



Available online at www.ewijst.org

ISSN: 0975-7112 (Print)

ISSN: 0975-7120 (Online)

Environ. We Int. J. Sci. Tech. 5 (2010) 155-162

Environment & We
An International
Journal of Science
& Technology

Comparative Ecomorphological Studies on *Datura alba* linn. Plants Growing Along Roadsides and Railway Tracks

Sneh Lata*, Divya Shah, and Poonam

Department of Botany, M.M.H. College, Ghaziabad, U.P., India

*E-mail: sneh.lata1@yahoo.com

Abstract

Automobiles are one of the major sources of air pollution. Plants growing along roadsides and railway tracks help in reducing the pollution level in the air and act as pollution sink. The importance of wild plants has been overlooked in the past but nowadays these plants are being used in preparation of number of drugs. The automobile exhaust and exhaust from diesel engine used in railways causes harmful changes in the morphology, physiology and anatomy of these plants. A study was conducted on the effect of automobile and diesel engine exhaust on phytosociological, germination, morphological and stomatal pattern of *Datura alba* Linn. Phytosociological studies were conducted in three different seasons summer, rainy and winter. Parameters like percentage frequency, density and abundance were studied. It was observed that percentage frequency, density and abundance were minimum in winter and maximum in rainy season. The leaf length, leaf breadth and leaf area of the leaves collected from polluted sites i.e. along roadside and railway showed varying degree of reduction as compared to the leaves collected from non polluted area. Parameters of germination including seed germination percentage, seedling height, shoot and root lengths were also studied. Seed germination percentage followed a decreasing trend from plants grown under control conditions to plants along railway tracks and finally it was minimum in plants growing along roadside. Similar decreasing trend was observed in seedling height, shoot and root length. Under the stressed conditions of automobile exhaust a decreasing pattern was noticed in stomatal frequency on both abaxial and adaxial surfaces in leaves collected from roadsides and railway tracks plants. Length and breadth of stomata and stomatal index were also reduced as we moved from unpolluted (plants grown in control conditions) to polluted sites (plants growing along railway tracks and roadsides).

Keywords: *Datura alba* Linn., Air pollution, Automobile exhaust, Roadside, Railway tracks.

Introduction

Air pollution is a global ecological problem and is likely to become a great threat with the rapid growth of population and increasing industrialization. Ghaziabad is an important town of Uttar Pradesh, which is in grip of heavy atmospheric pollution. The priority of creating pollution goes to automobiles. Automobile fleet of the country emit over 1.8 million tones of air pollution of which more than 80% are released in cities (Ahmad *et al* 1988). The pollutants released from automobiles are not only harmful to humans but also to plants and the environment. A large number of plants are found to be growing along roadsides and railway tracks. The effect of automobile exhaust on various roadside trees and other plants was studied by many workers.

All these plants are integral part of biodiversity and area of immense importance for the mankind. It has been reported that automobile exhaust resulted in alteration of various foliar characteristics. The role of various medicinal plants growing along the polluted areas was described by Schultze (1962). Further Panda (1989), Trivedi and Singh (1990) also observed that these pollutants not only change the morphology, physiology and anatomy of plants but also affect their medicinal properties. Madhavendra *et al.* (1990) analyzed the vegetation of an industrial area, Balanagar in Hyderabad, India. They searched for the identification of pollution sensitive, indicator, resistant and highly resistant species. The sensitive species showed various symptoms viz. defoliation, leaf bronzing, leaf chlorosis, hyponasty, epinasty, withering and necrosis. Quadir and Iqbal (1991) observed that growth some plants growing along roadside such as *Albizia lebbek*, *Pongamia pinnata* and reported that seed weight was very less in those plants, which were growing along roadsides.

