HERBAL REGULATION OF PLANT GROWTH AND METABOLISM OF TWO MINOR PULSE CROPS

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ABSTRACT

Foliar application of leaf extracts of neem (Azadirachta indica L.) and kalmegh (Andrographis paniculata L.) (50g/500ml each) on 30 days old plants of horse gram (Dolichos biflorus L. cv. BR 5) and grass pea (Lathyrus sativus L. cv. BIOL 212) under field conditions resulted in significant increase of the potential status of plants. The levels of chlorophyll, protein, insoluble carbohydrate, DNA and activity of catalase enzyme in leaves of seedlings were found to be higher in the treated plant samples. On the other hand, soluble carbohydrate contents were found to be lower in treated samples than control ones. The promising effects of the plant extracts on plant potentiation of horse gram and grass pea are apparent in this investigation.

Horse gram and grass pea suffer from the drawback of retaining a sound vigour of seeds and poor establishment of seedlings in field. To get rid of this handicap, strategies are now being undertaken to improve the storage potential of seeds and enhancing the seedling vigour (Pathak and Basu, 1980; Basu, 1994).

Plant extracts of neem and kalmegh possess medicinal and antimicrobial property (Saxena, 1987; Dey and Choudhuri, 1984), hence an experiment was conducted to analyse the efficacy of leaf extracts of these plants on plant potentiation of horse gram and grass pea under field condition.

The investigation was performed with freshly harvested healthy seeds of horse gram (Dolichos biflorus L. cv. BR 5) and grass pea (Lathyrus sativus L. cv. BIOL 212). After surface sterilization (0.1% HgCl₂ for 90 seconds) seeds were raised in the experimental field after amending the soil with basal dose of N.P.K.(2:1:1) and adequate amount of F.Y.M.

Leaf extracts of neem and kalmegh (50g /500 ml each) or distilled water were sprayed on 30 days old plants for 2 consecutive days. Data were recorded after 0, 45 and 90 days of spraying, which corresponds to 30, 75 and 120 days of plant age.

To determine the health status of plants some biochemical parameters like chlorophyll, protein, soluble carbohydrate, insoluble carbohydrate and DNA levels and catalase enzyme activity were analysed from the leaves of each plant species. The levels of chlorophyll and protein were analysed as per the methods of Arnon (1949) and Lowry et al. (1951) respectively. The levels of soluble and insoluble carbohydrate were determined following the method of McCready et al. (1950). Quantification of DNA was done following the method of Choudhuri and Chatterjee (1970). Extraction and estimation of the enzyme catalase was made following the method of Snell and Snell (1971) as modified by Biswas and Choudhuri (1978). For assaying these enzymes, the blank was taken as zero time control and the activities were expressed as \( \Delta OD \times TV / t \times v \), where \( \Delta OD \) is the difference of the OD of the blank and sample, 'TV' is the total volume of filtrate, 't' is the time (minute) of incubation with the substrate and 'v' is the volume of the filtrate for incubations (Fick and Qualset,1975). All the data were statistically analysed (Panse and Sukhatme,1967).

With the advancement of plant age both chlorophyll and protein contents of all...
Table 1. Effect of leaf extracts of neem and kalmegh (50g/500ml each) on the levels of chlorophyll, protein, soluble and insoluble carbohydrates and DNA and activity of catalase \((\Delta OD \times TV / t \times v)\) in leaves of Dolichos and Lathyrus plants, which underwent foliar treatment for two consecutive days (Data were recorded at 45 day intervals)

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Treatments</th>
<th>Chlorophyll (mg/g fr. wt.)</th>
<th>Protein (mg/g fr. wt.)</th>
<th>Soluble carbohydrate (mg/g fr. wt.)</th>
<th>Insoluble carbohydrate (mg/g fr. wt.)</th>
<th>DNA (mg/g fr. wt.)</th>
<th>Catalase activity ((\Delta OD \times TV / t \times v))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dolichos</td>
<td>50g/500ml</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neem</td>
<td>2.97</td>
<td>0.59</td>
<td>80.00</td>
<td>18.21</td>
<td>3.00</td>
<td>3.98</td>
<td>14.41</td>
</tr>
<tr>
<td>Kalmegh</td>
<td>3.61</td>
<td>0.96</td>
<td>97.11</td>
<td>39.12</td>
<td>1.97</td>
<td>2.01</td>
<td>18.17</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>0.31</td>
<td>0.08</td>
<td>0.81</td>
<td>1.01</td>
<td>0.21</td>
<td>0.39</td>
<td>0.19</td>
</tr>
<tr>
<td>Lathyrus</td>
<td>2.91</td>
<td>0.62</td>
<td>70.21</td>
<td>22.14</td>
<td>2.14</td>
<td>3.18</td>
<td>14.02</td>
</tr>
<tr>
<td>Control</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
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<tr>
<td>Neem</td>
<td>3.12</td>
<td>0.88</td>
<td>80.29</td>
<td>38.01</td>
<td>1.90</td>
<td>2.00</td>
<td>14.18</td>
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<tr>
<td>Kalmegh</td>
<td>3.44</td>
<td>0.98</td>
<td>90.29</td>
<td>48.01</td>
<td>1.33</td>
<td>1.90</td>
<td>15.00</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>0.27</td>
<td>0.09</td>
<td>0.91</td>
<td>0.21</td>
<td>0.26</td>
<td>0.19</td>
<td>0.02</td>
</tr>
</tbody>
</table>

The treated samples were found to increase up to 75 days of plant age and a reduction of the levels was noted at 120 days of plant age. However, the plant extracts arrested the rapid loss of chlorophyll and protein and the magnitude of retention was much higher in kalmegh treated samples in comparison to neem. Soluble carbohydrate levels were found to increase with the progress of plant age and the levels of insoluble carbohydrate declined at 120 days of plant age. Here also, the aqueous solutions of plant extracts arrested the rapid increase of soluble carbohydrate as well as the loss of insoluble carbohydrate levels. Results also showed that the level of DNA decreased during the progress of plant age irrespective of the treatment and control samples. However, the declining drift was slower in treated samples, and the effect was much more significant in kalmegh treated samples. An identical change was found when the data of catalase activity was recorded (Table 1).

Chlorophylls and proteins maintain normal functional life of plants and optimum levels of these macromolecules indicate vigour status of plants (Bhattacharjee and Gupta, 1984; Lama, 2000). Higher activity of catalase enzyme is indicative of plant vigour (Sarkar and Choudhuri, 1980). In this study, the rapid increase of soluble carbohydrate in leaves of control samples and arrestation of their increase in treated samples are indicative of the efficacy of the potent chemicals present in the crude aqueous solution of the plant extracts on the maintenance of plant vigour. The results on DNA analysis also pointed out the plant extract induced potentiation of plant health of Dolichos and Lathyrus species. In fact, higher levels of nucleic acids are reported to be present in healthy plants. Again, plants having subdued growth and poor field performance possess lower levels of nucleic acids (Rai, 2000; Lama, 2000).

Considering all the biochemical parameters, it can be concluded that both neem and kalmegh leaf extracts possess potent chemical agents for maintenance of higher plant potential and these delayed senescence of present experimental plants. However, the actual mechanism is yet to be explored.
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REFERENCES