculture because of its high nutritive values. Besides their higher dietetic value, they have a unique characteristic of maintaining and restoring soil fertility through biological nitrogen fixation and thus play a vital role in sustainable agriculture (Asthana, 1998). Pulses have a capacity to tolerate drought because of their deep root system (Rattanawongsa, N. 1993) and can be grown on marginal lands both as sole and intercrop. India is the largest producer and consumer of pulses in the world accounting for 33% of world ‘s area and 22% of world’s production of pulses (Ref). In India, mungbean grown mainly in the states of Punjab, Haryana Uttar Pradesh, Madhya Pradesh, Bihar part of Rajasthan, Himanchal Pradesh and Jammu Kashmir in an area of 3.44 million ha with production of 1.40 million tons with a productivity of 406 kg/ha (Agro pedia, 2011). Mungbean matures in about 60-70 days after sowing and it is an excellent crop for rotation in different cropping systems. Besides Uttar Pradesh is low as compare to other regions of India w.r.t. mungbean production and there is the need to improve the seed quality, stand establishment and ultimately the crop production particularly in Uttar Pradesh. Priming is such technique of seed enhancement in which seeds are soaked in the solution of inorganic salt, plant growth regulators etc for specific period. The beneficial effect of priming with plant growth regulators have been reported by several workers in different crops viz. barley, maize, chickpea and mungbean (Panjabi et al., 1982, Harris et al., 2004; Suresh et al., 2005 and Rashid et al. 2006). Keeping these facts in view, the present experiment was intended to understand the role of plant growth regulators (PGR) as priming agents on seed quality enhancement and enzymes activities involved in germination and nitrate assimilation during the germination of mungbean.
MATERIALS AND METHODS

The mungbean seeds were initially surface sterilized with 0.1% HgCl₂ for five minutes. Those seeds were thoroughly washed after surface sterilization and sand priming was done as per treatments using two concentrations 50 ppm and 100 ppm solution of each plant growth regulators viz. Indole Butyric Acid (IBA), Indole Acetic Acid (IAA), Gibberellic Acid (GA₃) and Kinetin separately for 8 h period. After completing the period of priming, the seeds were taken out from the container and allowed for shade drying. Primed and unprimed seeds of each variety were sown in pots and germination paper by using between the paper methods with three replications according to ISTA rules (Anon., 1999). Final germination and root/shoot length were recorded after seven days of sowing and at same time the fresh seedlings were kept for drying in oven at 80°C for twenty four hour. Dried samples were weighed with an electronic balance and the vigour index 1 & 2 was calculated by following the method of Abdul-baki and Anderson (1973) as germination percent x seedling length and germination percent x seedling dry weight respectively.

Nitrate reductase activity was assayed following the method of Jaworski, 1971 in 250 mg fresh leaves using Phosphate buffer, Sodium nitrite, Propanol, Chlorophenical Sulphanilamide and N-1 naphthyl ethylene diamine hydrochloride and O.D. was recorded on 540 nm. Standard curve was prepared with NaNO₂ solution. Whereas Nitrite reductase activity was estimated by the method of Ferari and Varner, 1971 placing 250 mg leaves sample in 4.5 ml assay medium containing Phosphate buffer Sodium nitrite and chlorophenical. Dimethylsulphoxide was added for reaction and finally Sulphanilamide and N-1 naphthyl ethylene diamine hydrochloride was added to complete the reaction and develop colour. The O.D. was recorded on 540 nm using 10 ml aliquot.

Alpha amylase activity was assayed following the method of Bernfeld, P. 1955. Fresh sample (01 gm) was grinded with 10 ml CaCl₂ and incubated overnight at 4°C. Supernatants were used as an enzyme solution. Following reagents were prepared as per standard procedures

1. 0.1 M Sodium acetate buffer, pH 4.7
2. 1% Starch solution
3. Dinitro salicylic acid reagent
4. 40% Rochelle salt solution
5. Maltose solution

Enzyme assay

- Pepette out 1 ml of starch solution and 1 ml of properly diluted enzyme in test tube
- Incubate it at 27°C for 15 min.
- Stop the reaction by addition of 2 ml dinitrosalicylic agent
- Heat the solution in the boiling water bath for 5 min.
- While the tubes are warm, add 1 ml potassium sodium tartrate solution
- Then cool it in running water
- Make the volume to 10 ml by addition of 6 ml of water
- Read the absorbance at 560 nm.
- Terminate the reaction at zero time in the control tubes.
- Prepare the standard graph with 0-100 ug maltose.