Khan *et al.* (1995) suggested that the plants growing under stressed conditions of automobile exhaust showed some variation in flowering and fruiting. A marked decrease in seed weight in *Azadirachta indica* and *Delonix regia* under stress conditions of pollution was observed by Iqbal and Siddique (1996). Aggarwal *et al.* (1996) calculated leaf area, dry weight ratio and photosynthetic pigments of some tree species collected from polluted site and found reduction in all parameters. The plants are growing along roadside and railway tracks help in reducing the pollution level in the air and act as pollution sink. From the earlier work it was realized that automobile exhaust and exhaust of railway engine caused harmful changes in different parameters of the plants. Maximum work was carried out on the effect of automobile exhaust on tree species and it was realized that most of the people collect the medicinal plants from highly polluted areas. Thus a study was conducted on the effect of automobile and diesel engine exhaust on phytosociological, germination and seedling growth, leaf morphology and stomatal pattern of *Datura alba* Linn., a medicinal herb, frequently growing along roadsides and railway track. It is a large annual herb belongs to family Solanaceae. All parts of the plants are strongly intoxicant, narcotic, aphrodisiac, antispasmodic. The plant contains about 0.70% of alkaloids of which scopolamine is the chief alkaloid. The plant is used in curing asthma, whooping cough, and bronchitis. Juice of the fruit is used to check dandruff. Paste of seeds is used for decaying teeth, piles etc.

Materials and Methods

The present work was performed on *Datura alba* Linn. are growing along roadsides and railway tracks in order to find out the sensitivity to automobile exhaust. For the proposed work three sites of Ghaziabad were selected

- Roadside areas of the city like Mohan Nagar and New bus stand.
- Railway track areas like Vivekanand Nagar and Raj Nagar where diesel engines operate.
- Areas away from busy roads and railway tracks like interior parts of ALTT center was used as control.

The plant was investigated for the following parameters

Phytosociological studies

Quadrat method was applied for phytosociological studies and following formulae were used

- Percentage frequency = Total number of quadrats in which species has occurred/ total number of quadrats
- Density = Total number of individual species / total number of quadrats studied
- Abundance = Total number of individuals of the species/total number of quadrats in which species has occurred

Germination and Seedling growth

For germination studies seeds were collected from already available plants from all three sites. The seeds were surface sterilized with 0.10% HgCl₂ solution for 10 minutes to check the fungal activity. After sterilization the seeds were rapidly washed with distilled water for at least 5-10 times and were sown in earthen pots. For determining the seedling growth, the day when plumule first appeared from the soil was considered as the first day. The readings were taken on the 5th, 7th and 9th day after germination.

Morphological studies of leaf

Ten leaves at the very top of the branch of each plant from each site were taken for morphology studies. For measuring leaf area, an outline sketch of leaf was made by placing it on a graph sheet and then numbers of squares were counted. Leaf length and breadth were measured by using simple scale.

Stomatal studies

Various epidermal traits like frequency of stomata, shape and size were measured using ocular and stage micrometers. The formula used for study were

- Stomatal index= $S \times 100 / E+S$

Where, S- number of stomata per microscopic field area, E- number of epidermal cells per microscopic field area.

- Frequency of stomata= Number of stomata/ Microscopic field area

Results

Datura alba Linn. is a large annual herb belonging to the family Solanaceae. It is a common weed found all over the country. It was observed for following parameters.

Phytosociological studies

Observations were made in three different seasons, summer, rainy and winter. A decreasing trend was noticed in the parameters from control to roadside (Table 1).

Table 1 Effect of automobile and diesel exhaust on *Datura alba* Linn. on percentage frequency, density and abundance during various seasons.

Seasons	Sites	Frequency (%)	Density (%)	Abundance (%)
Summer	Control	25.00 ±1.19	1.00 ±0.008	37.10 ±0.010
	Railway Track	00.44* ±1.19	38.00 ±1.19	84.1±1.19
	Road side	00.04***±1.29	7.00* ±0.003	14.10* ±0.008
Rainy	Control	16.00 ±1.01	50.10 ±0.002	89.10 ±0.006
	Railway Track	0.005***±1.06	89.00±0.005	34.10***±0.007
	Road side	74.00** ±1.04	67.00** ±0.07	92.1** ±0.005
Winter	Control	4.00±1.05	4.00 ±0.006	1±0.004
	Railway Track	63.00 ±1.06	72.00***±0.002	37.00***±0.002
	Road side	0.42** ±1.04	41.00***±0.004	26.00***±0.001

Values represent mean ± S.E. (n=10), * Significant at 5%, ** Significant at 1%

Germination and Seedling growth

The germination percentage in cases where seeds were taken from railway tracks and roadsides was less than control. Maximum seedling height was observed in control sets and minimum in roadside sets. Similarly root length also decreased from control to roadside. Shoot length also exhibited the same response (Table 2).

