Int J Pharm Bio Sci 2013 Jan; 4(1): (B) 755 - 759

Research Article **Environmental Science**

International Journal of Pharma and Bio Sciences **ISSN 0975-6299**

EFFECT ON GROWTH PARAMETERS OF BRINJAL (SOLANUM MELONGENA L.) AFTER EXPOSURE OF CEMENT DUST

ENESPA* AND S. K. DWIVEDI

Department of Environmental Science, Babasaheb Bhimrao Ambedkar University, Lucknow-226025, U.P., India

ABSTRACT

The effect of cement dust on the growth parameters of brinjal (*Solanum melongena*) was studied. The cement dust (2 g/plant) exhibited both inhibitory and promotory effects on different growth parameters of the *S. melongena.* The decrease in the number of leaves (37.19 and 62.28%), leaf area (57.93 and 57.26%), root length (48.21 and 56.75%), shoot length (27.27 and 38.98%), plant circumference (31.56 and 54.93%), dry weight of leaves (60.06 and 76.95%), dry weight of plant (56.65 and 85%), root/shoot length ratio (28.54 and 32.19%), specific leaf weight (5.55 and 46.43%) and an increase in specific leaf area (-4.32 and -85.75%) in cement dust treated plants. However, leaf area ratio (3.33%) and leaf weight ratio (7.52%) decreased after 45 days of seedling growth as compared to control. But, after 65 days of seedling growth, leaf weight ratio (-53.66%) and leaf area ratio (-185.42%) were increased as compared to control.

KEYWORDS: Cement dust, air pollution, seedling growth, *Solanum melongena*.

ENESPA
Department of Environmental Science, Babasaheb Bhimrao Ambedkar University, Lucknow-226025, U.P., India

INTRODUCTION

Air pollution is a major problem in modern society. In the recent past, air pollutants were responsible for vegetation injury and crop yield losses[11]. All combustion process release gases and particles into the air which include toxic metals, organic molecules, radioactive isotope, soot particles and oxides of sulphur, nitrogen and carbon[1]. These pollutants caused injury and damage to plants in a number of ways[9, 23, 8]. These pollutants include various gases and tiny particles or particles that can harm human health and damage the environment. The interaction between plants and different types of pollutants has been investigated by many authors. Most studies on the influence of environment pollution focus on physiological and ultra structural aspects[2]. Increased concentrations of the above pollutants and also cement dust causes progressive reduction in the photosynthetic ability of leaves, closure of leaf stomata, inhibited pollen germination and mainly, reduction in growth and productivity of plants[4]. More recent researches have shown that cement dust decreased the growth, productivity and concentration of chlorophyll in a number of annual non-leguminous crops[22, 18, 15]. Many effects of cement dust have been studied on conifers growing in Central European forests[14]. The harmful effect of cement dust on plant characteristics have been also studied [16, 7]. A long term impact of high dust pollution from a cement industries on growth, carbohydrate content and nutrient composition were studied in 6 year old Norway spruce (*Picea abies*), white spruce (*P. glauca*), black spruce (*P. mariana*), scots pine (*Pinus sylvestris*) and Douglas Fir (*Pseudotsuga menziesii*) planted in field experiment[16]. It has been observed that rice in the polluted area displayed decreased plant growth, reduced accumulation of phyto-mass and reduction in grain yield as compared to controls. Grain quality and soil properties also suffered in the polluted area[20,10]. Cement dust had a significant effect on the growth and structure of some plant species compared with non polluted plants.Very little information is available in the literature on the effect of cement dust on vegetable plants. Therefore, the present study was undertaken to find out the effect of cement dust on morphological parameters of brinjal (*S. melongena* L.).

MATERIALS AND METHODS

The effects of cement dust (2 g/ plant) on the growth of brinjal (*S. melongena L.)* were studied in the garden of the Department of Environmental Science, Babasaheb Bhimrao Ambedkar University, Lucknow. Seedlings were obtained from the randomly grown seeds in small pots filled with loam soil (2:1; fine sand and FYM). The cement dust (Ca_3SiO_5, 50-70%: Ca_2SiO_4, 15-30%: $Ca_3Al_2O_4$, 5-10%:$Ca_4Al_nFe_{2-n}O_7$, 5-15% and 3-8% oxides of calcium and magnesium) at 2g/plant was spread by bulb sprayer or duster 4 oz (Centro) on the treated plants, twice a week up to 6 weeks. After every week, the position of the pots was changed for obtaining random sampling. Three replicates were maintained for each treatment and irrigation was provided by tap water. At the end of the experiment, plants were uprooted carefully from pots and were washed under tap water.

