

Impact of Automobile Pollution on the Morphology of *Jacaranda mimosifolia* D. Don. in Jammu City

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ABSTRACT

The present study was made to evaluate the impact of automobile pollution on morphology of leaf, fruit and seeds, stomatal index, seed germination and seedling growth of *Jacaranda mimosifolia* D. Don. commonly called Nili gulmohur. The studies indicated that the plant species, being sensitive to vehicular pollution, can best be used for air pollution monitoring.

Key words: Air Pollution, Monitoring, Stomatal Index, Germination, *Jacaranda mimosifolia*

INTRODUCTION

Due to progressive development and increase in population the demand on transport is increasing year after year. With the increase of vehicular numbers the air pollution has also risen unexpectedly. Some of the most important constituents of vehicular exhaust include carbon monoxide (CO), carbon dioxide (CO₂), unburnt complex hydrocarbons such as 3,4 benzopyrene, oxides of nitrogen (NO_x), oxides of sulphur (SO_x), partially burnt products like aldehydes, acroleins, lead compounds, soot and other particulate matter. Attempts have been made to develop certain plant strains, which can be specifically used for predicting the concentration of a particular pollutant and thus can be used in bioassay techniques. (Chaphekar, 1978). On the basis of their response to pollutants under field and laboratory conditions, plants have been classified into sensitive and tolerant categories. One such plant used in biomonitoring studies is *Jacaranda mimosifolia* D. Don. growing in Jammu region of the J&K, State (Iqbal 1991).

Very little information is available on the growth and seed germination of some common roadside trees, including *J. mimosifolia* D. Don. being severely affected by automobile pollution (Iqbal, 1991). However, studies on some weeds indicated that the heavy vehicular pollution inhibit the size of the stomata besides increasing the number of stomata, number of epidermal cells and stomatal index (Salgare and Iyer, 1991). In the present work the impact of vehicular pollution on fruits, seeds, micromorphology of leaves and seed germination of *J. mimosifolia* D. Don. has been assessed.

STUDY AREA

The plantation of *J. mimosifolia* D. Don. is quite common on the roadsides of Jammu city situated at an altitude of 300m (a.s.l) within geographical coordinates of 32° 44' N latitude, 74° 54' E longitude. It is an excellent tree for avenues, parks and gardens, having graceful foliage, beautiful flowers, and pleasant shade and wood, being moderately hard with very fine texture, is commonly used for making small furniture goods (Randhawa, 1996).

The present study focused on two different sites for drawing a comparison vis-à-vis the impact of automobile pollution (Fig. 1 & 2).

Site I: The vegetated site on national highway, from Vikram chowk to Satwari having a very high traffic flow rate, signifies the polluted site (Table 1).

Site II: The vegetated site selected at the new University campus is considered to be a clean site, having very low traffic flow rate (Table 1).

Table 1. Average traffic flow rate per hour from Monday to Sunday, at sites I & II

| Site | Time period (hr) | Heavy vehicles/hr (I) | | | Medium vehicles/hr (II) | | | Light vehicles/hr (III) | | | Overall average of N/hr (x) | Overall average of P/hr (y) | Overall average of Z/hr (z) |
|------|------------------|-----------------------|-----|-----|-------------------------|-----|-----|-------------------------|----|------|-----------------------------|-----------------------------|-----------------------------|
| | | N | P | Z | N | P | Z | N | P | Z | | | |
| I | 0800-2400 | 187 | 29 | 216 | 179 | 24 | 203 | 1142 | 86 | 1230 | 1506 | 141 | 1687 |
| II | 0600-2400 | 1 | Neg | 1 | 3 | Neg | 3 | 53 | 3 | 66 | 67 | 3 | 73 |

N = Vehicles having normal emission

P = Vehicles having excessive emission

Z = Average vehicular flow per hour

Neg. = Negligible

MATERIAL AND METHODS

Collection of plant material at both the sites was done during vegetative as well as reproductive phase of plant species. The leaf material was analysed for various morphological features like area of stomata, stomatal index, stomatal frequency (Salisbury, 1927) while the fruit part was analysed for various parameters like pod weight, pod length, number of seeds/pod and seed weight. Studies on seed germination were conducted for estimating the root-shoot length and weight of 4 weeks old seedling.