Morphological Studies of Leaf

The leaf length, leaf breadth and leaf area of the leaves collected from polluted sites i.e. along roadside and railway showed varying degree of reduction as compared to the leaves collected from non polluted area i.e. control (Table 3).

Stomatal Studies

For stomatal studies, size of the guard cell and pore, stomatal frequency on adaxial and abaxial surfaces and type of stomata were investigated. Like other

parameters, the reductions were more pronounced in plants found along roadsides. (Table 4)

Table 2 Impact of automobile and diesel engine exhaust on percentage seed germination and seedling growth of *Datura alba* Linn.

Parameters	Days	Control	Railway Track	Road Sides
Seed germination (%)		95.95 ±2.23	86.00 ±2.03	80.44* ±2.08
Seedling height (cm)	5	9.40 ±0.15	8.78** ±0.29	8.39** ±0.09
	7	11.30±0.06	10.98** ±0.09	8.39** ±0.09
	9	14.77 ±0.70	14.37±0.04	12.00**±0.30
Root length (cm)	5	4.62 ±0.05	4.30 ±0.04	4.00**±0.09
	7	5.02 ±0.13	4.78 ±0.12	4.68** ±0.05
	9	5.77 ±0.07	5.48 ±0.08	5.00** ±0.06
Shoot length (cm)	5	4.78 ±0.12	4.48±0.12	4.39 ±0.12
	7	6.25 ±0.16	6.20 ±0.19	6.19 ±0.14
	9	9.00±0.15	8.89±0.29	7.00**±0.04

Values represent mean ± S.E. (n=10), * Significant at 5%, ** Significant at 1%

Table 3 Impact of automobile exhaust on leaf length, leaf breadth and leaf area of *Datura alba* Linn.

Parameters	Control	Railway track	Roadside
Leaf length (cm)	14.41 ±1.02	12.58 ± 1.02*	12.20 ± 1.25*
Leaf breadth(cm)	7.06 ± 0.06	6.97 ± 0.04	6.82 ± 0.05*
Leaf area (cm ²)	53.5 ± 2.49	48.2 ± 2.44	46.00 ± 1.81**

Values represent mean ± S.E. (n=10), * Significant at 5%, ** Significant at 1%

Table 4 Impact of automobile and diesel engine exhaust on the stomatal studies in the leaves of *Datura alba* Linn.

Parameters	Control	Railway track	Roadside
Guard cells	L= 0.595 ±0.006	L= 0.582 ±0.301	L= 0.482* ±0.006
	B= 0.472 ±0.058	B= 0.451 ±0.038	B= 0.321* ±0.069
Pore size	L= 0.412 ±0.009	L= 0.405 ±0.002	L= 0.365* ±0.001
	B= 0.245 ±0.004	B= 0.225** ±0.008	B= 0.219** ±0.002
Stomatal index (adaxial surface)	35.548 ±2.892	34.548 ±2.889	34.533 ±2.887
Stomatal index (abaxial surface)	37.896 ±2.962	37.832 ±2.921	36.533 ±2.155
Frequency (adaxial surface)	16-32/UA	16-30/UA	15-32/UA
Frequency (abaxial surface)	17-38/UA	16-36/UA	16-30/UA

Values represent mean ± S.E. (n=10), * Significant at 5%, ** Significant at 1% L- Length, B-Breadth, /UA-per unit area

The data from CPCP (Central Pollution Control Board), SPCB (State Pollution Control Board) was analyzed and it was observed that in high vehicular area, the air quality was low. This might be due to the automobile exhaust.

