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### **A Review of on Pollution Bioindicators**

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#### **ABSTRACT**

Pollution is an undesirable change in the physical, chemical or biological features of air, soil and water which causes harmful effects on biological life and produces many dangerous effects on biota. Qualitative analysis of the harmful effect of pollution on environment is indicated by the taking consideration of the by a group of living organism which are act as bioindicators against pollution. The various types of the indicators are useful to indicate the progressive effects of the different types of the pollutants on the environment. The bioindicators are very sensitive to pollution. Any small amount of change in the environment, which is caused by pollutants, is greatly indicated by the bioindicators. They are very sensitive towards pollution. The quality of an ecosystem can be estimated by the these bioindicators as they play a key-role in the examining the changes. The microbes, plants, animals, bacteria, biotic communities show different levels of sensitivity toward the pollutants and these are successfully employed as bioindicators to find and predict environmental pollution in a sensible and timely manner.

**KEYWORDS:** *Bioindicators, Indicator Species, Environmental Pollution*

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## **INTRODUCTION**

Bioindicator means a living unit or group of organisms which is a part of the ecosystem that displays or impart the information of the environment by Parmar et al<sup>1</sup>. In general, the bioindication method was used from the ancient times as well as the present time. In the past most used living organisms as bioindicator was lichens and it was used as bioindicator for the environmental pollution. Also, now various organism are now used for the current and future tasks of bioindication against pollution by Wiłkomirski<sup>2</sup>. Considering this definition, the current study is aimed to select many different types of bioindicators which are microorganisms, lichens, animals, or plants. According to Posudin<sup>3</sup>, they produce some molecular signals under certain environmental conditions which helps to find out alterations in given environmental system. The Plato was the first to cite the effect of human activity's as an environmental indicator on fruit tree harvest by Rapport<sup>4</sup>. According to the Dale and Beyeler<sup>5</sup>, biological indicators should represent the compositions of the ecological system like structure, function, and nature and to find out early warning signal of an environmental pollution by ecological indicators there are three main problems to calculate the data. (1) Monitoring programs (2) Choice of ecological indicators (3) Management and monitoring programs often lack scientific rigor. Lindenmayer et al<sup>6</sup>, states that the we must find out way or method the relationships between potential indicator species and biodiversity; which are still not well recognized. There should be carefully designed studies, which are necessary to find out relationship between a bioindicator and its role in maintaining the its related ecosystem. The conservation of biological diversity has become one of the important goals of managing forests in an ecologically sustainable way. According to the Mueller<sup>7</sup> the complete monitoring of the ecosystem is possible by bioindicator, if simple data related to bioindicator is available. Bioindicator are those organisms which reflects the qualitative information about the environmental characteristics of a place and on the other hand the biomonitors are the organisms which shows the quantitative information about an environment. As the subjective knowledge increases about the bioindicators there is also increase in knowledge of the complexity and dynamic structure of ecosystem by Markert et. al<sup>8</sup>. According to the Pratt and Crains<sup>9</sup> those living organism could become indicator species which can be examined easily from their habitat in an ecosystem by Landres<sup>10</sup>. Bioindicators measuring procedures can easily assessed the effect of external factors on the ecosystem, Markert<sup>11</sup>. The process of monitoring the ecological changes is directly related to the human future. We are totally dependent on the biological productivity of the planet. As we know that biological indicator species is sensitive to alternations. Its detections of the single population of the bioindicator is more useful and cheaper method in monitoring environment pollutants by Spellerberg<sup>12</sup>. Bioindicators tells the effects of the

pollutants from the starting point and are useful in predicting the level and degree of pollutants by Pai<sup>13</sup> and Verma<sup>14</sup>.

The various living organisms like bacteria, fungi, plants, animals and other biotic communities can be used as a bio tool for assessing the various degrees of sensitivity toward pollution and hence can act as bioindicators in a timely way by Ali<sup>15</sup>. Whereas various physico-chemical and biological monitoring programmes can be used to collect the pollution sensitive data by Melamed<sup>16</sup>.

## BIOINDICATOR OF AIR POLLUTION

The plant which is used for indicating the air quality of a given local ecosystem is called as the "Pollution Indicator Plant." The indicator plant consists of chambers, which are used to trap the particulate matter and having toxin removal capacity with the help of filters. The bioindicator plants are specific in sensitivity towards specific types of toxins. Their response is very quick or prompt to selected types of toxins and they show visible adverse effects of toxins by their foliage symptoms also. They show responses towards pollutants i.e. toxins (from low to high range) symptoms. They are cheap i.e. cost-effective models to demonstrate the level of pollutants (toxins) in an ecosystem. The various plants which are used as bioindicators are given below.

### 1. Algae

Algae is normally used to handle and act as a bioindicator against air and water pollution. Aerial or subaerial algae both types are used as bioindicators and are having species-specific relations with the pollution. They are having much sensitivity towards the pollution as compared to the higher plants which are acting as bioindicators. Algae provides a much quicker physiochemical response as compared to the higher plants. Almost all types of algae (lithohabulous, corticophilous and epiphytic algae) blue green algae and diatoms are suitable bioindicators and some of the lower plants and ferns can be used also as biomonitors. In this case two types of species could be used; one type is species that is pollution tolerant and the second type is the pollution sensitive species. Also, in this biomonitoring both types of i.e. aerial as well as subaerial habitats are used. Some of them are *Chlorella*, *Chlorococcum*, *Chroococcus*, *Chlorosarcinopsis*, *Trebouxia*, *Gloeocystis*, *Pleurococcus*, *Oscillatoria*, *Chlorohormidium*, *Stichococcus*, *Chlamydomona*, *Gloeocapsa*, *Nostoc*, *Scytonema*, and *Schizothrix* and diatoms- *Navicula* and *Nitzschia*.