All data obtained from fient experiment were analyzed as per standard statistical procedure.

RESULTS AND DISCUSSION

Mungbean seeds primed with different plant growth regulators including GA₃, IAA, IBA and Kinetin showed significant improvement in seed quality parameters over unprimed control. Enhancement in germination of both the varieties (Samrat and Pusa Vishal) was noticed when the seeds were primed with 50 and 100 ppm doses of each of GA₃, IAA, IBA and Kinetin. Among the PGR, priming with GA₃ @100 ppm showed maximum germination (80.5%) followed by IAA @ 50 ppm (78.1%) and IBA @ 50 ppm (77.8%) over control (65.1%). Percent improvement in germination was recorded 23.5, 19.8 and 19.4 with GA₃ 100 ppm, IAA 50 ppm and IBA 50 ppm respectively comparing with control (Table 1).
Similarly, field emergence was also followed the same trend and it was significantly higher with GA3 100 ppm (66.6%), followed by IAA 50 ppm (54.9%) and IBA 50 ppm (55.3%). Improvement in field emergence due to PGR priming were 99.04, 64.19 and 59.24 with GA3 100 ppm, IAA 50 ppm and IBA 50 ppm respectively over control (Table 2).

Seedling length is the sum up of shoot length and root length and it was noted significantly higher with GA3 100 ppm (43.5%) over control (29.17) with the 49.43 percent improvement

Table 1. Response of plant growth regulators priming on germination (%) in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination (%)</th>
<th>Treatment Mean</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean over control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Samrat</td>
<td>P. Vishal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>65.90</td>
<td>64.40</td>
<td>65.15</td>
</tr>
<tr>
<td>GA3 50 ppm</td>
<td>72.88</td>
<td>77.58</td>
<td>75.23</td>
</tr>
<tr>
<td>GA3 100 ppm</td>
<td>80.10</td>
<td>80.87</td>
<td>80.48</td>
</tr>
<tr>
<td>IAA 50 ppm</td>
<td>79.50</td>
<td>76.66</td>
<td>78.08</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>72.21</td>
<td>79.50</td>
<td>75.85</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>77.12</td>
<td>78.52</td>
<td>77.82</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>75.85</td>
<td>78.52</td>
<td>77.18</td>
</tr>
<tr>
<td>Kinetin 50 ppm</td>
<td>74.29</td>
<td>80.64</td>
<td>77.46</td>
</tr>
<tr>
<td>Kinetin 100 ppm</td>
<td>75.04</td>
<td>78.52</td>
<td>76.78</td>
</tr>
<tr>
<td>Varietal Mean</td>
<td>74.65</td>
<td>77.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SE ±</td>
<td>CD (P=0.05)</td>
<td></td>
</tr>
<tr>
<td>Variety (V)</td>
<td>0.41</td>
<td>0.84 **</td>
<td></td>
</tr>
<tr>
<td>Treatment (T)</td>
<td>0.88</td>
<td>1.79 **</td>
<td></td>
</tr>
<tr>
<td>V×T</td>
<td>1.24</td>
<td>2.53 **</td>
<td></td>
</tr>
<tr>
<td>CV</td>
<td>2.04%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Response of plant growth regulators priming on field emergence in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Field emergence (%)</th>
<th>Treatment Mean</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean over control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Samrat</td>
<td>P. Vishal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>33.49</td>
<td>33.36</td>
<td>33.49</td>
</tr>
<tr>
<td>GA3 50 ppm</td>
<td>46.66</td>
<td>46.66</td>
<td>46.66</td>
</tr>
<tr>
<td>GA3 100 ppm</td>
<td>60.00</td>
<td>73.33</td>
<td>66.66</td>
</tr>
<tr>
<td>IAA 50 ppm</td>
<td>43.33</td>
<td>66.66</td>
<td>54.99</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>50.43</td>
<td>46.66</td>
<td>48.33</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>43.33</td>
<td>63.33</td>
<td>53.33</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>43.33</td>
<td>43.33</td>
<td>53.33</td>
</tr>
<tr>
<td>Kinetin 50 ppm</td>
<td>50.00</td>
<td>43.66</td>
<td>46.83</td>
</tr>
<tr>
<td>Kinetin 100 ppm</td>
<td>40.00</td>
<td>60.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Varietal Mean</td>
<td>45.61</td>
<td>55.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SE ±</td>
<td>CD (P=0.05)</td>
<td></td>
</tr>
<tr>
<td>Variety (V)</td>
<td>0.38</td>
<td>0.56 **</td>
<td></td>
</tr>
<tr>
<td>Treatment (T)</td>
<td>0.82</td>
<td>1.19 **</td>
<td></td>
</tr>
<tr>
<td>V×T</td>
<td>1.16</td>
<td>1.68 **</td>
<td></td>
</tr>
<tr>
<td>CV</td>
<td>2.69%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Plant growth regulators priming enhances seed quality and enzymes activity in mungbean (Table 3). The response of IAA 100 ppm was also remarkable (36.16%) and it was followed by GA3 50 ppm (34.79%). Variety Samrat showed significantly higher seedling length over P.Vishal (Table 3). Interaction V × T was significant and noted highest seedling length with GA3 100 ppm. Similarly seedling dry weight is the actual gain in growth and it was increased maximum (65.6%) with GA3 100 ppm followed by GA3 50 ppm (43.92%), Kinetin 50 ppm (43.68%) and IAA 100 ppm (43.6%) over unprimed control. Variety P.Vishal showed significantly higher seedling dry weight over Samrat. Interaction of V × T was significant and it was noted highest with GA3.