Discussion

The pollutants emitted by the automobiles are absorbed by the plants growing along roadsides and railway track sites and strongly influence the various activities of these plants. The plants growing along railway tracks and roadsides also influenced differently regarding their different physiological processes. Phytosociological studies shows that percentage frequency, density and abundance were minimum in winter and maximum in rainy season. The environmental conditions such as light, temperature and humidity strongly influence the uptake of pollutants by plants and their sensitivity to air pollutants (Noland and Kozlowski, 1979). Heek and Brandt (1977) suggested that the degree of sensitivity of a plant species depends on its developmental stage, nutritional status and environmental factors. Further a conspicuous reduction in the percentage of seed germination was observed in *Datura alba* Linn. The growth of seedling was better in the seeds of unpolluted than polluted areas. Decrease in germination was probably due to the production of less number of viable seeds under stressed condition of automobile exhaust (Quadir and Iqbal, 1991). Seeds collected from railway track areas showed less inhibitory effects in their growth as compared to the seeds of roadside area. Thukral and Kaur (1987) suggested that inhibition in seedling growth might have been due to inhibition in root growth elongation in the apical zone by exhaust. Deepak *et al.* (1999) analyzed that exposure of plants to 0.06ppm SO₂ significantly reduced plant height, leaf area, biomass and yield. The root/shoot ratio decreased significantly due to CO₂ and CO₂ + SO₂ treatment at 45 days age. Plants provide enormous leaf area for adsorption and accumulation of air pollutants. Leaf is the most important vegetative organ since food material is synthesized in it. It remains in direct contact with the atmosphere. All the morphological parameters including leaf length, leaf breadth and leaf area depicted a sharp decline along railway track sites and roadsides in *Datura alba* Linn.

Decline in all the parameters were found to be dependent on pollution. These reductions were more drastic at roadside than railway track site. It might be due to the reason that pollutants emitted by automobile got deposited on leaf surfaces and caused the blockage of stomata. In general height of plant, number of leaves per plant, leaf area, lamina size, petiole size and flower or spikes per plant decreased in plants growing along railway track and roadsides. It has also been reported that plants found in highly polluted area showed abnormal changes in morphological characters as induced by exhaust. These findings were observed by Billen *et al.* (1990), Sharma and Prakash (1991) and Tomar *et al.* (1993) on different plants. To minimize the impact of pollutants, plants might have reduced their leaf structure in the form of destruction of cells or tissues. Sarkar *et al.* (1986) observed the effect of automobile exhaust pollution on *Clerodendron inerme*, *Salanum tovvum* Linn. and *Calotropis procera* (Ait) R.Br. growing along a road carrying dense traffic. Visible injuries caused by pollution were in the form of stunted growth, chlorosis, blackening and drying of leaves and reduced leaf area. Efe *et al.* (1993) suggested that leaf dimensions viz, leaf area, leaf length and leaf breadth were reduced as an adaptation to survive under auto exhaust pollution. The leaves have many stomata on the abaxial and adaxial surface. A sharp decline was recorded in the parameters like length and breadth of guard cells,

size of pore and stomatal frequency in the leaves of polluted plants as compared to control. Reduction in the size of cells of stomata was probably because of the adaptation in the plants in order to struggle with stressed condition of atmospheric pollution. Further the reduction in the pore size and stomatal index may be an adaptation in the plants to minimize the entry of pollutants through stomata. A sharp decline was recorded in all parameters i.e. length and breadth of stomata, size of pore and stomatal frequency etc. in few tree species growing in industrial area in the vicinity of exhaust. So the present finding indicate that the exhaust released from automobiles and diesel engines causes abnormal changes in the various phytosociological characters, seed germination and seedling growth, leaf and stomatal characters of *Datura alba* Linn. Further a detailed study on the effect of air pollution on the medicinal constituents of *Datura alba* Linn. will give us more information regarding the collection of such plants for the preparation of various drugs.

Author's contributions: **Dr. (Mrs.) Sneh Lata** (Reader), contributed in the experimental design, preparation, supervisor of Divya Shah and Poonam and also the corresponding author of the manuscript; **Divya Shah** (Research Scholar), do statistical analysis of the data and final editing of the manuscript and **Poonam** (Research Scholar), performed the experiments and do the calculation in the manuscript.