RESULTS

The study on qualitative and quantitative morphological details of leaf, pods and seeds from polluted site showed significant variations when compared to those collected from the clean site (Table. 2). The area of stomata on abaxial surface of leaves collected from polluted site was comparatively lesser to the leaves collected from clean site. On the other hand, opposite trend was followed for stomatal index and stomatal frequency. Not only the leaf morphology was affected, but also the pods were affected due to automobile pollution. The pod of *J. mimosifolia* D. Don. at polluted site were dark brown as compared to the pods collected from clean site which were brighter in colour. Reduction in weight of pods at polluted site was also observed. The average number of seeds/pod and percentage of healthy seeds per pod were observed to be 65 ± 6.77 and

Table 2. Impact of auto-exhaust pollution on quantitative morphology of *J. mimosifolia* D. Don. in Jammu city

| S.No. | Parameter studied | Polluted site (I) | Clean site (II) |
|-------|--|----------------------------------|----------------------------------|
| 01 | Area of stomata (μm^2) | 304.60 ± 112.21 (150-540) | 616.80 ± 111.98 (414-806) |
| 02 | No. of stomata (mm^2) of leaf | 391.3 | 364.0 |
| 03 | Stomatal Index (S.I) | 24.09 ± 6.67 (10.0-44.4) | 17.34 ± 6.92 (7.69-27.27) |
| 04 | Average pod length (cm) | 6.69 ± 0.62 (5.0 - 7.8) | 5.94 ± 0.38 (5.2 - 7.2) |
| 05 | Average pod weight (gm) | 4.372 | 4.953 |
| 06 | Average no. of seeds/pod | 65 ± 6.77 (51 - 77) | 74 ± 9.72 (47 - 88) |
| 07 | %age of healthy seeds/ pod | 52.06 (38.98 - 69.49) | 83.64 (77.63 - 89.55) |
| 08 | Average weight of seeds (mg) | 9.5 | 11.8 |
| 09 | Time taken for germination (days) | 10.0 | 7.0 |
| 10 | Percentage germination | 37.0 | 90 |
| 11 | Average root length of seedling (cm) | 3.4 | 4.2 |
| 12 | Average shoot length of seedling (cm) | 7.9 | 9.1 |
| 13 | Dry weight of 4 week old seedling (mg) | 71 | 74 |

52.06 at polluted site and 74 ± 9.73 and 83.64 at unpolluted site respectively. The average weight of seed per pod showed significant differences between polluted and unpolluted sites.

Studies on seed germination revealed significant changes which reflected the intensity of vehicular pollution. The time taken for seed germination for the different zones also showed significant variation, being 10 days for those collected from the polluted site and 7 days for the ones obtained from the unpolluted site. Further the average length of root, shoot and dry weight of 4 weeks old seedling was lesser for those raised from the seeds of polluted site while opposite was true for the unpolluted site.

DISCUSSION

A perusal of the data reveals that the vehicular pollution has a negative impact on the overall growth of *J. mimosifolia* D. Don. The decrease in stomatal size and increase in stomatal frequency and stomatal index gains further support from the findings of Salgare and Iyer (1991) who conducted their studies on the impact of auto exhaust pollution on micro morphology of some weeds growing along the road side.

The decrease in pod weight and the increase in length and breadth of pods collected from polluted site as compared to the clean site is further supported by the studies of Iqbal (1991) on some trees. Similar results have also been obtained by Sexena *et al* (1991), showing a decrease in the seed weight of crops – (wheat and sorghum) growing adjacent to the highway.

In present study a decrease in percentage of healthy seeds per pod and average weight of seed collected from polluted site to that of clean site was also noted. Studies related to the germination of seeds collected from the two different sites showed that the seeds of polluted site germinated in a longer period of time and as such have lesser viability which might be due to the inhibitory effects of some pollutants. This gains further support from the earlier findings of Iqbal (1991) during his investigations on some road side trees like *Peltophorium roxburghii*, *Melia azadirachta*, *Dalbergia sissoo* and *Leucenmea leucocephala*.

The reduction in root length, shoot length and dry weight of four week old seedling raised from the seeds of polluted site as compared to that of clean site is again probably attributed to the vehicular pollution in the environment.

In conclusion, it appears that the plant *Jacaranda mimosifolia* D. Don. is very sensitive to the pollutants released by automobiles and thus can be used for pollution monitoring studies.



Fig. 1. *Jacaranda mimosaefolia* D. Don grows along National Highway having very high traffic flow (polluted site)



Fig.2. *Jacaranda mimosaefolia* D. Don grows in the lawns of Jammu University campus (represents the unpolluted site)

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