Table 3. Response of plant growth regulators priming on seedling length in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seedling length</th>
<th>Treatment Mean</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Samrat</td>
<td>P. Vishal</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>28.90</td>
<td>29.45</td>
<td>29.17</td>
</tr>
<tr>
<td>GA3 50 ppm</td>
<td>39.16</td>
<td>39.49</td>
<td>39.32</td>
</tr>
<tr>
<td>GA3 100 ppm</td>
<td>44.09</td>
<td>43.09</td>
<td>43.59</td>
</tr>
<tr>
<td>IAA 50 ppm</td>
<td>37.15</td>
<td>39.00</td>
<td>38.07</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>42.84</td>
<td>36.61</td>
<td>39.72</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>34.62</td>
<td>37.01</td>
<td>35.81</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>35.05</td>
<td>34.38</td>
<td>34.71</td>
</tr>
<tr>
<td>Kinetin 50 ppm</td>
<td>36.67</td>
<td>38.06</td>
<td>37.36</td>
</tr>
<tr>
<td>Kinetin 100 ppm</td>
<td>37.60</td>
<td>37.81</td>
<td>37.70</td>
</tr>
<tr>
<td>Varietal Mean</td>
<td>37.34</td>
<td>37.21</td>
<td>29.2</td>
</tr>
</tbody>
</table>

SE ± CD (P=0.05)

Variety (V) 0.00842 0.017 **
Treatment (T) 0.01786 0.036 **
V×T 0.02526 0.051 **
CV 0.08%

Table 4. Response of plant growth regulators priming on seedling dry weight in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seedling dry weight</th>
<th>Treatment Mean</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Samrat</td>
<td>P. Vishal</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>12.90</td>
<td>12.29</td>
<td>12.59</td>
</tr>
<tr>
<td>GA3 50 ppm</td>
<td>17.30</td>
<td>18.95</td>
<td>18.12</td>
</tr>
<tr>
<td>GA3 100 ppm</td>
<td>21.14</td>
<td>20.56</td>
<td>20.85</td>
</tr>
<tr>
<td>IAA 50 ppm</td>
<td>16.29</td>
<td>17.96</td>
<td>17.12</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>20.44</td>
<td>15.72</td>
<td>18.08</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>14.65</td>
<td>16.78</td>
<td>15.71</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>16.80</td>
<td>15.93</td>
<td>16.36</td>
</tr>
<tr>
<td>Kinetin 50 ppm</td>
<td>16.91</td>
<td>19.28</td>
<td>18.09</td>
</tr>
<tr>
<td>Kinetin 100 ppm</td>
<td>17.36</td>
<td>17.59</td>
<td>17.47</td>
</tr>
<tr>
<td>Varietal Mean</td>
<td>17.08</td>
<td>17.22</td>
<td>38.7</td>
</tr>
</tbody>
</table>

SE ± CD (P=0.05)

Variety (V) 0.005 0.010 **
Treatment (T) 0.011 0.023 **
V×T 0.016 0.32**
CV 0.11%
100 ppm in samrat (Table 4). Observed enhancement in seed quality parameters might be the result of osmo-priming with growth regulators which imbibed the seeds and initiate the early stages of germination being osmo-lite and key hormones for germination. As a result maximum enhancement in vigour Index I & II was noted with GA3 100 ppm priming treatment followed by IAA 100 ppm (Vigour Index I) (Table 5) and Kinetin 50 ppm (Vigour Index II) (Table 6) due to the fact that the process of cell division and cell enlargement was induced through these plant growth regulators priming.