References

- Agarwal, S., Tiwari, S.L., 1996. Effect of industrial air pollution on leaf area and dry weight ratio and photosynthetic pigment of some tree species. *Environment and Ecology*. 14(4), 818-820.
- Ahmad, K.J, Yunus, M., Singh, S.N., Srivastva, K., Singh, N., Pandey, V. Mishra, J., 1989. Study of plants in relation to air pollution In *A summary of R&D activities of N.B.R.I. Lucknow*. pp 1-11.
- Billen, N., Schatzle, H., Seufert, G., Arndt, U., 1990. Performance of some growth variables and automobile exhaust pollution. *Environmental Pollution*, 68, 419-434.
- Deepa, S., Gavali, J.G., Krishnayya, N.S.R., 2000. Stomatal studies of few tree species growing in industrial area. *Advances in Plant Sciences*. 13(1), 209-212.
- Deepak, S.S., Agrawal, M., 1999. Growth and yield responses of wheat plants to elevated levels of CO₂ and SO₂ singly and in combination. *Environmental Pollution*. 104(3), 411-419.
- Efe, N., Ozbay, O., 1993. Effect of air pollutant sulphurdioxide on the morphology and anatomy of some plants (Maize and soybeans) *Doga Turk Botanik Dergisi* 17(4), 207-214.
- Heck, W.W., Brandt, C.S., 1977. Impact of air pollutants on vegetation: Crops, forests, native. Stern, A.C. (ed.) Air Pollution. *Academic press, New York*.
- Hirano, T., 1994, Studies on the effect of dust on photosynthesis of plant leaves. *Bulletin of university of Osaka prefecture Series-B Agriculture and Biology*. 46, 237-271.
- Iqbal, M.Z., Shafiq, M., Ali, S.F., 1994. Effect of automobile pollution on seed weight and branch length of some plants. *Turkish Journal of Botany*, 18(6), 475-479.
- Iqbal, M.Z. and Siddiqui, A.D., 1996. Effect of autovehicular emission on pods and seed germination of some plants. *Polish Journal of Environmental Studies*. 5(1), 67-69.

- Khan, A.U., Siddique, S, Naz, F., 1995. Effect of automobile exhaust on some tree species lining the Lahore Mall : a case study. *Pakistan Journal of Forestry*. 45(2), 45-51.
- Madhavendra, S.S., Satyakala, G., Jamil, K., 1990. Survey of vegetation in an industrial area. *Indian Journal of Environmental Health*, 32(2), 115-123
- Noland, T.L., Kozlowski, T.T., 1979. Effects of SO₂ on stomatal aperture and sulphur uptake of woody angiosperm seedlings. *Canadian Journal of Forest Research*, 9, 57-62
- Panda, S., 1989. Effect of environmental pollution on physiological aspects of plant. *Indian Journal of Applied Pure Biology* 4, 55-5
- Quadir, N., Iqbal, M.Z., 1991. Growth of some plants raised from polluted and unpolluted seeds. *International Journal of Environmental Studies*. 39 (1-2), 95-99
- Sarkar, R.M., Banerjee, A., Mukerjj, S., 1986. Acceleration of peroxidase and catalase activities in leaves of wild dicotyledonous plants as an indicator of automobile exhaust pollution. *Environmental Pollution (series A)*, 42, 289-295.
- Sharma, T.K., Prakash G., 1991. Effect of sulphur dioxide on *Lycopersicon esculentum*. *Journal of Indian Botanical Society*, 70, 201-205.
- Suhulter, R.E., 1962. The role of ethnobotanist in the search for new medicinal plants. *Lloydia* 4, 257-266.
- Thukral, A.K., Kaur, P., 1987. Effect of some trace elements of polluted waters on the germination of *Cyamopsis tetragonoloba* taut. *Indian Journal of Ecology*. 14(2), 180-185.
- Tomar, Y.S., Gupta V., Prakash G., 1993. Assessment of growth, yield and biochemical components in *Abelmoschus esculentus* Moench cv. Pusa makhmali fumigated with sulphur dioxide. *Journal of Indian Botanical Society* 72, 119-126
- Trivedi, M.L., Singh, R.S., 1990. Effect of air pollution on epidermal structure of *Croton bonplandianum* Baill. *New Botanist* 17(34), 225-229