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CODEN: IAASCA **ORIGINAL ARTICLE**

Impact of Cement industry Pollution on Physio-morphological attributes of Apricot tree (*Prunus armeniaca*) around industrial belt Khrew, Kashmir

Roufur Rafiq* and D M Kumawat
*Research Scholar, School of studies in Environment Management
Vikram University Ujjain, M.P, 456010, India
Cell no. : +91-8821983543 E-mail: roufevs13@gmail.com
Professor & Head, School of studies in Environment Management
Vikram University Ujjain, M.P.456010, India

ABSTRACT
Survival of plants in the vicinity of industrial areas is being threatened by particulates. This study was aimed to know the effect of cement industries dust on various parts of apricot tree growing at different distances from the cement industrial belt Khrew, Kashmir, India. Sampling was done at different distances ranging from 0.5-2.0 kms from the point source. The chlorophyll, carotenoid pigments, pH of leaf wash, pH of leaf extract and leaf size (length) were reduced in dust-exposed plant species as compared to control site Lethapora (13 km away from the cement factories).Increased concentration of cement dust pollutants causes invisible injuries like progressive decline in photosynthetic ability and closure of leaf stomata and thus affect the growth and productivity of apricot tree. Besides the deleterious effects of the dust were expressed by the reduction in size of the leaf, damaged leaf margin and change in colour. Overall study shows that apricot trees growing near cement industries were adversely affected physiologically.
Key words: *Cement dust, Chlorophyll, Pollution, Apricot Tree.*

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INTRODUCTION

Cement industry is one of the most boomed up industry in India. It is second largest cement producer in the world after china. Cement industry is the one of the 17 most polluting industries listed by Central Pollution Control Board. During the last decades, the emission of dust from cement factories has increased alarmingly due to expansion of existing cement plants to meet the requirement of cement materials for construction work. In comparison with gaseous air pollutants, many of which are readily recognized as being the cause of injury to various types of vegetation [1,2], relatively limited studies have been carried out on the effect of cement dust pollution on vegetation especially in Jammu and Kashmir.

Cement dust pollution severely affects the growth and morphology of plants. It might be in the form of visible markings on the foliage such as chlorosis, necrosis, veinal deformities, mottling etc. Ade-Ademilua *et al*., [3] reported a significant reduction in shoot length, total leaf area and dry weight of plants affected by cement dust pollution. A significant delay in germination of seeds which was followed by growth retardation in terms of plant height and leaf area, number of leaves, length of petiole, number of flowers and fruits, fresh and dry weight were also seen by Katiyar *et al.,* [4]. Reduction in growth parameters are due to the cumulative effects of the causal factors on the physiological processes necessary for plant growth and its development [5]. Dust deposition reduces diffusive resistance and increases temperature of leaf, making the tree more likely to be susceptible to drought. It also causes slight decrease in transpiration rate, stomatal conductance while increasing the leaf temperature.

Photosynthetic pigments mainly- chlorophyll and carotenoid contents, are affected by a variety of stress factors. As these are the dominant photosynthetic pigments in green plants and assessment of their concentrations in foliage provide an estimate of potential photosynthetic capability [6,7]. Chlorophyll 'a' is being more severely affected than chlorophyll 'b'. Chlorophyll 'a' is degraded to phaeophytin through

replacement of Mg+2 ions in chlorophyll molecules, while chlorophyll 'b' forms chlorophyllide 'b' through the removal of phytol group of the molecule [8]. All the atmospheric pollutants retained by leaves are transformed inside the plant and affect its photosynthesis and respiration. This damage appears in the form of chlorotic and necrotic lesions at leaves level [9]. Analysis of photosynthetic pigments may provide insight into the physiological status of vegetation [10].

The present study was undertaken with the objective to assess the impact of cement industries dust on the physiological and morphological attributes of Apricot (*Prunus armeniaca*) planted in the vicinity of cement industries in Khrew area of Pulwama district in Kashmir.

