



Research Paper

Response of Almond tree (*Prunus amygdalus*) against Particulate Pollutants around industrial belt Khrew, Kashmir, India

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Abstract: This study was aimed to know the impact of cement industries dust on various parts of Almond 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, Carotenoids, pH of leaf wash, pH of leaf extracts and leaf size (length) were reduced in dust-exposed plant species as compared to control site Lethapora (13 km away from the cement factories). Survival of plants in the vicinity of industrial areas is being threatened by particulates. Increased concentration of cement dust pollutants causes invisible injuries like progressive decline in photosynthetic ability and closure of leaf stomata and thus affects the growth and productivity of Almond. 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 Almond trees growing near cement industries were adversely affected physiologically.

Keywords: Cement dust, Chlorophyll, Pollution, Almond.

INTRODUCTION:

Kashmiri almonds are known for their superiority of taste and are very popular with the consumers. Its trees are the first blooming fruit trees and an enchanting sight that lends glamour to the spring in Kashmir, almond, known as the king of nuts among dry fruits, is a highly nutritious food. It is rich in almost all the elements needed by the body. It is an effective health-building food, both for the body and mind and a valuable food remedy for several common ailments. Almond is a complete food with different types of healthy fats, minerals, vitamins, calcium, carbohydrates, proteins, fibers and other health secrets in it, which can help us fight various diseases right from the problem of memory loss to the Siemans loss. Almonds help reducing the risk of heart disease, diabetes, and some chronic diseases. It also rejuvenates the skin, gives it a glow and helps us in looking younger. If almond paste is regularly applied

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to the skin, it helps in preventing wrinkles, pimples, black heads etc. and prevents skin from getting dry.

The almond cultivation in India is restricted to selected hilly areas of Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh. The J&K government has formulated almond development program for bringing additional 12000 hectares more area under its cultivation in a phased manner. Presently, an area of 18870 hectares is under almond cultivation with total production of 9672 metric tones. The experts have suggested strategies for increasing almond fruit set and artificial pollination with bouquets. The research has indicated that the bouquets increased the fruit set and the affected decreased rapidly with the distance even with a tree. The pollen germination tests revealed no differences between one day old flowers from cut or intact limbs. Then the bud pollination was found to be very effective as it would accept pollen from the same flower and would overcome self- compatibility and highest fruit set was 5.66 per cent in Jammu and Kashmir.

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 (Gupta and Mishra, 1994; Iqbal and Shafiq, 2001), 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.*, (2008) 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.*, (2015). 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 (Schutzki and Cregg, 2007). Dust deposition reduces diffusive resistance and increases temperature of leaf, making the tree more likely to be susceptible to drought (Farmer 1993). 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 (Gitelson and Merzlyak, 1996; Carter, 1998). 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 (Rao and Le Blane, 1966). 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 (Landis and

Yu, 1995). Analysis of photosynthetic pigments may provide insight into the physiological status of vegetation (Moran *et al.*, 2000).

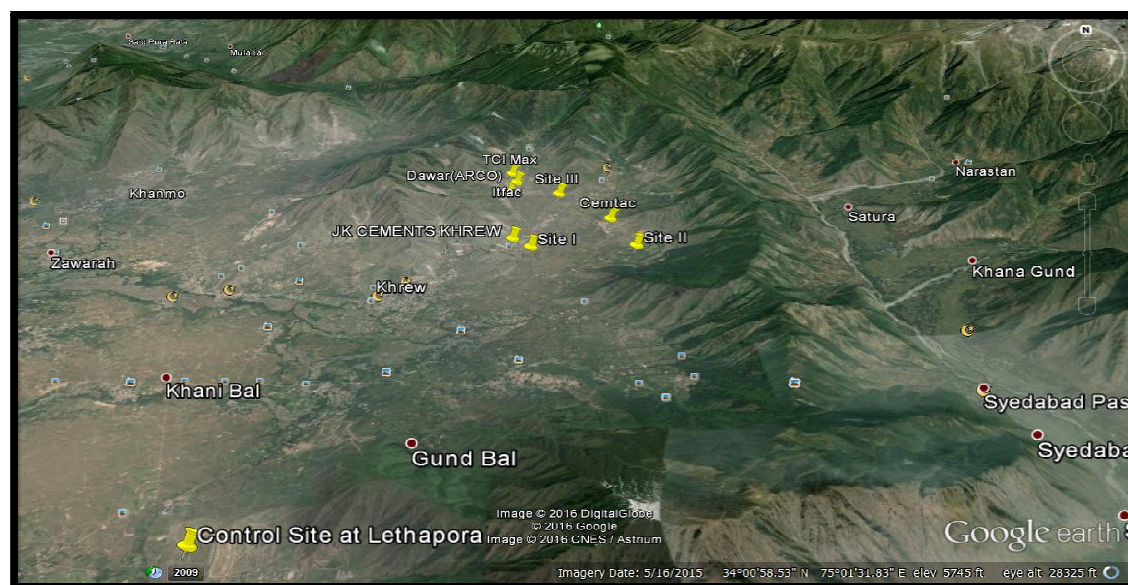
The present study was undertaken with the objective to assess the impact of cement industries dust on the physiological and morphological attributes of Almond tree (*Prunus amygdalus*) planted in the vicinity of cement industries in Khrew area of Pulwama district in Kashmir.

