

## Indoor Gardening: An Eco-friendly Approach for Environmental Sustainability

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### SUMMARY

Filtration systems and air purifiers do not lessen intensities of indoor air pollutants; in fact, worsens the problem. More benign addition to air filtration is the use of different indoor ornamentals plants. Indoor ornamental plants can remove toxicants and volatile organic compounds from air.

### INTRODUCTION

Poor air quality is associated with health problems throughout the world due to rapid urbanization and industrialization. Urban air pollution is a question of global health concern. Recent incidence of toxic fog which is hovering on metro cities is of great concern. It is caused by many factors which are complex and will take a long way to find proper solution. Little relief is possible if we rely on ornamental plants which can mitigate at least indoor air pollution. Indoor air is assumed more polluted than outdoor environment. People spend major portion of time indoors in office, house, schools, colleges, shops. Air quality of indoor environment is thus very critical for human health. As homes become more hi-tech, indoor air pollutants are easily trapped. If the building construction is not designed to maintain indoor-outdoor air exchange, consequence is amplified concentrations of indoor air pollutants. As outdoor air enters, it mixes with pollutants derived from indoor sources such as Volatile Organic Compounds (VOC's). VOC's are released from synthetic furnishings, finishes, solvents, polished furniture, insulations, curtains, carpets, copiers and printers, and other painted household articles. Indoor air pollution is one of the vital ecological threats to human health.

### Toxic Chemicals Found In Home and Working Environments

Toxic chemicals or VOC's found in home and working environments are Trichloroethylene, Benzene, Formaldehyde, Xylene, Carbon monoxide, Ammonia *etc.*

**Trichloroethylene:** It is used in printing inks, paints, dry-cleaning industry, and adhesives. Short-term exposure to Trichloroethylene can result in dizziness and nausea.

**Benzene:** This solvent is present in inks, oils, paints, plastics and rubber. It is also used to make detergents and pharmaceuticals. Short-term exposure to benzene can result in irritation to eyes and skin, drowsiness and headaches.

**Formaldehyde:** It is found in foam insulations, plywood panelling, synthetic fabrics, paper bags, facial tissues, napkins and household cleaning agents. Short-term exposure to formaldehyde can result in irritation to nose, mouth and throat, swelling of the larynx *etc.*

**Xylene:** It is found in leather and paint industries, printing, tobacco smoke and vehicle exhausts. Its short-term exposure can result in irritation to mouth and throat, headaches, dizziness and heart problems.

**Ammonia:** It is found in floor waxes, window cleaners, salts and fertilisers. Short-term exposure to ammonia can result in irritation to eyes and throat.

### Harmful Effects of Indoor Air Pollution

All these toxic chemicals or VOC's pollute the indoor atmosphere without any visual warning. Neglecting indoor air pollution results in frequent illness, allergies, asthma, bronchial infection, sore throat, sinus, headache, cancer and many other ailments. Even at slight levels, mixture of VOC's can cause these ailments resulting in 'sick-building-syndrome' or 'building-related illness. Indoor environments, in general have raised CO<sub>2</sub> levels from human respiration, which can add substantially to headaches, stuffiness, drowsiness or loss of concentration.

### NASA Clean Air Study

NASA conducted Clean Air Study to demonstrate effectiveness of plants to purify air. NASA researchers tested air filtering qualities of several indoor plants against toxic chemicals found in home and working environments. According to NASA, greening work places with indoor plants can soak up these pollutants and

make our interiors refreshing. Plants were placed in a sealed chamber and subjected to each chemical. Researchers monitored the level of chemical in the chamber over the course of 24 hours, total plant leaf surface area and total amount of each chemical removed per plant. House plants that need little light were found to show potential for removing trace pollutants from indoor air. Its researchers suggest that efficient air cleaning is accomplished with at least 1 plant / 100 sq. ft. of home / office space.

### Benefits of Indoor plants

It is proven that indoor plants reduce indoor air pollution, reduce workplace illness, reduce sick-leave absences, reduce stress and negativity, do not create unhealthy mould problems, raise performance and productivity, improve job satisfaction, enhance business image with potential clients, improve school performance and patient well-being and contribute to meeting at least 75% of Indoor Environmental Quality (IEQ) criteria. Indoor plants reduce all types of urban air pollution (90% of which comes from fossil fuel combustion) like Nitrogen and Sulphur oxides, CO<sub>2</sub>, CO, VOC's, Fine particulate matter, Ozone etc.

