IMPACT OF AIR POLLUTION ON FLORAL MORPHOLOGY AND CHARACTERISTICS OF Cassia glauca Lamk. IN INDORE (INDIA)

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ABSTRACT

The present study gives an idea of changes taking place in floral and pollen characteristics of Cassia glauca Lamk. under the influence of urban air pollution. Characters like floral morphology, floral biomass, pollen viability and pollen size were found to be adversely affected. The length of sepals, petals, stamens and carpel; all were found to be reduced in comparison to the Low pollution area. Pollen size and viability were also affected adversely. The present study indicates that the air around heavily vehicular polluted area is injurious to the floral parts.

Key Words: Urban air pollution, Floral morphology, Pollen viability, Pollen size.

INTRODUCTION

Much attention has been given to the air pollution these days, because development of society has led to more and more air pollution, making it a global problem. Polluted air has a drastic effect on all components of ecosystem. In all the big cities of the country about a million tones of pollutants are being released into the atmosphere everyday and of these above 75% is accounted by the exhaust gases from automobiles¹³. Plants being stationary are constantly exposed to different air pollutants. They absorb and accumulate these pollutants through their exposed parts and sometimes show specific responses too; thus they can be used as indicator of air pollution⁴⁻⁵.

Aims and Objectives

Indore is moderately industrialized and densely populated city of Madhya Pradesh (India) with heavy vehicular traffic. Important national highways Mumbai-Agra and Indore-Ahmedabad pass through this city and thus magnify the problem of pollution. The automobile emissions contains SO₂, NOx, hydrocarbons and particulates. Plants growing along roadside are adversely affected due to these pollutants. In many plants pollutants have been reported to interfere with reproductive biology leading to retarding effects on flowering, fruiting and seed setting. The present work is aimed to study the effect of air pollutants on floral morphology.

The present investigation was carried out on Cassia glauca Lamk. plants. Cassia glauca Lamk. is a glabrous, deciduous tree, 5-
10m tall. Leaves 10-25cm long. Flowers in axillary corymbose racemes shorter than leaves, calyx yellow, glabrous, petals bright yellow, stamens 10 all perfect, subequal. Flowering and fruiting time is September to May. Sampling was done at two different study sites in Indore city. Site 1 was Scheme no.78 which is considered as Low pollution area (LPA). It is situated towards northern side of Indore city and is free from industries and there is very low traffic frequency. Site 2 was Agra – Bombay road (NH-3) which is considered as Heavy vehicular pollution area (VPA). It is backbone of the city and large number of vehicles passes through it (shown in Map). At the two study sites of the city Cassia glauca Lamk. trees are planted extensively with other plant species. Pollution load and data of ambient air quality of the study areas were obtained from regional office of M.P. Pollution Control Board, Indore (Table -1).

MATERIAL AND METHODS
Sampling of flowers was done in between 9 to 10am in the month of January 2007, at a height of 3-5meter from ground level. The size of sample was 100 flowers per tree. Flowers were collected from all sides of tree in polythene bags, kept in ice box and immediately brought to the laboratory.

Floral biomass—Fresh weight of flowers was recorded with the help of Digital Pan Balance (Keroy, K-200) before placing in oven at 80°C for 24 hrs. in order to find out their dry weight.

Floral morphology—Length and breadth of floral parts i.e. sepals, petals, stamens and carpel were measured with the help of thread and measuring scale.

Pollen size—Size of pollens were measured with the help of ocular and stage micrometer scale.

Pollen viability—Pollens from freshly open flowers were obtained and mixed with 2, 3, 5, Triphenyl tetrazolium salt (1%) to study pollen viability.

RESULTS AND DISCUSSION
Reproductive biology is one of the most convenient and excellent biomonitoring system for environmental pollution. The number, size, fresh weight and dry weight, stamens and style length, anther size, pollen size and viability offer very good quantitative relationships with pollutants in the environment. Values presented in Table 2 shows the effect of urban air pollution on floral morphology and pollen characteristics. Considerable reduction in all the parameter studied, clearly indicates the adverse effect of air pollution on reproductive biology of Cassia glauca Lamk.

Reduction in the size of flower has been observed in vehicular polluted area as compared to Low polluted area. Size of sepals was much reduced as compared to that of petals. Length and breadth of sepals was reduced by 4.44% and 6.66% respectively, while length and breadth of petals was reduced by 5.19% and 1.23% respectively in Vehicular polluted area. Similar reductions were seen in size of stamens (6.66%) and carpel (5.26%) in flowers collected from Vehicular polluted area. Reduction in dry weight of flowers was found to be much higher (16.072%) as compared to that of fresh weight (6.628%). Apparently the flowers appeared unaffected but significant reduction in floral biomass in Vehicular polluted area has been observed as compared to the Low polluted area. The response of pollen was also similar in automobile polluted area. Although there was less reduction in size of pollen at vehicular polluted area (12.64%), the pollen viability was much affected due to air pollution as pollens of Low polluted area were 87% viable while pollens of vehicular polluted area were only 73% viable, showing 16% reduction.

