ECO-PHYSICOCHEMICAL EFFECTS OF AUTO-EXHAUST POLLUTION ON *Cassia fistula* LEAVES GROWING ALONG AGRA-BOMBAY ROAD NH-3 (INDIA)

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ABSTRACT

The leaf area, photosynthetic pigment, leaf biomass and leaf area - dry weight ratio, (L/D ratio) of *Cassia fistula* were investigated in relation to auto-exhaust pollution. A significant reduction in the photosynthetic pigment content and leaf biomass was observed.

However, Leaf area/dry weight ratio was increased in plants facing air pollution stress. Photosynthetic pigment content and leaf biomass was found to be positively correlated. The reduction in photosynthetic pigment and dry weight decreases with increase in distance from pollution source i.e. roadsides.

Key Words: Photosynthetic pigments, Leaf area/biomass ratio, Auto-exhaust pollution.

INTRODUCTION

The tremendous increase in mobilization of human society has resulted in phenomenal rise in vehicular traffic on the major roadways. The auto exhaust emitted from automobiles contains a deadly mixture of poisonous gases like SO₂, NOₓ, CO and particulates which affects the human being and vegetation. The problem is of much concern in our country as the vehicular population is increasing at an alarming rate every year. According to World Health Organization, the concentration of suspended particulate matter is decreasing in developed countries due to strict rules and increasing in developing countries³.

Looking to these aspects the present study was carried out to know the impact of ambient air on eco-physiology of *Cassia fistula* growing near NH-3 Agra-Bombay Road.

MATERIAL AND METHODS

Leaves of *Cassia fistula* growing along road side 10 meter away (P₁), 100 meters away (P₂) and 1000 meters away from the roadsides were collected.

Leaves collected from 1000 meter away i.e. university campus Khandwa Road were considered as reference i.e. less polluted
area. Five leaflets in triplicates were plucked carefully and placed in a poly bag from the height of 3-4 meter and brought to laboratory.

The leaf area of the hundred leaflets was determined by using a Planimeter. Dry weight of the same leaflets was determined by drying them in an oven at 80ºC for 24 hours and expressed in grams per leaflet. The leaf area - dry weight ratio of these leaflets were also determined.

The chlorophyll content of the leaflets collected at the date of first sampling 1st day and after 7th, 14th and 21st day was determined following

RESULTS AND DISCUSSION

Table 1: Chlorophyll a (Chl a) and Chlorophyll b (Chl b) content and % reduction.

<table>
<thead>
<tr>
<th>Days</th>
<th>P1</th>
<th>P2</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chl a</td>
<td>% Reduction</td>
<td>Chl b</td>
</tr>
<tr>
<td>1st Day</td>
<td>0.161</td>
<td>28.29</td>
<td>1.040</td>
</tr>
<tr>
<td>7th Day</td>
<td>0.110</td>
<td>46.87</td>
<td>0.985</td>
</tr>
<tr>
<td>14th Day</td>
<td>0.105</td>
<td>52.45</td>
<td>0.955</td>
</tr>
<tr>
<td>21st Day</td>
<td>0.008</td>
<td>58.49</td>
<td>0.920</td>
</tr>
</tbody>
</table>

Note: P1 - 10 meters away from roadside.
      P2 - 100 meters away from roadside.
      R - 1000 meter away from road side reference area.

Fig. 2: Chl.b content with duration.
Fig. 2: Chl.a content with duration.

Table 2: Leaf area, dry weight, and L/D ratio.

<table>
<thead>
<tr>
<th>No</th>
<th>Leaf Area *</th>
<th>Dry Weight</th>
<th>L/D Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P₁</td>
<td>P₂</td>
<td>P₁</td>
</tr>
<tr>
<td>1</td>
<td>71</td>
<td>39</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td>72</td>
<td>48</td>
<td>51</td>
</tr>
<tr>
<td>3</td>
<td>73</td>
<td>32</td>
<td>55</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>46</td>
<td>54</td>
</tr>
<tr>
<td>5</td>
<td>65</td>
<td>52</td>
<td>66</td>
</tr>
<tr>
<td>6</td>
<td>62</td>
<td>46</td>
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</tr>
<tr>
<td>7</td>
<td>46</td>
<td>51</td>
<td>28</td>
</tr>
<tr>
<td>8</td>
<td>46</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>19</td>
<td>39</td>
<td>35</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>45</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>55.90</td>
<td>42.80</td>
<td>47.60</td>
</tr>
<tr>
<td></td>
<td>±19.70</td>
<td>±7.54</td>
<td>±12.68</td>
</tr>
</tbody>
</table>

- Average of 100 leaflets is considered
Fig. 3a: Leaf area in sites P1, P2 and reference area.

Fig. 3b: Dry weight of leaf in sites P1, P2 and reference area.
The effect of urban pollution on the Cassia fistula leaves is presented in Table 1 which indicates that there was an overall reduction in chlorophyll a and b both. The percent reduction increases with the exposure period from 1st day to 21st day of sampling. There were 28.29, 46.87, 52.45 and 58.49 and 36.56, 40.30, 40.31 and 40.69 % reduction was recorded on 1st day to 21st day of observation in P1 and P2 sites respectively (Fig. 1). Similar observation was noted in chlorophyll b, the rate of change in photosynthetic pigment of leaves was more in polluted area as compared to reference (Fig. 2).

The reduction in chlorophyll can be attributed to SO$_2$ induced activity resulting in removal of magnesium ion, which converts it into phaeophytin, and modify the light spectrum characteristics$^{3,4}$. However Ziegler (1977)$^{5}$ suggested that reduction in chlorophyll is caused by toxic ions formed by the dissolution of SO$_2$ in water inside leaf tissue, which preferentially incorporate into thylakoid membrane. Another study suggested that super oxide radicals formed might also oxidize chlorophyll pigments$^6$. Reduction in the chlorophyll of plants exposed to air enriched by SO$_2$ has been reported by many workers$^{5,13}$. However in present study the reduction in photosynthetic pigments have been attributed to the mixture of pollutants specially SO$_2$ and NOx.

The leaf area, leaf biomass and L/D ratio of leaves is given in Table 2. In general there was reduction in leaf area and dry weight from P$_1$ and P$_2$ sites (Fig. 3a and Fig. 3b). However L/D ratio was increased in P$_1$ and P$_2$ with respect to reference plants (Fig. 4). The increase in L/D ratio decreases with increase in distance from the source of pollution. These results are in confirmation with the reduction in photosynthetic pigments. Since the amount of chlorophyll is directly related with dry matter production.

Rao M.V. and Dube, 1988$^{14}$ and Kumawat and Dube$^{15}$ have earlier reported similar observation regarding leaf area dry weight ratio in plants growing around Dewas Industrial area and at Ujjain in plant growing around a steel industry. Thus the present work confirms the previous work. The increase in the ratio is in correction with decrease in the source of population.

It is interesting to note that in spite of increase in the leaf area at P$_1$ site. There was an overall reduction in photosynthetic pigments and dry matter production, which has further resulted in increased leaf area dry weight ratio.
CONCLUSION

With the present work we conclude that the Chlorophyll content and L/D ratio can be treated as simple and a better parameter for quick and low cost environmental-bio monitoring.

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