### Some Ornamental Plant Species Recommended for Indoor Gardening Purpose

African Violet (*Saintpaulia species*), Aloe Vera (*Aloe barbadensis*), Bamboo Palm (*Chamaedorea seifrizii*), Barberton Daisy (*Gerbera jamesonii*), Boston Fern (*Nephrolepis exaltata 'Bostoniensis'*), Cast-iron Plant (*Aspidistra elatior*), Chinese Evergreen (*Aglaonema modestum*), Christmas Cactus (*Schlumbergera spp.*), *Dracaena fragrans*, *Dracaena marginata*, *Dracaena reflexa*, Dumbcane (*Dieffenbachia amoena*), English Ivy (*Hedera Helix*), Flamingo Lily (*Anthurium andraeanum*), Golden Pothos / Devil's Ivy (*Epipremnum aureum*), Jade Plant (*Crassula argentea*), Lady Palm (*Rhaphis excelsa*), Parlour Palm (*Chamaedorea elegans*), Peace-Lily (*Spathiphyllum*), Pot mum (*Chrysanthemum morifolium*), Rubber Plant (*Ficus elastica*), Snake Plant (*Sansevieria trifasciata*), Spider Plant (*Chlorophytum comosum*), Split-leaf Philodendron (*Monstera deliciosa*), *Peperomia*, *Philodendron selloum*, Umbrella Tree (*Schefflera actinophylla*), Weeping Fig (*Ficus benjamina*) etc.

### Selecting Indoor Plants

Always start indoor gardening with plants free from pest and diseases. Avoid bringing plant indoor if it shows signs of insects or diseases. The plants selected for indoor gardening should be healthy-looking from top to bottom. Always match the plant to indoor growing conditions. Know the environmental conditions prevailing at your homes (especially where the plant(s) are going to be placed) and find a plant that will best grow under these conditions.

**Acclimatization:** Process of acclimation reduces the shock an ornamental plant suffers when they are moved to area with significantly different environmental conditions. One should acclimatize house plants when placing them outdoor by gradually increasing the light intensities and reversing the process when placing or bringing them back indoors. For newly purchased indoor ornamentals, acclimatize them by initially locating them in a high light area of home and gradually moving them to their permanent darker location over a period of four to eight weeks.

### Environmental Factors

The environmental factors which affect the growth of indoor plants are Light, Temperature, Humidity, Ventilation, Water and Fertilization. Any of these factors in wrong proportion will prevent proper plant growth indoors.

**Light:** It is the most essential factor for indoor plant growth. Light is the ultimate source of energy requirement for growth of plants in indoor. Light influences synthesis of chlorophyll and anthocyanins, opening of stomata, rate of plant growth, leaf size, flower and seed production, maintenance of leaf temperature and determination of plant morphology.

Three aspects of light to consider are Intensity, Duration and Quality. The intensity of light controls the length of internode and variegation of leaves.

### **Classification of Plants Suitable For Indoor Gardening Based On Their Requirement of Light.**

#### **Plants with low light intensity requirement (0.5-0.8 Klx / 500 – 800 lux )**

*Aspidistra, Aglaonema, Fatshedera, Fittonia, Maranta, Nephrolepis, Sansevieria* etc.

#### **Plants with medium light intensity requirement (0.8-1.6 Klx / 800 – 1600 lux)**

*Asparagus, Anthurium andreanum, Adiantum, Calathea, Chlorophytum, Draceana, Dieffenbachia, Ficus elastica, Monstera, Pilea, Peperomia, Sansevieria, Scindapsus* etc.

#### **Plants with high light intensity requirement (1.6– 3.2 Klx / 1600 – 3200 lux)**

*Ananas, Bilbergia, Cryptanthus, Coleus, Codiaeum, Hoya carnosa, Hedera, Pedilanthus, Yucca*

### **Indoor Light Intensity**

Indoor light intensity varies according to the location / distance from source, time of the day, latitude and time of year. Using the light readings, home can be divided into four areas, which have the following light levels for 8 hours per day:

1. Low-light areas : 25 ft-c–75 ft-c (270- 800 lux)
2. Medium-light areas: 75 ft-c–200 ft-c (800- 2000 lux)
3. High-light areas : >200 ft-c but not direct sunlight (> 2000 lux)
4. Sunny light areas : at least 4 hours of direct sunlight

### **Light Conditions**

A southern exposure typically provides the greatest light intensity, than western, eastern and northern. Symptoms of insufficient light intensity include weak growth, long spindly stems, poor color in older leaves and leaf loss or failure to flower.

### **Photoperiodic Response (Duration)**

Duration refers to the length of light exposure. A daily exposure to light, preferably 8-16 hours, is needed for plant processes. Symptoms of insufficient duration of light are small leaves, spindly stems and older leaf drop. Short-day plants - Poinsettia, Kalanchoe and Christmas cactus.

Long-day plants - Cineraria.

Day-neutral plants - African violet.

### **Temperature**

Temperature affects productivity and plant growth and manipulates flowering and plant height. In general foliage plants requires a temperature of 21-26°C during day and 15-20°C during night whereas flowering plants requires a temperature of 21-26°C during day and 12- 16°C during night. Most indoor plants tolerate normal temperature fluctuations. Low night temperature stimulates physiological recovery from moisture loss, intensifies flower color and prolongs flower life. Excessively high or low temperature may cause plant failure, stop growth, or cause spindly growth and foliage damage or drop.