Activities of nitrate assimilation enzymes including nitrate & nitrite reductase initiated immediately after onset of germination since they are reducing nitrate nitrogen to the available forms to the germinating seedlings and they were also influenced maximum by GA3 100 ppm priming followed by IAA 100ppm (in case of nitrate reductase) (Table 7) and IAA 50 ppm (in case of nitrite reductase). Variety P.Vishal showed higher NR activity where as Samrat showed higher NIR activity (Table 8). Alpha amylase is the key enzyme of germination process and it was very much enhanced with PGR priming. The maximum enhancement was noted with GA3 100 ppm followed by IAA 50 ppm and Kinetin 100 ppm (Table 9). Varieties did not show the significant variation in alpha amylase activity. Plant growth regulators evaluated have shown the positive effects on the enzymes activities might be due their

Table 5. Response of plant growth regulators priming on vigour index I in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vigour Index I</th>
<th>Treatment Mean</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Samrat</td>
<td>P. Vishal</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>2368.9</td>
<td>2444.9</td>
<td>2406.9</td>
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<tr>
<td>GA3 50 ppm</td>
<td>3250.5</td>
<td>3278.2</td>
<td>3264.3</td>
</tr>
<tr>
<td>GA3 100 ppm</td>
<td>3660.0</td>
<td>3577.0</td>
<td>3618.5</td>
</tr>
<tr>
<td>IAA 50 ppm</td>
<td>3083.7</td>
<td>3237.2</td>
<td>3160.4</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>3556.8</td>
<td>3029.1</td>
<td>3293.0</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>2874.0</td>
<td>3072.3</td>
<td>2973.1</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>2909.7</td>
<td>2853.5</td>
<td>2881.6</td>
</tr>
<tr>
<td>Kinetin 50 ppm</td>
<td>3043.3</td>
<td>3159.2</td>
<td>3101.5</td>
</tr>
<tr>
<td>Kinetin 100 ppm</td>
<td>3121.1</td>
<td>3138.5</td>
<td>3129.7</td>
</tr>
<tr>
<td>Varietal Mean</td>
<td>3096.5</td>
<td>3087.8</td>
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</table>

Table 6. Response of plant growth regulators priming on vigour index II in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vigour Index II</th>
<th>Treatment Mean</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Samrat</td>
<td>P. Vishal</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1071.1</td>
<td>1020.0</td>
<td>1045.6</td>
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<tr>
<td>GA3 50 ppm</td>
<td>1435.9</td>
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<td>1504.3</td>
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<tr>
<td>GA3 100 ppm</td>
<td>1754.6</td>
<td>1706.7</td>
<td>1730.6</td>
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<tr>
<td>IAA 50 ppm</td>
<td>1352.3</td>
<td>1490.9</td>
<td>1421.6</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>1696.5</td>
<td>1305.3</td>
<td>1500.9</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>1216.2</td>
<td>1393.0</td>
<td>1304.6</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>1394.9</td>
<td>1322.7</td>
<td>1358.8</td>
</tr>
<tr>
<td>Kinetin 50 ppm</td>
<td>1404.0</td>
<td>1600.7</td>
<td>1502.4</td>
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<tr>
<td>Kinetin 100 ppm</td>
<td>1441.3</td>
<td>1460.2</td>
<td>1450.7</td>
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<tr>
<td>Varietal Mean</td>
<td>1418.5</td>
<td>1430.3</td>
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</tr>
</tbody>
</table>
Plant growth regulators priming enhances seed quality and enzymes activity in mungbean.