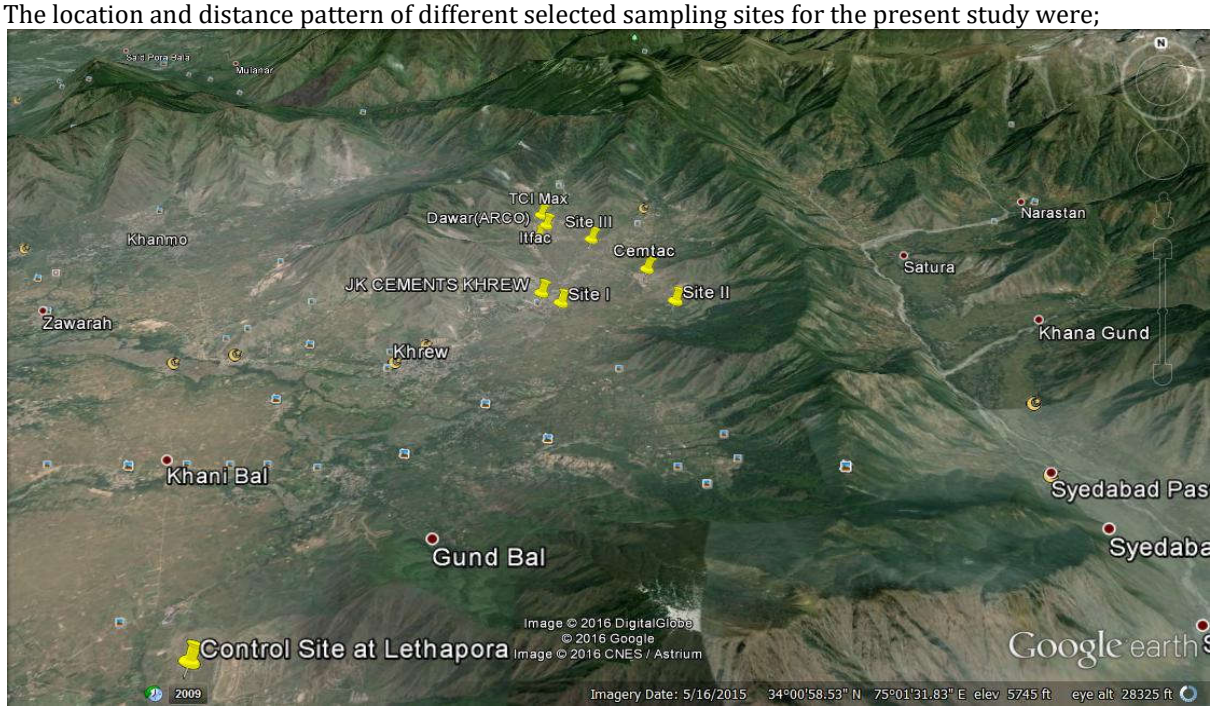
MATERIAL AND METHODS

Study area:

Khrew is a town and notified committee area in Pulwama district in the Indian state of Jammu and Kashmir. Khrew is located at 34º 01 08.11 N and 75º 00 23. 95 E. It has average elevation of 1,650 meters. Khrew is 21km away from Srinagar city and is bounded by Wuyan in the west. Ladhu in the south, Shar-e-Shalli in the south East. While as eastern, North eastern and northern boundaries are formed by Satapokhren, Zantrag, Nagandar and Bathen adjoining foot hill villages of Khrew. It is surrounded by lofty mountains in the north Western, North Eastern and South Eastern directions. The village have a substantial amount of agricultural land covering an area of 1143.01 hectares. The natural vegetation in the study area is generally of herbs and dwarf shrubs. The vegetation on the upper reaches of the northern aspects holds *Pinus wallichiana* as the major cover. Mostly Saffron (*Crocus sativus* L.), Maize (*Zea mays*), Walnut (*Juglans regia* L.), Almonds (*Prunus amygdalus*), Mustard (*Brassica compestris)* and Apricot (*Prunus armeniaca* L.) occupy the major portion of the agricultural land in the vicinity of the cement factories. Industrial activities contributing towards the environmental pollution are Brick Kiln manufacturing, stone crushing and cement manufacturing. Because of improper dust control equipments and at least 40 to 50 stone crushers, 15000 people besides crops are directly affected by the giant cement factories (JK cement a government run enterprise, TCI Max, Cemtac Cements Pvt. Ltd., Itfac Cements Pvt. Ltd., and Dawar (Arco) Cements Pvt. Ltd).