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 34° 01'08.11" N and 75° 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 has 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 campestris*) 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 JK Cement factory in the southeast direction, with dense human population. The geographical coordinates of the site were 34° 01'48.76"N and 75° 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 34° 01'56.44' N and 75° 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 (Arco), 0.85 km 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 34° 02' 52.22' N and 75° 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 33° 58'15.08' N and 74° 58' 57. 87' E and the altitude of the site was 1651 m above mean sea level.

In the present study only Almond trees were studied for their response against heavy particulates emitted from cement industries. Collection of samples of vegetative parts of the Almond tree was performed at each site during 2013 to 2015 on seasonal basis .The samples were analysed for Physico-chemical parameters of chloroplast pigment, pH of leaf wash, pH of leaf extract, Leaf size (cm).Chlorophyll and Carotenoid were extracted in 80% acetone and readings were measured at 645,663,510 and 480 nm and calculations were made according to Arnon (1949) using absorption coefficient.

The leaf wash pH was determined following Pawar *et al.*, 1988. Leaf extract pH was estimated by method recommended by Singh and Rao, 1983. Leaf size estimation was carried out using planimeter.

RESULTS AND DISCUSSION:

The impact of cement dust on Chlorophyll pigments and leaf length of Almond tree at various study sites around cement industrial area Khrew are given in Table 1. The data

reveals that chlorophyll a concentration fluctuated from 0.159 to 0.298 mg/gm, chlorophyll b from 0.104 to 0.46 mg/gm at site III and at control site in Almond 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, (1972); Singh and Rao, (1978). The shading effect of such layer could lead to suppression of chlorophyll a synthesis (Peirce, 1910 and Czaja, 1962).

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 alkalinity with maximum value in case of site

III, followed by site I, site II and minimum 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 aluminium in the leaf tissue probably increasing pH of the leaf extract. The leaf length of studied almond tree showed a significant decline of 0.8 cm (site III) as compared to control site.

Table 1. Mean Impact of Cement dust deposition on the Chlorophyll pigments, biomass and leaf length of Almond tree at various study sites around Cement industrial belt Khrew from (2013-2015)

Parameter	Site-I	Site-II	Site-III	Site-IV
Chlorophyll 'a' mg/g	0.186±0.005	0.193±0.004	0.159±0.009	0.298±0.007
Chlorophyll 'b' mg/g	0.106±0.005	0.108±0.006	0.104±0.003	0.46±0.05
Carotenoids g/g	0.108±0.008	0.116±0.006	0.103±0.003	0.193±0.004
pH of leaf wash	9.14±0.03	8.326±0.050	9.20±0.075	7.32±0.101
pH of leaf extract	7.31±0.036	7.05±0.036	7.463±0.105	6.94±0.05
Leaf size(cm)(length)	5.56±0.305	5.90±0.080	5.4±0.264	6.29±0.364

The size of almond 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.*, (2008) 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.*, (2015): Rafiq and Kumawat (2016).

In the present study also stunted growth in highly polluted zone and decrease in leaf area could be seen. Overall growth of the almond tree 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 Almond 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, pH of leaf wash, pH of leaf extract, Leaf size was affected by cement industry pollution. The Almond 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 tree 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 almond trees were 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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