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Effect of atmospheric pollutants on lichens in different zones in Ranchi city

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Abstract : Atmospheric pollutants concentration effects lichen. The presence of lichens on the bark of trees and on the walls at all the three sampling sites indicates that the level of concentration of gaseous pollutants is not alarming.

Key words: air pollution, lichens, cuticle, stomata

INTRODUCTION

Lichens comprise a unique group of plant that consists of two unrelated organism, a fungus and an alga, growing together in a close symbiotic association. Lichens have long been recognized as sensitive indicators of environmental conditions. The decline of lichens around city centers is attributed to air pollution.

Lichens lack a protective cuticle and stomata. They have direct dependence on atmosphere for nutrients (poikilohydrous nature), longevity, stability, and perennial condition of thallus. They have high degree of sensitivity to changes in substrate pH and pollutants which makes them ideal organisms to study the impact of air pollution. Lichens are good accumulators of many elements, particularly heavy metals and radio nuclides.

Some sensitive lichen species develop structural changes in response to air pollution including reduced photosynthesis and bleaching. Pollution can also cause the death of lichen algae, discoloration and reduced growth of the lichen fungus, or kill lichen completely. Hence the species of lichens present in a location and the concentration of pollutants measured in those lichens can tell us a lot about air quality.

Lichens are the plants that occur in most adverse conditions of climate and substrate and like little sponges take up everything that comes their way, including air pollution. They are, therefore, suitable for use as pollution monitors. Extensive work has been done in the temperate Europe and North America for assessing the usefulness of lichens as bio-indicators of atmospheric pollution. A qualitative scale has also been constructed on the basis of frequency cover of lichens for the estimation of air pollution. It has been found that pollutants consisting of SO_2, NO, NO_2, O_3, etc. have different effects on the lichen species.

Importance of lichens

Lichens are universally distributed organisms occurring in varied climatic conditions ranging from the poles to the tropics in earth. They may look like crust, spreading rapidly over the surface (crustose lichens) or leafy and loosely attached to the surface (foliose lichens)

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and branched and shrubby, hanging from tree twigs or branches, with a single attachment (fruticose lichens). A lichen is a composite organism that arises from algae or cyanobacteria (or both) living among filaments of a fungus in a symbiotic relationship. The combined life form has properties that are very different from the properties of its component organisms. The study of lichen remains quite neglected throughout the world, through they together with mosses form dominant organisms in ecosystem covering over 10% of the earth terrestrial habitats, particularly at higher elevations. Lichens with cynobacterial blue green symbionts, contribute significantly for forest nitrogen fixation.

The sensitivity of lichens to air pollution is reflected in various ways such as decline in diversity, absence of sensitive species, and morphological, anatomical and physiological changes. The high sensitivity of lichens is related to their physiology and morphology. The stronger the dependency of the mycobiont on the photobiont, the more sensitive the lichen is to air pollution. The photobiont upon exposure to air pollution may use metabolic energy for repair of its cellular structures that would otherwise be used for maintenance of its photosynthetic activity. It, thus, leaves less metabolic energy available for the mycobiont. The alteration of the balance between the photobiont and mycobiont can lead to the breakdown of the symbiotic association. Therefore, lichen decline may result not only from the accumulation of toxic substances, but also from altered nutrient supplies that favor one symbiont over the other.

The quality of air quality is getting worse all over the world. The presence and absence of lichens and different species around different pollution sources has been used for problems connected to air pollution.

Sampling sites

Ranchi city is located at 23.23^{0}N latitude & 85.23^{0}E longitude and around 654 meters above sea level in the plateau of Ranchi. The total area covered by Ranchi urban agglomeration is 35 sq. km. The population is about 846, 454.

Sampling location:

Ashoknagar - Residential zone,
Kantatoli - Commercial and Residential zone
Tupudana - Industrial zone

The Sampling and identification of Lichens

The lichen specimens were collected with chisel and hammer. The host tree type, location of host tree, and location of the lichens thallus (on trunk, branch, twigs or leaves, soil or rock substratum) together with other ecological notes were recorded. The collected specimens were investigated for taxonomic purposes.

RESULTS

Both crustose and foliose variety of lichens was seen at the sampling sites. Table below lists the types of substratum where lichens were observed at the three sampling sites.

Table: Types of substratum where lichens were observed at the three sampling sites.

Sl. No	Type of substratum	Kantatoli	Ashoknagar	Tupudana
1.	Bark of trees	Present	Present	Present
2.	Leaves of trees	Absent	Absent	Absent
3.	Wall both plastered and unplastered	Present	Present	Present
4	Soil	Absent	Absent	Absent
5.	Rock	Absent	Present	Present

Effect of Air Pollution on Lichens

The presence of lichens on the bark of trees and on the walls at all the three sampling sites indicates that the level of concentration of gaseous pollutants is not alarming.

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