Table 7. Response of plant growth regulators priming on nitrate reductase activity in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Samrat (n mole g⁻¹f.w.h⁻¹)</th>
<th>P. Vishal (n mole g⁻¹f.w.h⁻¹)</th>
<th>Treatment mean (n mole g⁻¹f.w.h⁻¹)</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>75.16</td>
<td>73.67</td>
<td>74.41</td>
<td></td>
</tr>
<tr>
<td>GA₃ 50 ppm</td>
<td>108.02</td>
<td>107.02</td>
<td>107.5</td>
<td>44.4</td>
</tr>
<tr>
<td>GA₃ 100 ppm</td>
<td>127.68</td>
<td>120.34</td>
<td>124.0</td>
<td>74.4</td>
</tr>
<tr>
<td>IAA 50 ppm</td>
<td>89.85</td>
<td>100.30</td>
<td>95.07</td>
<td>27.7</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>117.35</td>
<td>111.38</td>
<td>114.36</td>
<td>53.6</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>81.51</td>
<td>87.11</td>
<td>84.31</td>
<td>13.3</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>79.15</td>
<td>79.52</td>
<td>79.335</td>
<td>6.6</td>
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<tr>
<td>Kinetin 50 ppm</td>
<td>85.24</td>
<td>92.46</td>
<td>88.85</td>
<td>19.4</td>
</tr>
<tr>
<td>Kinetin 100 ppm</td>
<td>86.61</td>
<td>95.70</td>
<td>91.155</td>
<td>22.4</td>
</tr>
<tr>
<td>Varietal Mean</td>
<td>94.50</td>
<td>96.38</td>
<td>95.38</td>
<td></td>
</tr>
</tbody>
</table>

SE ± CD (P=0.05)

Variety (V) 0.072 0.147 **
Treatment (T) 0.153 0.312**
V×T 0.217 0.442**
CV 0.27%

Table 8. Response of plant growth regulators priming on nitrite reductase activity in mungbean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Samrat (n mole g⁻¹f.w.h⁻¹)</th>
<th>P. Vishal (n mole g⁻¹f.w.h⁻¹)</th>
<th>Treatment Mean (n mole g⁻¹f.w.h⁻¹)</th>
<th>% increase over control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>27.89</td>
<td>27.89</td>
<td>27.89</td>
<td></td>
</tr>
<tr>
<td>GA₃ 50 ppm</td>
<td>82.20</td>
<td>54.31</td>
<td>68.25</td>
<td>44.7</td>
</tr>
<tr>
<td>GA₃ 100 ppm</td>
<td>104.22</td>
<td>54.31</td>
<td>79.26</td>
<td>84.1</td>
</tr>
<tr>
<td>IAA 50 ppm</td>
<td>52.84</td>
<td>49.51</td>
<td>51.17</td>
<td>83.4</td>
</tr>
<tr>
<td>IAA 100 ppm</td>
<td>45.50</td>
<td>36.70</td>
<td>41.01</td>
<td>47.3</td>
</tr>
<tr>
<td>IBA 50 ppm</td>
<td>41.10</td>
<td>42.57</td>
<td>41.83</td>
<td>49.9</td>
</tr>
<tr>
<td>IBA 100 ppm</td>
<td>55.78</td>
<td>32.29</td>
<td>44.03</td>
<td>57.8</td>
</tr>
<tr>
<td>Kinetin 50 ppm</td>
<td>45.50</td>
<td>45.50</td>
<td>45.5</td>
<td>63.1</td>
</tr>
<tr>
<td>Kinetin 100 ppm</td>
<td>36.70</td>
<td>36.70</td>
<td>36.7</td>
<td>31.5</td>
</tr>
<tr>
<td>Varietal Mean</td>
<td>54.63</td>
<td>42.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SE ± CD (P=0.05)

Variety (V) 0.712 1.447
Treatment (T) 1.510 3.071
V×T 2.136 4.343
CV 5.43%

Conclusively, priming with GA₃ @100ppm performed better than rest of the priming treatments in respect of all the characters studied. Improvement in growth parameters might be the result of exogenous application of plant growth regulators through seed priming which could enhanced the seed quality parameters during seedling stage by enhancing the process of cell enlargement, cell division and involvement in activation process induced through priming.
activitation of several enzymes involved in germination process and growth of newly emerged seedlings. These results are also in harmony to some extent with the findings of Patel and Saxena 1994, Iqbal & Ashraf, 2007 and Perveen et al., 2010 in wheat, Panjabi et al. 1982 in barley, Harris et al. 2004 in maize, rice and chickpea, Rashid et al. 2004 and Tiwari et al. 2013 in mungbean, Suresh and Janagoudar, 2005 in chickpea and Rashid et al. 2006 in barley. This technology may be adopted to improve the seed quality of pulses especially mungbean.

REFERENCES