Study Sites:

The location and distance pattern of different selected sampling sites for the present study were;



Site-I: This site was located at a distance of 0.5 km from the J&K Cement factory in the southeast direction, with dense human population. The geographical coordinates of the site were 34º 01 48.76 N and 75º 01 12. 38 E and the altitude of the site was 1730 m above mean sea level. The area is covered with dwarf herbs and grasses with some scattered shrubs.

Site-II: This site was located at a distance of 1.0 km from the Cemtac Cement factory in the northeast direction. The geographical coordinates of the site were 34º 01 56.44 N and 75º 02 05. 22 E and the altitude of the site was 1794 m above mean sea level.
Site-III: This site was located at a distance of 1.20 km away from TCI Max, 0.85 km from Dawar, 0.85km from Itfac, 1.85km from JK cements and 1.25 km from Cemtac cement factories towards northwest side at an altitude of 1858m AMSL with geographical coordinates 34º 02 52.22 N and 75º 01 17.45 E. This site is located in the middle of the industries and receives lot of cement dust released from the above said industries. This site was chosen for studying the cumulative effect of factories. Vehicular emission also added to the pollution level. Various horticultural trees and agricultural crops, of this site are exposed to heavy particulate pollutants.
Site-IV: This site was taken as a Reference (Control) site at Lethapora, Pampore at a distance of 13kms far away from the industrial belt Khrew. The area remains under saffron and paddy cultivation with scattered horticultural orchards and it apparently receive least cement dust from the factory or any other kind of source. The geographical coordinates of the site were 33º 58 15.08 N and 74º 58 57. 87 E and the altitude of the site was 1651 m above mean sea level.
In the present study only Apricot plantations were studied for their response against heavy particulates emitted from cement industries. Collection of samples of vegetative parts of the apricot tree was performed at each site during 2014 and 2015 on seasonal basis .The samples were analysed for Physico-chemical parameters of chloroplast pigment, Carotenoids, pH of leaf wash, pH of leaf extract, Leaf size (cm).Chlorophyll and carotenoids were extracted in 80% acetone and readings were measured at 645,663,510 and 480 nm and calculations were made according to Arnon [11] using absorption coefficient. The leaf wash pH was determined following Pawar *et al.,* [12]. Leaf extract pH was estimated by method recommended by Singh and Rao, [13].Leaf size estimation was carried out using planimeter.

RESULTS AND DISCUSSION:
The impact of cement dust on Chlorophyll pigments and leaf length of Apricot at various study sites around cement industrial area Khrew are given in Table 1. The data reveals that chlorophyll a concentration fluctuated from 0.346 to 0.398mg/gm, chlorophyll b from 0.046 to 0.191mg/gm and total chlorophyll from 0.392 to 0.589 mg/g at site III and at control site in apricot tree. The chlorophyll and carotenoid concentration increases as the age of plant and the distance from industry. The lowest concentration of both (chlorophyll and carotenoid) is found at site III which receives highest dust fall from all industries. Similar results regarding the chloroplast damaged by cement dust on leaf causing reduction in chlorophyll concentration in different plants were reported by Lerman, [15]; Singh and Rao, [16]. The shading effect of such layer could lead to suppression of chlorophyll a synthesis [17, 14].

Table 1. Chlorophyll pigments and leaf length of Apricot at various study sites around c industrial belt Khrew from (2014-2015).