(i)Plant growth analysis

Plant growth parameters i.e. number of leaves, leaf area (cm^2), root and shoot length (cm), plant circumference (cm), dry weight of leaves (g), dry weight of plant (g), root/shoot length ratio (cm cm^{-1}), specific leaf area (cm^2 g^{-1}), specific leaf weight (g cm^{-2}), leaf weight ratio (g g^{-1}), leaf area ratio (cm^2 g^{-1}) were measured at two stages i.e. 45 and 65 days after sowing (DAS). Ten plants of uniform size were selected from each of the control and treatment pots for growth analysis. Plant samples were separated into stem, root and leaves and their leaf area was measured by plotting the plucked leaves on graph paper and area was calculated. Dry weight of the plant parts was obtained by placing the plant material in an electric hot air oven at 70^0C for two days. The leaf area ratio (LAR) and specific leaf weight (SLW) were calculated using the formula as given by Gardner[5]. Data were statistically analyzed by the one-way ANOVA method.

RESULTS AND DISCUSSION

The data (effect of cement dust) revealed that with respect to the number of leaves, root length and shoot length in treated plant were decreased up to 37.19 , 62.28% (significant at 0.01%), 48.21, 56.75% (non-significant) and 27.27, 38.98% (significant at 0.01%) as compared with control. The leaf area (cm^2) decreased up to 57.93%, 57.26% (non significant), plant circumference (cm) decreased up to 31.56, 54.93% (significant at 0.01%) and leaf dry weight (g) decreased up to 60.06 and 76.95% (significant at 0.01%). The plant dry weight (g) decreased up to 56.65, 85% (significant at 0.01%), root/shoot length ratio (cm cm^{-1}) decreased up to 28.54, 32.19% (not significant) and specific leaf area (cm^2 g^{-1}) increased up to -4.32, -85.75% (significant at 0.01%). The specific leaf weight(g cm^2) decreased up 5.55, 46.43% (significant at 0.01%), leaf weight ratio (g g^{-1}) and leaf area ratio (cm^2 g^{-1}) both decreased up to 7.52 and 3.33% after 45 days of seeding growth compared to control. However, after 65 days, the seedling growth increased up to -53.66 and -185.42% (both significant at 0.01%) compared to control (Table 1).

Table 1

Effect of cement dust (2 g/ plant) on different growth parameters of brinjal (S. melongena L.)

Growth parameters	After 45 days		After 65 days	
	Control	Treatment with cement dust	Control	Treatment with cement dust
Number of leaves	14.33±2.08	9.00±1.00 (37.19)*	32.66±2.08	11.66±1.52 (62.28)*
Root length (cm)	34.10± 1.65	17.66 ± 1.52 (48.21)*	34.66± 0.57	14.33 ± 1.52 (56.75)*
Shoot length (cm)	29.33 ± 1.52	21.33± 1.52 (27.27)*	45.33±0.57	27.66 ± 0.57 (38.98)*
Leaf area (cm^2)	170.33 ± 0.57	71.33 ± 1.52 (57.93)*	172.33±0.57	73.66 ± 0.57 (57.26)*
Plant circumference (cm)	2.63 ± 0.05	1.80 ± 0.01 (31.56)*	4.06 ± 0.11	1.83 ± 0.05 (54.93)*
Leaf dry weight (g)	3.18 ± 0.02	1.27 ± 0.01 (60.06)*	9.63 ± 0.01	2.22 ± 0.01 (76.95)*
Plant dry weight (g)	5.56 ± 0.02	2.41± 0.01 (56.65)*	23.4 ± 0.03	3.52±0.01 (85)*
Root/shoot length ratio (cm cm^{-1})	1.16 ± 0.11	0.82 ± 0.06 (28.54)*	0.76 ± 0.01	0.52 ± 0.04 (32.19)*
Specific leaf area (cm^2 g^{-1})	53.56 ± 0.62	55.87± 1.15 (-4.32)*	17.89 ± 0.03	33.23 ± 0.08 (-85.75)*
Specific leaf weight (g cm^{-2})	0.018±0.00	0.017 ± 0.00 (5.55)*	0.056± 0.00	0.03 ± 0.00 (46.43)*
Leaf weight ratio (g g^{-1})	0.572 ± 0.00	0.529 ±0.00 (7.52)*	0.41 ± 0.00	0.63 ± 0.00 (-53.66)*
Leaf area ratio (cm^2 g^{-1})	30.62± 0.21	29.6 ± 0.68 (3.33)*	7.34± 0.01	20.95± 0.08 (-185.42)*

