MONITORING OF HEAVY METAL (MERCURY CHLORIDE) TOXICITY BY USING POLLEN AS INDICATORS - POLLEN OF VIGNA UNGUICULATA A CRITICAL REVIEW

S.A. Salgare* and Suwarna Gawde

Salgare Research Foundation Pvt. Ltd.
Prathamesh Society, Shivaji Chowk, KARJAT - 410 201, (INDIA)

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ABSTRACT

Seeds of Vigna unguiculata (L.) Walp. var. Pusa barsati (cowpea) were sown in white-transparent polythene bags (35 x 25 cm) containing garden soil. Each bag contains 20 seeds. These bags were watered on every alternate day for the first 7 days. After 7 days each bag was separately treated with the different concentrations (0.001, 0.01, 0.1, 1, 10, 100 mg/ml) of mercury chloride with the quantity of 500 ml on every alternate days till the end of the life-cycle of the crop. Excess seedlings were removed after 15 days of sowing leaving the identical and healthy 5 seedlings in each bag. Cent percent mortality of V. unguiculata was caused by 100 mg/ml of the heavy metal after one week of treatment. After 3 weeks of treatment of 10 mg/ml mercury chloride prevented cent percent germination of pollen of all the 4 series, while even the treatment of 1 mg/ml heavy metal suppressed the germination of pollen of F-48 and F-72 series. The treatment of 0.001, 0.01, 0.1 mg/ml stimulated the germination of F series. All the different concentrations of the heavy metal tried inhibited the germination of pollen of F-24, F-48, F-72 series of V. unguiculata. The treatment of all the concentrations of the heavy metal inhibited the pollen tube growth of all the 4 series of successive flowers. All these observations were made after 3 weeks of uniform flowering in all the sets.

Key Words: Heavy metals, Crop Physiology, Toxicology, Environmental Sciences.

INTRODUCTION

Seeds of vigna unguiculata (L.) walp var. Pusa barsati in polythene bags has watered on alternate day followed the treatment with Hgcl, at different concentrations till the end of the life cycle of crop. It was observed that Mercury chloride prevented 100% germination of pollen of all series-and also heavy metals inhibits the pollen tube growth of all the 4 series of successive flowers. Hence in this study, it was found that the pollen tube growth is more sensitive than the pollen germination.
the authorized dealers and 20 seeds were sown in white-transparent polythene bags (35x25 cm) containing garden soil. These bags were watered on every alternate day for the first 7 days. After 7 days each bag was separately treated with the different concentrations (0.001, 0.01, 0.1, 1, 10, 100 mg/ml) of mercury chloride with the quantity of 500 ml on every alternate days till the end of the life-cycle of the crop. Excess seedlings were removed after 15 days of sowing leaving the identical and healthy 5 seedlings in each bag. There were 10 replicates of each treatment. A set of control was also grown simultaneously which was watered with the same quantity. An optimum concentrations (10% for F-24 and F-48 series, 20% for F-72 series and 50% for F series) of sucrose were used for the germination of pollen of successive flowers. Pollen grains were incubated soon after the dehiscence of anthers. The cultures were then transferred to a moist filter chamber, stored at room temperature (26-31°C) having RH 57% and in diffuse laboratory light. The experiments were run in triplicate and average results were recorded. Observations were made by 24 hours after incubation. For each experiment a random count of 100 grains was made (from different fields on the slide) to determine the pollen germination. For measurement of length of pollen tubes, 50 tubes were selected randomly and measured at a magnification of 100x. The data obtained is statistically analyzed applying ‘t’ test. Present observations were made three weeks after uniform flowering in all the sets.

RESULTS AND DISCUSSION

Initiation of flowering was noted in an untreated crop of Vigna unguiculata after 53 days of sowing. It was started earlier in the crop treated with 0.001, 0.01, 0.1 mg/ml mercury chloride by 10 days, where as it was delayed in the crop treated with 1 and 10 mg/ml concentrations by one and 3 days respectively. After one week of treatment of 100 mg/ml of mercury chloride cent percent mortality was noted. Treatment of 10 mg/ml mercury chloride prevented cent percent germination of pollen of all the 4 series. However, the treatment of 1 mg/ml heavy metal suppressed the germination of pollen of F-48 and F-72 series. The treatment of 0.001, 0.01, 0.1 mg/ml stimulated the germination of F series. The treatment of all the different concentrations of the heavy metal tried caused decrease in the percentage of germination of

Table 1. Effect of mercury chloride on pollen germination of successive flowers of Vigna unguiculata.
(Tested 3 weeks after treatment)
(Values given are mean ± SE of 500)