Parameter	Site-I	Site-II	Site-III	Site-IV
Chlorophyll 'a' mg/g	0.357±0.007	0.362±0.004	0.345±0.004	0.397±0.005
Chlorophyll 'b' mg/g	0.051±0.003	0.054±0.0015	0.045±0.003	0.191±0.003
Carotenoids mg/g	0.814±0.004	0.852±0.006	0.795±0.007	0.890±0.008
pH of leaf wash	9.15±0.025	8.72±0.060	9.64±0.121	7.04±0.03
pH of leaf extract	7.61±0.055	7.50±0.404	7.93±0.050	6.53±0.045
Leaf size(cm) (length)	5.4±0.100	5.5±0.020	5.3±0.200	6.1±0.251

Carotenoid pigments found in mature leaves are often not obvious because of the masking presence of chlorophyll. When chlorophyll is not present, as in autumn foliage, the yellows and oranges of the carotenoids are predominant. For the same reason, Carotenoid colours often predominate in ripe fruit after being unmasked by the disappearance of chlorophyll. Significant change was observed in Carotenoid concentration of trees nearest to the cement factories.
pH of leaf wash and leaf extract are important parameters and used as indicators of air pollution in the area.The pH of leaf wash and pH of leaf extract showed an increase in the values i-e., towards the alkanity with maximum value in case of site III, followed by site I ,site II and minium value at the farthest site (site

IV).With increase in cement dust concentration there was a progressive increase in pH of leaf wash and extract.The rise in pH could be due to the formation of hydroxide of almunium in the leaf tissue probably increasing pH of the leaf extract.The leaf length of studied apricot showed a significant decline of 0.8 cm (site III) as compared to control site.The size of apricot tree was fairly smaller, in the close vicinity of the industry as compared to those of the sites away from the source. Cement dust pollution severely affects the growth and morphology of plants. It might be in the form of visible markings on the foliage such as chlorosis, necrosis, veinal deformities, mottling etc. Ade-Ademilua *et al*., [19] reported a significant reduction in shoot length, total leaf area and dry weight of plants affected by cement dust pollution. A significant delay in germination of seeds which was followed by growth retardation in terms of plant height and leaf area, number of leaves, length of petiole, number of flowers and fruits, fresh and dry weight were also seen by Katiyar *et al.,* [18].
In the present study also stunned growth in highly polluted zone and decrease in leaf area could be seen. Overall growth of the test plant was reduced.

CONCLUSION

The present study has shown that the deposition of cement dust has an effect on vegetation characteristics and natural communities that may alter the competitive balance between plant species. The physio- morphological characters of apricot tree were studied at different distances from the industry and compared with the control plant. The data obtained from different sites indicate that chloroplast pigment, carotenoids, pH of leaf wash, pH of leaf extract, Leaf size were affected by cement industry pollution. The apricot trees growing in control site were healthy than the trees growing near the cement factories. As the distance from the industry increases the plant growth also improves. Exposure to particulate deposition may alter plant growth and its physiology without physical damage to the plant. Moreover, accumulation of dust particulates on studied plant leaves could be a major problem in their production. It was proposed that the pigment content of the light harvesting complex is an important aspect related to the tolerance of plants to dust pollution. Chlorophyll content is essential for the photosynthetic activity and reduction in chlorophyll content has been used as an indicator of air pollution since it is fairly sensitive to air pollutants.Very fine particles(<1.0μm) present in cement dust closes the stomata thereby interfering with gaseous exchange resulting in detrimental changes in the leaf physiology. In general, the growth and development of plant was found to be affected negatively by cement dust, which may be due to the presence of different toxic pollutants in the cement dust.It clearly indicates that the cement industry pollution affect the photosynthetic activity and chlorophyll content adversely.Therefore, it is suggested that adequate green belt should be developed in and around the industrial area khrew in order to restrict spreading of cement dust.

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