Values shown are the mean ±SD of 3 replicates, significant at p≤0.01

****: Data presented in parenthesis indicates percent increase/decrease.***

Cement dust is injurious to plants growing around the cement factory. The present study indicates that the cement dust pollution has produced an adverse effect on the growth of *S. melongena*. Decrease in dry weight of *S. melongena* was observed as compared to cement dust untreated plants. The damage done by pollution to photosynthesis and respiration in plants can cause decrease in dry matter production. Reduction in the leaf area, reduction in biomass in plants was due to poor growth. Leaf dry matter and specific leaf weight increased with leaf age as found earlier[19]. The values of leaf physiological parameters reported for olive trees[6, 19]. Pollutants can cause reductions in leaf area result in reduced absorbed radiations and subsequently in reduced photosynthetic rate and leaf number may be due to decreased leaf production rate and enhanced senescence, leaf injury, stomatal damage, premature senescence, disturb membrane permeability and reduce growth and yield in sensitive plant species[24]. In the present study, plants grown in polluted site showed reductions in leaf area and petiole length. These results are in agreement with those of Dineva[3], Jahan and Iqbal[13].

The number of leaves, leaf area, dry weight, plant height, plant circumference has decreased in cement treated plants were found greatly affected of *S. melongena*. The decrease in various growth attributes in treated plants could be due to synergistic effect of various pollutants on metabolic processes which inhibits many enzyme systems of plants[23]. In a study in the area around Chunar Cement Factory in Sonbhadra district of Uttar Pradesh, dust deposition, pH of different plant tissues, and epidermal and cuticular traits were determined for *Azadirachta indicia, Cajanus cajan, Eucalyptus citriodora, Delonix regia, Eugenia jambolana (Syzygium cumini), Mangifera indica, Phyleanthus emblica, Morus alba, Thevetia nerifolia, Psidium guajava* and *Ziziphus mauritiana*. Plants growing near the factory were severely affected showing foliar injury symptoms and very poor growth as reported in the present study. Thirty five plant species were classified as sensitive, intermediate or tolerant to pollution and several species which are good collectors of cement dust and are resistant to pollution are recommended for growing in polluted sites[17]. Vegetation is an effective indicator of the overall impact of air pollution. A large number of trees and shrubs have been identified and used as dust filters to check the rising urban dust pollution level[21]. The long term, low-concentration exposures of air pollution produces harmful impacts on plant leaves without visible injury[12]. In summary, plant adaptation to changing environmental factors involves both short-and long term physiological responses.

ACKNOWLEDGEMENT

Financial support provided to senior author under Rajiv Gandhi National Fellowship Scheme is gratefully acknowledged.

REFERENCES

1. Agbaire P.O. and Esiefarienrhe E. Air pollution tolerance indices (apti) of some plants around Otorogun gas plant in Delta State. Nigeria. *J. Appl. Sci. Environ*. Manage, 13(1): 11-14, (2009).
2. Alves E.S.M., Baesso Moura and Domingos M. Structural analysis of *Tillandsia usneoides* L. exposed to air pollutants in Sao Paulo City-Brazil, *Water, Air and Soil Pollut.*, 189(1-4): 61-68, (2008).
3. Dineva S.B. Comparative studies of the leaf morphology and structure of white ash *Fraxinus americana* L. and London plane tree *Platanus acerifolia* Willd growing in polluted area. Dendrobiology, 52: 3-8, (2004).
4. Farmer A.M. The effects of dust on vegetation-A review. *Environ. Pollut.*, 79: 63-75, (1993).
5. Gardner F.P., Pearce R.B. and Mitchell R.L. Growth and Development,