Table 1
Monthly average values of different pollutants at Indore city in winter-2007

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>LPA</td>
<td>SPM</td>
<td>140.25</td>
<td>152.43</td>
<td>171</td>
</tr>
<tr>
<td></td>
<td>SO\textsubscript{2}</td>
<td>5.88</td>
<td>5.06</td>
<td>4.92</td>
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<tr>
<td></td>
<td>NO\textsubscript{2}</td>
<td>12.17</td>
<td>10.55</td>
<td>10.04</td>
</tr>
<tr>
<td>VPA</td>
<td>SPM</td>
<td>217.71</td>
<td>193.91</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>SO\textsubscript{2}</td>
<td>11.98</td>
<td>8.67</td>
<td>13.81</td>
</tr>
<tr>
<td></td>
<td>NO\textsubscript{2}</td>
<td>19.58</td>
<td>16.15</td>
<td>25.91</td>
</tr>
</tbody>
</table>

N.B. All values in $\mu g m^{-3}$

SPM Suspended particulate matter.
SO\textsubscript{2} Sulphur dioxide
NO\textsubscript{x} Oxides of Nitrogen

Table 2

Floral Biomass (gm) and Length and breadth (cm) of different floral parts, pollen characteristics of Cassia Glauca Lamk, collected from different polluted area of Indore City

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameters</th>
<th>Site-I (LPA)</th>
<th>Site-II (VPA)</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fresh wt. of flowers</td>
<td>27.27 ± 0.3363</td>
<td>25.26 ± 0.3353</td>
<td>6.62%</td>
</tr>
<tr>
<td>2</td>
<td>Dry weight of flowers</td>
<td>6.39 ± 0.05466</td>
<td>5.368 ± 0.04728</td>
<td>16.70%</td>
</tr>
<tr>
<td>3</td>
<td>Length of sepals</td>
<td>0.9 ± 0.894</td>
<td>0.86 ± 0.0234</td>
<td>4.44%</td>
</tr>
<tr>
<td>4</td>
<td>Breadth of sepals</td>
<td>0.6 ± 0.1095</td>
<td>0.56 ± 0.01581</td>
<td>6.66%</td>
</tr>
<tr>
<td>5</td>
<td>Length of petals</td>
<td>3.08 ± 0.0221</td>
<td>2.92 ± 0.0365</td>
<td>5.19%</td>
</tr>
<tr>
<td>6</td>
<td>Breadth of petals</td>
<td>1.62 ± 0.05540</td>
<td>1.6 ± 0.05458</td>
<td>1.23%</td>
</tr>
<tr>
<td>7</td>
<td>Length of stamens</td>
<td>0.75 ± 0.02408</td>
<td>0.70 ± 0.02345</td>
<td>6.66%</td>
</tr>
<tr>
<td>8</td>
<td>Length of carpel</td>
<td>2.85 ± 0.4219</td>
<td>2.70 ± 0.03946</td>
<td>5.26%</td>
</tr>
<tr>
<td>9</td>
<td>Pollen size ($\mu m$)</td>
<td>50.607 ± 0.9917</td>
<td>44.209 ± 0.7260</td>
<td>12.64%</td>
</tr>
<tr>
<td>10</td>
<td>Pollen viability</td>
<td>87 ± 7.34</td>
<td>73 ± 3.346</td>
<td>16.09%</td>
</tr>
</tbody>
</table>

LPA Low polluted area.
VPA Vehicular polluted area.

Plants are very sensitive to air pollutants at their reproductive stage. Flower size reduction due to air pollution has been reported in Calendula (D.regia, P.innerme), Cassia siamea. Such reduction in size and weight of flower seems to occur due to disturbed plant metabolism and poor availability of photosynthates under pollution stress\textsuperscript{3-14}. Due to extreme sensitivity to air pollutants, pollens have been used for air
pollution monitoring world over. Apparently the reduction in size of pollen and viability in polluted area as compared to Low pollution area seems due to heavy pollution load. Reduction in pollen size and pollen viability due to SPM, and air pollutants like SO$_2$, O$_3$, NO$_2$, HF and other automobile exhausts has been reported in C. siamea by Chauhan and Singh and Chauhan et al., Fedotov et al., also reported SO$_2$ induced reduction in pollen viability, size and shape of pine pollen grains$^{15-18}$.

Indore is a thickly populated city, with heavy traffic load. Also, every year more than 8000 new vehicles are added to the already existing number of automobiles (RTO, Indore. March-2006). Besides the bad quality of roads and narrow lanes further adds to the pollution load. All these problems along with dry climatic conditions make the scenario further worse, especially in winter season. Thus, the plants of Cassia glauca Lamk. growing at road side exhibited significant impact of automobile pollution on their floral morphology$^{19-22}$.

ACKNOWLEDGEMENT

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REFERENCES


**Fig.** Map of Indore City showing Sampling Sites.