<table>
<thead>
<tr>
<th>Conc.</th>
<th>T in %</th>
<th>%DFC</th>
<th>T in %</th>
<th>%DFC</th>
<th>T in %</th>
<th>%DFC</th>
<th>T in %</th>
<th>%DFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F-24</td>
<td>F-48</td>
<td>F-72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.001</td>
<td>23.80±4.14</td>
<td>+021.05</td>
<td>12.80±1.98</td>
<td>-08.57</td>
<td>8.60±1.47</td>
<td>-16.50</td>
<td>5.60±0.81</td>
<td>-24.32</td>
</tr>
<tr>
<td>0.01</td>
<td>25.00±1.99</td>
<td>+031.58</td>
<td>10.80±0.86</td>
<td>-22.86</td>
<td>7.40±0.98</td>
<td>-28.16</td>
<td>5.20±1.16</td>
<td>-29.73</td>
</tr>
<tr>
<td>0.001</td>
<td>40.20±3.23</td>
<td>+111.58</td>
<td>08.60±1.21</td>
<td>-38.57</td>
<td>6.00±1.30</td>
<td>-41.75</td>
<td>4.00±0.84</td>
<td>-45.95</td>
</tr>
<tr>
<td>0.01</td>
<td>09.60±2.25</td>
<td>-049.47</td>
<td>07.40±1.57</td>
<td>-47.14</td>
<td>NG</td>
<td>NG</td>
<td>NG</td>
<td>NG</td>
</tr>
<tr>
<td>0.10</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
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<tr>
<td>0.10</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
</tr>
<tr>
<td>1.00</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
</tr>
</tbody>
</table>

APD, all plants died; Conc., concentrations of mercury chloride in mg/ml; %DFC, percentage difference from control; NG, no germination; -, inhibition; +, stimulation.
pollen of F-24, F-48, F-72 series of *V. unguiculata*. The treatment of 0.001, 0.01, 0.1 mg/ml stimulated the germination of F series (Table 1). Pollen of F-24 series produced longer tubes than F series (Table 2). This proves that the use of pollen of F series as per the existing method for pollen storage and their subsequent use in plant breeding program is not justified. The treatment of all the concentrations of the heavy metal inhibited the pollen tube growth of all the 4 series of successive flowers. This proves that the pollen tube growth is more sensitive than the pollen germination.

Pollen germination and tube elongation are two distinct processes differing in their sensitivity to different concentrations of the herbicide was also confirmed with this extensive work (Tables 1, 2). However, Nair, Nambudiri and Thomas (1973) stated that it has been significant that the optimum percentage of germination and tube length were attained in the same growth medium. It could be concluded that the observations of Nair, Nambudiri and Thomas (1973) are superficial and misleading.

**CONCLUSION**

Present investigation proves that pollen development and activity are more sensitive indicators of adverse factors in the botanical environment and the use of an entire vascular plant (Berg, 1973; Brandt, 1974; Vick and Bevan, 1976; Rasmussan, 1977; Navara, Horvath and Kaleta, 1978; Mhatre, 1980; Mhatre, Chaphekar, Ramani Rao, Patil, Haldar, 1980; Shetye, 1982 and Giridhar, 1984) as an indicator of pollution is a very crud method and rather a wrong choice. There is no evidence of any entire vascular plant exhibiting this much degree of sensitivity. This is very clearly confirmed in the present critical review (Tables 1-2).

**Table 2. Effect of mercury chloride on pollen tube growth of successive flowers of Vigna unguiculata.**

*(Tested 3 weeks after treatment)*

*(Values given are mean ± SE of 500)*

<table>
<thead>
<tr>
<th>Pollen tube growth in μm</th>
<th>F</th>
<th>F-24</th>
<th>F-48</th>
<th>F-72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conc.</td>
<td>T in %</td>
<td>%DFC</td>
<td>T in %</td>
<td>%DFC</td>
</tr>
<tr>
<td>0.001</td>
<td>80.00±22.32</td>
<td>-60.00</td>
<td>126.00±20.84</td>
<td>-49.60</td>
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<tr>
<td>0.01</td>
<td>74.00±11.64</td>
<td>-63.00</td>
<td>104.00±8.11</td>
<td>-58.40</td>
</tr>
<tr>
<td>0.001</td>
<td>68.00±12.39</td>
<td>-66.00</td>
<td>092.00±15.27</td>
<td>-63.20</td>
</tr>
<tr>
<td>0001</td>
<td>52.00±11.98</td>
<td>-74.00</td>
<td>076.00±21.55</td>
<td>-69.60</td>
</tr>
<tr>
<td>0010</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
</tr>
<tr>
<td>0100</td>
<td>NG</td>
<td>APD</td>
<td>NG</td>
<td>APD</td>
</tr>
</tbody>
</table>

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5. Mhatre G.N., Chaphekar S.B., Ramani


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