Physiology of Crop Plants. The Iowa State University Press. Ames. pp, 187-208, (1985).
6. Gucci R, Massai R., Casano S., Costagli G. The effect of leaf age on CO2 assimilation and stomatal conductance of field-grown olive trees. *Acta Hort*., 474: 289–292, (1999).
7. Gostin I.N. Air Pollution: Effects on the Leaf Structure of some *Fabaceae* Species. *Not. Bot. Hort. Agrobot*. Cluj, 37 (2): 57-63, (2009).
8. Iqbal M., Mahmooduzzafar F., Nighat and Khan P.R. Photosynthetic, metabolic and growth responses of *Triumfetta rhomboidea* to coal-smoke pollution at different stages of plant ontogeny. *J. Plant Interactions* 5:11-19, (2010).
9. Iqbal M., Srivastava P.S. and Siddiqi T.O. Anthropogenic stresses in the environment and their consequences. In: Environmental Hazards: Plants and People. (eds.) Iqbal, M., P.S. Srivastava and T.O. Siddiqi. CBS Publishers, New Delhi, pp, 1-37, (2000).
10. Joshi P.C. and Swami A. Air pollution induced changes in the photosynthetic pigments of selected plant species. *J. Environ. Boil.,* 30(2): 295-298, (2009).
11. Joshi P.C. and Swami A. Physiologigal responses of some tree species under roadside automobile pollution stress around city of Haridwar, India. Environmentalist, 27: 365- 374, (2007).
12. Joshi N., Chauhan A. and Joshi P.C. Impact of industrial air pollutants on some biochemical parameters and yield in wheat and mustard plants. Environmentalist, 29: 398- 404, (2009).
13. Jahan S. and Iqbal M.Z. Morphological and anatomical studies of leaves of different plants affected by motor vehicles exhaust. *J. of Islamic Academy of Sci.,* 5(1): 21-23, (1992).
14. Lepedus H., Cesar V. and Suver M. The annual changes or chloroplast pigments content in current- and previous-year needles or Norway spruce (*Picea abies* L. Karst.) exposed to cement dust pollution. *Acta Botanica Croatica*, 62: 27–35, (2003).
15. Liu J.L., Du M., Shang K.Y., Chen S.Y., Xu H.B., Xie M.Y. The effects of cement dust pollution on rice, rape and soil. *J. Plant Resources Environ*., 6: 42-47, (1997).
16. Mandre M., Kloseiko J. and Ots K. The effect of cement dust on the growth, content of nutrients and carbohydrates in various organs of five conifer species. *Baltic- Forestry,* 6 (2): 16-23, (2000).
17. Misra J.N., Singh V., Panday M.,Yunus M., Yunus (Ed.), N. Singh and Kok L. J. Evaluation of plants growing around a cement Factory. Environmental stress: indication,mitigation and eco-conservation, 269-283, (2000).
18. Pandey D.D., Kumar S. Impact of cement dust pollution on biomass, chlorophyll, nutrients and grain characteristics of wheat. *Environ. Ecol*., 14: 872-875, (1996).
19. Proietti P., Famiani F. Diurnal and seasonal changes in photosynthetic characteristics in different olive (*Olea europaea* L.) cultivars. Photosynthetica, 40: 171-176, (2002).
20. Rao C.M. and Narayanan A. Growth of rice plants exposed to cement dust pollution. *J. of Res. ANGRAU*, 26(3-4): 11-14, (1998).
21. Rai A., Kulshreshtha K., Srivastava P.K. and Mohanty C.S. Leaf surface structure alterations due to particulate pollution in some common plants. Environmentalist, 30: 18- 23, (2009).
22. Satao R.N., Kene H.K., Nalamwar R.V., Ulemale R.B. Effect of cement dust pollution on growth and yield of cotton. *Ann. Plant Physiol*., 7**:** 73-77, (1993).
23. Singh S.N. and Verma A. Phytoremediation of Air Pollutants: A Review. In: Environmental Bioremediation Technology, S.N. and R. D. Tripathi (Eds.). Springer, Berlin Heidelberg, pp: 293- 314, (2007).
24. Tiwari S., Agrawal M. and Marshall F.M. Evaluation of ambient air pollution impact on carrot plants at a sub urban site using open top chambers. Environmental Monitoring and Assessment, 119: 15-30, (2006).