Two critical stimuli that induce flowering are day length and temperature. Short-day plants initiate flowers only when the day length is less than a species-specific critical number of hours. Long-day plants initiate flowering only when day length exceeds a species-specific critical number of hours. Day-neutral plants initiate flowers independent of day length.

### **Temperature / Day Length**

- Cool temperature/short-day – Christmas cacti, Gardenia, Kalanchoe, Cattleya orchid
- Cool temperature/long-day – Tuberous begonia, Cineraria,
- Cool temperature/day-neutral – Geranium, Tulips, Amaryllis, Wax begonia,
- Warm temperature/short-day - Poinsettia, Mum, Bougainvillea.

- Warm temperature/day-neutral – African violet, Spathiphyllum, Impatiens, Anthurium, Phalaenopsis.

### **Humidity**

It is the percent of the moisture saturation of air. Most indoor plants grow best with relative humidity of over 50%. Humidity can be increased by using Humidifiers, Humidity trays or Misting.

### **Containers**

A good indoor plant container should be large enough to provide room for soil and roots, should have sufficient head room for proper watering, should provide bottom drainage and should be appealing. Clay and ceramic, plastic and fiberglass, wood, aluminium, copper, brass or any other material can be used as containers. Ornamental containers are nothing but an outer shell to cover a plain pot. Clay pots provide excellent aeration for plant roots, although they are easily broken. Ceramic pots are glazed on the outside and sometimes inside too. They are frequently designed without drainage. They are best used when a pot with drainage is used for the plant and placed in the ceramic pot for decoration. Plastic and fiberglass containers are usually quite light, easy to handle, relatively inexpensive and quite attractive in shape and color. Plastic pots are easy clean for reuse, and because they are not porous, they need less frequent watering. Drainage is most important part of any pot to be used for indoor plants. The bottom of your pots should be filled with gravel or stones to help with drainage.

### **Growing Media for Indoor Plants**

The growing media used for indoor plants should meet the requirements like good quality, high water holding capacity, high nutrient holding capacity, good porosity for root aeration and drainage and neutral pH. Common media combinations used are Cocopeat, Perlite, Sphagnum moss, Vermiculite, Vermicompost, Shredded bark and Leaf molds.

### **Repotting**

Actively growing indoor plants need repotting from time to time - very rarely with some slower growing plants and more frequently with others. Repotting should be done in foliage plants when their roots have filled the pot and are growing out the bottom. Potting media should be moistened before repotting begins. To remove plants from the pots, hold your hand over the soil, with the plant between the index and middle fingers and knock the lip of the container against a solid object. Pot selected for repotting should be at least 2 inches more in diameter than the pot the plant is currently growing in. After placing the plant in the new pot, fill the void space with more media to settle.

### **Watering**

Indoor plant roots are usually in the bottom two-thirds of the pot, so do not water until the bottom two-thirds starts to dry out slightly. Best way to know this is physically monitor soil moisture content with finger. Watering of the pot until water runs out of the bottom is advised. It serves two purposes -ie.) washes out excess fertilizer residues and guarantees that bottom two-thirds of pot receives sufficient water.

### **Fertilizing**

Fertilizing increases the growth of stunted plants, provides darker green color, increases flowering and increases insect and disease resistance. Some plants can be fertilized every two weeks, while others will go well for several months without needing any supplement. As a general rule, use a recommended fertilizer every two weeks. Fertilizer should not be put on the soil without being mixed with water. Nitrogen is responsible for green and lush growth. Phosphorous is responsible for strong roots and flowering. Potassium is responsible for bright colours, strong stems and disease resistance.

### **Pinching**

To keep a plant, compact but bushy, frequent pinching is required. This involves the removal of 1 inch or less of new stem and leaf growth. Pinching back to just above a node, makes the plant more attractive and stimulates new growth.

### **Pruning**

Pruning includes removing more than terminal shoot tips. An entire branch or section of a plant should be pruned for the sake of appearance or plant health.

### **Disbudding**

Disbudding is done to obtain larger blooms from a few choice buds or to prevent flowering in a very young plant or recently rooted cutting that should not bear physical drain of flowering early.

### **Training on trellises**

Indoor plants like Ivies, Philodendron and Syngonium are grown in a formal pattern on trellises.

### **Cleaning**

Cleaning is important to keep the plant clean and neat. It improves them aesthetically and helps reduce the incidence of insects and diseases.

## **CONCLUSION**

Considering the present scenario, there is a pressing need to promote indoor gardening. We should select a proper strategy including ornamental plants for mitigating indoor air pollution. Steps should be initiated to explore the possibility of using of various species of indoor ornamental plants for controlling indoor air pollutants and thereby improve Indoor Air Quality and Indoor Environmental Quality.

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