



ISSN : 0973-7057

Environmental management by air purifying plants

Madhuri Kumari Das*

University Department of Zoology, Ranchi University, Ranchi, Jharkhand, India

Received : 13th November, 2017 ; Revised : 28th December, 2017

Abstract: In the race of development humans have become indifferent towards their nature which has become the reason of environmental equilibrium disturbance, due to which environmental management came into existence which includes the management of all environmental components like air, water, soil, flora, fauna etc. Air is a component which we can't limit to a certain area like water or land thus the pollution in it is most likely to be spread very easily. In some cases it has been found that the air in a close compact building is worse than the air outside due to the presence of certain carcinogenic chemicals that are used in the manufacturing of synthetic material, paints, dyes, furniture wax etc. These chemicals are benzene, formaldehyde, trichloroethylene etc. which may cause cancer, asthma, allergies and the sick building syndrome (SBS). The very famous "NASA CLEAN AIR STUDY" was conducted by the NASA in order to keep astronauts healthy in space and long term space habitation that performed by scientist Bill Wolverton and co-workers and at the end of the study they concluded that, there are some plants in nature that can remove the toxins very efficiently in a very less duration of time eg: *Sansevieria trifasciata*, *Chlorophytum comosum*. So despite of using costly air purifiers these air purifying plants can be the best and cheap alternative to get clean and pure air.

Keywords: Sick building syndrome (SBS), NASA clean air study, Bill Wolverton, *Sansevieria trifasciata*, *Chlorophytum comosum*.

INTRODUCTION

Earth is the most beautiful planet which is blessed by the life and the nature but due to the greed of the superior organism of the planet the system is destroying, the real forest is being replaced by concrete jungle, the ocean is being replaced by the venomous pollutants and air is being substituted with toxins. Keeping all these in mind the Environmental management has become the need of today's world. Managing the whole environment is quite challenging but people can maintain the mini indoor environment where we spend most of our time by using some special plants. In some cases it has been also found that the air inside the closed building is worse than the air

outside, in such case these plants can play a game changing role.

MATERIALS & METHODS

Several research papers & article have been consulted

MAJOR INDOOR TOXINS:

There are certain chemicals that are used in the manufacturing of most of the house hold materials. These chemicals are generally used in paints and synthetic fabrics, the chemicals are chiefly used as industrial solvents, these chemicals are volatile and thus are easily evaporated at normal temperature to air, the air containing such chemicals easily comes in a direct contact of our respiratory system and enters our blood. If the concentration of such chemical exceed the threshold level then it can lead to serious health

*Corresponding author :

Phone : 8092160273

E-mail : madhu345rose@gmail.com

Proceedings of 7th International Conference on -"Global Scenario of Life Science, Agriculture, Nursing & Medical Research for the Welfare of Rural & Urban Folk(GOSLANRUF, 3-5 December, 2017)" held at METAS College of Nursing, Ranchi, Jharkhand & Organised jointly by MSET-ICCB & METAS.

problems. Certain pollutants like Ammonia found in most household cleanser, CO (carbon monoxide), NO (nitric oxide) are the stake holders of indoor pollution. These pollutants or toxins can cause allergies, asthma, sick-building syndrome and even the cancer¹. The sick-building syndrome is the collection of symptoms shown by a person

when remains in the closed compact non-ventilated room filled with these toxins. Sick-building syndrome has often observed in offices as these toxins affect our nervous system, the person will feel confusion, restlessness, anxiety, dizziness and that slows down the working efficiency of person and eventually effect the output².

Table: Major indoor toxins

| TOXINS | SOURCES | EFFECTS |
|----------------------|---|--|
| 1. Formaldehyde | Glue, Paints, Plywood, waxed paper | Cause Leukemia |
| 2. Trichloroethylene | Paints, ink, adhesive, paint removers | Affect nervous system, harmful during pregnancy (affect fetus organ development), carcinogenic |
| 3. Benzene | Plastic resins, dyes, cigarette smoke, glue | Carcinogenic, damage central nervous system |
| 4. Xylene | Paints, tobacco smoke, rubber, leather | Affect nervous system (confusion, dizziness, fatigue) |

NASACLEANAIR STUDY



A very famous study was performed by NASA (National Aeronautics and Space Administration) with ALCA (Associated landscape contractor of America U.S) in order to keep astronauts healthy in space shuttle and to facilitate long term space habitation known as “NASA CLEAN AIR STUDY”. This famous study was performed by the American scientist specialized in chemistry, microbiology, biochemistry, marine biology and environmental engineering Dr. B.C Bill Wolverton with his co-workers and the first list of air filtering plants was compiled by NASA as a part of clean air study published in 1989. Some of those plants were: Snake plant (*Sansevieria trifasciata*), Spider plant (*Chlorophytum comosum*), Areca palm (*Chrysalidocarpus lutescens*), Chinese evergreen (*Aglaonema ovatum*)³ etc. This study ignited the interest in the mind of people.

All plants are able to purify indoor air to some degree by normal photosynthesis but some were found to be more beneficial than other in removing more than 90% of household toxins. They tested a plant named spider plant (*Chlorophytum comosum*), this plant was placed in the sealed Plexiglas chamber, the air inside the chamber was contaminated with formaldehyde , after 24 hours they

found that the plant removed 95% of formaldehyde from the chamber. So these plants not only used in space shuttles but can be used at home as well.