### 2. Tulsi

It is a very sensitive plant toward pollution. A slight change in the environment's pollution is detected by this plant. It can be used as a bioindicator against air pollution caused by automobiles. It can also be useful for finding the increased level of nitrogen and sulphur dioxide in a given atmosphere.

### 3. Tobacco

It is used as bioindicator to check the level of the ozone. In this method tobacco seedlings are used along with ozone sensitive and ozone resistant variety. They are then raised (up to 10 days old seedling stage) in the controlled environment to check the ozone pollution level.

### 4. Moss

The famous moss for calculating air pollution and act as a bioindicator is the *Tillandsia usneoides*. It is commonly called as Spanish moss, is a close relative of the plant pineapple (order *Bromeliales*, family *Bromeliaceae*, genus *Tillandsia* and species *usneoides*). It is an epiphyte, (plant which absorbs moisture and nutrients from the air.). Its body is covered by thin scales which are called as trichomes that cover the whole plant. These trichomes or scales play an important role in the absorption of moisture and nutrients from the air. Air pollutants are absorbed by this Spanish moss *T. usneoides*. It is active bioindicator against the acidic air and most harmful pollution. An experiment was conducted at two stages in first stage polluted air sample was taken from the Houston and then checked the air pollutants from this by applying gas chromatographic technique. In the second phase polluted air was put in an Environmental Study Chamber (ESC) along with Spanish moss. It was closed chamber and observed that most of the pollutants were absorbed by the trichome or scale of the moss.

### 5. Herbs and Grasses

As compared to shrubs and trees the grass and the herbs are more sensitive towards the pollution. They show Crown die-back disease due to increase in the pollutants like HF, NO<sub>2</sub>, SO<sub>2</sub>, and HCl. Death of tree is also there due to increase in the above said pollutants.

### 6. Lettuce plant

These plants are well known for its bioaccumulation for trace element pollution. They were raised in the greenhouse plant under specific condition to check the air pollutants

### 7. Lichen

Lichen is used as a bioindicator against pollution. Its growth and health are used to assess many types of air pollutants. This bioindicator is a symbiont of algae and fungi. These living organisms are used as an instrument for assessing sulfur dioxide levels in given air. Also, they are cheap bioinstrument and give quick results against pollution. Lichens are very useful in forestry to find the site of conifer transplantation. Since lichens are very sensitive towards sulfur dioxide these trees are also very sensitive toward the sulfur dioxide levels. As increase in the sulphur dioxide level reduces the germination and growth of lichens. So is the case with conifers also. Some specific lichen

like *Xanthoriacandelaria*, *Xanthoria elegans* etc. are used as bioindicators against heavy metal pollutant like Lead, Chromium, Copper, Cadmium, Nickel. These are released from the vehicle along the roadside. So above species of lichen are good bioindicators of roadside pollution.

### 8. Pine tree barks and needles

In this study Australian pine (*Pinus nigra*), Italian stone pine (*Pinus Pinea L.*) and Turkish red pine (*Pinus brutia Ten.*) are used against pollution. Pine tree bark and needle acts as bioindicator for pollution of various places highway, urban or industrial. This bioindicator is used to detect various degree concentration of the heavy metal pollution like Mercury, Nickel, Lead and Chromium etc.

### 9. Spider

Some of spider species's web (like *Achaearaneatepidariorum* and *Araneusventricosus* ), pollution activity assessed by Xiao<sup>17</sup> and According to him they are useful bioindicator against heavy metal pollution (Mercury, Nickel, Lead and Chromium etc.). These webs are at as efficient trapping system for air borne pollutants, which are prevalent in the urban areas.

### 10. Pigeons

This bird act as a good bioindicator of air pollution. Heavy metal pollution (Mercury, Zinc and Lead) can be detected in its blood sample, liver sample and lung and in kidney sample etc. The damage detected in above sample was in the form the DNA damage by Pauline<sup>18</sup>.

## BIOINDICATOR OF SOIL POLLUTION

The soil pollutants are of various types like phosphates, nitrites, nitrates, sulfates and manmade (anthropogenic) pollutants.

### 1. Biological material (grass, bark, pine needle, leaves)

Some of biological material like grass, bark, pine needles and leaves are best bioindicator against pollution. These can be used to assess the degree of contamination and its relative source.

### 2. Fungi and Bacteria

Many species of fungi and bacteria are act as bioindicator. the main fungi species used as bioindicator are *Aspergillus sp.*, *Trichoderma sp.*, *Fusarium sp.*, and *Rhizoctonia sp.* The bacterial bioindicator specie belong to the *Bacillus species*. The population of above fungi and the bacterial species in the soil sample act as the bioindicator against heavy metal pollution.

### 3. Macro invertebrates of soil

Some of the invertebrates of soil like (Oligochaeta, Hymenoptera, Dipetra, Arachnida etc.) are acting as bioindicators of heavy metals pollution. As soil invertebrate gives direct response to

pollution caused by heavy metals. Among soil species there is a enormous invertebrate biomass is formed of earthworms by Haeba et al.<sup>19</sup>. Earthworm also as bioindicator of soil pollution.

#### 4. Algal species

The main algal species act as bioindicator *Hormidiumflaccidum*, *Chlorella vulgaris* and *C. pyrenoidosa*, etc by Hosmani<sup>20</sup>. There is change in number and frequency of occurring the algal species if there is slight change in the physical and chemical factors nature of soil. Alters the composition of algal flora. Soil pollutants are minerals, nitrates, nitrites, sulfates, phosphates, anthropogenic pollutants.

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