AIR-PURIFYING PLANTS

1. *Chlorophytum comosum* (Spider plant)



Chlorophytum comosum (Spider plant)

Classification:

- Kingdom – Plantae
- Division – Angiosperm
- Class – Monocotyledon
- Order – Asparagales
- Family – Asparagaceae
- Genus – *Chlorophytum*
- Species – *comosum*

Native to: South America

Identification

- Thin, flat, long leaves of length 35-40 cm and width 0.5- 1 cm
- Leaves grows in bunch and gives the appearance of grass
- Green coloured leaves with whitish peripheral margin, parallel venation
- Bulbous root

Plant qualities

- NASA has placed this plant among the top three houseplants
- Great ability to remove formaldehyde from air
- A room filled with many spider plant may reduce the amount of CO (carbon monoxide) and NO₂ (Nitrogen dioxide) upto 2% in just 24 hours, as it absorbs the air borne toxin as a part of their normal breathing process and transport them to their root where microbes feeds and detoxifies them.⁴

2. *Sansevieria trifasciata* (Snake plant)



Sansevieria trifasciata (snake plant)

Classification:

Kingdom- Plantae
Division- Angiosperm
Class- Monocotyledon
Order- Aspargales
Family- Asparagaceae
Genus- *Sansevieria*
Species- *trifasciata*

Native to: Madagascar

Identification

- Thick, long leaves, vertically growing and arranged in rosette pattern with parallel venation.
- Mature leaves are dark green in colour and have grey-green cross bandings.
- Leaf length 28-30 inches and width 5-6 cm.
- Stem negligible, root rhizome like.

Plant quality

- This plant filters trichloroethylene, xylene, toluene and benzene from the air.
- NASA have found that it is one of the best plant for improving indoor air quality by passive absorption of NO (Nitrogen oxide) and formaldehyde.
- The amazing quality of this plant is that it sucks CO₂ and release O₂ at night by CAM (Crassulacean acid metabolism) pathway, it is a CO₂ fixing pathway that have evolved in plant as adaptation of arid condition. It has scotoactive stomata that remain close during daytime to reduce water loss and open at night to collect CO₂, this CO₂ is stored as the 4-carbon **malic acid** in vacuole at night and then in daytime the malic acid is converted back to CO₂ to use during photosynthesis⁵. This plant though produces CO₂ but never release it and thus best for indoor use.

Dr. Wolverton presented a paper that get published in the "Journal of the Mississippi academy of science" in 1996 concluded that not only the plants but the potting soil also removes air borne toxins due to the presence of microbes that have a great ability to adapt for such toxins.⁶

FUTURE ASPECTS

Improving the outdoor air is quite challenging in short duration of time but the indoor air quality can be managed by using these plants. Air purifying plants are the best and cheapest alternative of electronic air purifiers, because air purifiers apart from consuming energy produces OZONE (O₃), as ozone is a powerful oxidant it can react with a wide range of cellular components and biological materials, and may affect tissues of the respiratory tract or lung.

The accumulated evidence on health effects is reviewed in WHO (1987) and WHO (1995). Studies indicate that exposures to ozone concentrations in the range 160 - 360 $\mu\text{g}\cdot\text{m}^{-3}$ for a period of 1-8 hours reduces various pulmonary function parameters.⁷The National Institute of Environmental Health Sciences (NIEHS) at the National Institutes of Health reports that ozone also triggers asthma and may aggravate other respiratory illnesses such as pneumonia and bronchitis. Ozone concentrations can make the small bands of muscles that help control breathing more sensitive to dry air, cold or dust, so ozone exposure may increase allergic responses in susceptible people⁸. The air quality of some area like Delhi has become worse, the air pollution have spikes far beyond the acceptable levels. These plants can play an amazing role in maintaining at least a good air quality inside the room .These plants can be used in home, hospitals, offices, schools and not only that it should be used in all compact chambers like cars, buses, metro trains, airplane that have the high risk of having air borne toxins.

CHALLENGE

The biggest challenge for these plants is that people are not aware of it. Many people are familiar with such plants but don't know about the air purifying qualities, they just use such plants as a decorative item. If people started using such plants they can effectively create a good environment even in a very congested compact area with least expense. The actual problem is, even if we give information to people about such plants, they listen to it but don't bother to bring these plant in their day to day life, this indifferent nature of people is the actual problem and that's the reason people are not able to utilize such a blessing of mother nature.

SOLUTION

Keeping in mind the seriousness of the situation it is not the time just to discuss the problems and precautions; it is actually the time to find the solution. So how can we make people aware of it? The best solution is – to include one chapter on these plants in the **N.C.E.R.T books**, not only the chapters but also the projects are to be given to the students so that parents (family) can also get involved.

This step will dramatically provide a good reach of this information to the people of all class, age and categories.

CONCLUSION

Air pollution is not the issue of a single country but the whole world, works are going on to control that but it will actually take some time but if we somehow manage to maintain indoor air quality we can save ourselves from the major health related issues like cancer, allergy, asthma etc, the use of air purifying plant is the best way to get rid of indoor toxins from the place where we dwell in a very less duration of time and it can be a life changing step for humankind.

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Biospectra : Vol. 12(2), December, 2017 (Spl. Issue)

An International Biannual Refereed Journal of Life Sciences

