

Interior Softscaping

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**A Palm Guide for
INTERIOR SOFTSCAPING
(For Students, Scholars, Amateur Landscapers and all Garden lovers)**

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Preface:

Having a garden is a thing of past, present and future. Imagine a home or even a hut would become so artistic and royal if it is surrounded by umpteen numbers of plants and flora. I as a landscaper would like to recall the lustrous shires of the Hobbits as depicted in the famous series of Lord of the Rings only because the houses (practically huts) look very elegant simply because of the plants and floral diversity present. As I say umpteen numbers of plants, reader would not fail to imagine their first deal with landscape is to dump the plants. Of course, it itself will be a landscape but much to the animals, insects, reptiles and even ferocious nasty snakes. Hence there appears the role of a landscaper. Since evangelical times, Biblical times, garden have played important role in the human history, Eden Garden, erstwhile Hanging Garden of Babylon, Garden of Versailles, Gardens of Venice, Kew Garden, Mughal Gardens of India etc but all had one similarity is their massiveness over land. Coming to the 21st century, land has become dearer than youth talent! Concrete jungles are making their way; swathes of forest areas are removed and replaced with eco-garden, silicon valley and other anthropogenic structures. But one cant compensate with beauty, plants, biodiversity given our own health will be affected.

Wide buildings became skyscrapers so the garden became vertical gardens. People density increased as occupants increased so to purify the internal environment plants are needed. So the need for interiorscaping. This book is an attempt to cater the needs of an amateur landscaper, students, scientists anyone who is ready to engage with interior design. Upon googling (i.e. searching on Google), reader may find numerous books, information, but this book will be a palm book for all. Throughout the book the author has tried to exemplify things but the readers have to update themselves regularly over internet. This book contains topics pertaining to basics of interior softscaping (plant arrangement and selection), their maintenance, selection, light and ventilation arrangement, container selection etc. This book can rather be referred to as a monograph for interior softscaping.

-Authors

INTERIOR SOFTSCAPING

1. Introduction

Interior softscaping (a.k.a. plantscaping) is not a fad. It is started as part of the back to earth, back to nature, back to the senses movement of the 1970s and continues unabated. Indoor plants are not non essential luxuries; they are integral part of contemporary design, playing an important role in the American way of life. Plants enhance the interiors of our buildings and contribute to the psychological well- being of people. As pollution absorbers, plants improve our general health. Every one can relate to plants.

The interior landscape profession that evolved over the last 25 years has become legitimized and offers excellent career opportunities. Today, the business has become more complex and competitive, requiring a high level of horticultural knowledge and business savvy.

Interior landscaping is the practice of designing, arranging, and caring for living plants in enclosed environments. Academics and authors tend to be aligned with one term set with their own definition. Richard Gains, AIA the author of Interior Plantscaping (1977), says he uses the term plantscapes to "differentiate from interior landscape office planning." Gains' plantscape definition is restricted to plants within enclosed structures.

Nelson Hammer, ASLA author of Interior Landscapes: An American Design Portfolio of Green Environments (1999) features gardens inside buildings defined as 'interior landscapes'. Interestingly, Paul Cooper landscape architect and author of Interiorscapes: gardens within buildings (2003) extend his definition to include gardens that are "open to the air, as well as gardens that, although not contained by the architecture, are intrinsic to it." 'Interiorscape' is also the name of a trade magazine for the interior landscape community. In contrast of the tendency to favor one term, the cover of Interiorscape magazine bears the slogan "interior plantscaper's most read, most awarded information source since 1981." While the definitions differ, Interior landscape, plantscape, and interiorscape are synonymous.

2. The Goal

To create a harmonious and aesthetically pleasing interiorscape which will perform satisfactorily with respect to plant longevity, plant quality and plant care.

3. History

- ✓ The Chinese - First evidence for interior use of plants 3,000 years ago.
- ✓ The Egyptians and the Babylonians - The Hanging Gardens of Babylon, built around 605 B.C.
- ✓ The Greeks - Origin of the true pot gardening.

- ✓ The Romans - The first use of plants in architecturally confined spaces; Mica or talc - covered hothouse (greenhouse) for the cultivation of exotic plants, after 290 A.D. - glass was used.
- ✓ Dark Ages - After the invasion of Rome (476 A.D) Horticultural knowledge kept alive in monasteries.
- ✓ The Crusades (1100- 1300 A.D.) introduced new species.
- ✓ Renaissance Development - Revival of pot gardening; Orangeries and greenhouses were a common feature of the wealthy estates.
- ✓ The discovery of America (1492), India (1498) and Java (1511) led to the introduction of new plants into Southern Europe.
- ✓ First botanical garden - Padua, 1545.
- ✓ Eighteenth Century - Over 5,000 species were introduced; improvements in glass manufacture resulted in clear panels, transmitting more light.
- ✓ The first American hothouse was built in New England in 1737 by Andrew Faneuil.
- ✓ Victorian Pursuits (1841 - 1903) – English interest in exotic plants at its peak; by 1820 the Kew Botanic Garden had 8,000 species.
- ✓ N.B. Ward (1831) introduced Wardian Cases (terrariums).
- ✓ Indoor gardening becomes popular in America.

3.1. Recent Developments:

In the early years Philadelphia area was the foliage capital of USA. In the late 1930s the interest was renewed the introduction of dish gardens. The first modern interior landscape which used plants on a grand scale was installed in 1967 in the Ford Foundation Building in New York.

3.2. Foreign Influences:

The Japanese garden - a composition of texture and shape, using stone, water, sand, and plants as the artistic medium. Scandinavian countries follow the contemporary design of interior landscaping.

4. The appreciating House plants:

It matters little whether an indoor garden is a few pots on a windowsill or a luxuriant garden room. Whatever the size of a collection of house plants, it adds a bright new dimension to the domestic scene. Even if you live in the country and have the green outdoors at threshold, house plants bring a different view of the outdoor world into your home. No matter what the outdoor climate, we can now enjoy the brilliant colors and fragrance of plants from tropical rain

forests and arid deserts. And we can do so simply by staying home and tending our indoor gardens.

4.1. The beauty of foliage

4.1.1. Variety in shape

The most dependably attractive feature of house plants is their foliage although different leaves obviously display a variety of attributes. Leaf shapes themselves are infinitely varied. Eg: *Heptapleurum arboricola*, *Asplenium nidus*, *Aeonium arboreum*, *Chamaerops humilis* and etc.

4.1.2. Texture and Form

One of the most distinctive qualities of any leaf is its texture. Where house plants are concerned it is true to say that there are as many suitable differences in leaf texture as in shape and size. Most of the leaves are seldom simply smooth surfaced. They are as diverse as the plants they grow on. Eg; *Pellaea rotundifolia*, *Nepholpis exaltata*, *Peperomia caperata* and *Ficus elastica*.

4.1.3. The pattern on leaves

The decorative effect of foliage can be heightened and dramatized by endless variations of pattern. Although there is green in every normal living leaf (since chlorophyll is essential for growth), sometimes there are areas where chlorophyll is missing and these parts do not look green. The resultant color pattern is known as variegation. Eg; *Fittonia sp*, *Dieffenbachia variegata*, *Pelargonium*, *Agave*, *Calathea makoyana*.

4.1.4. The drama of color

Although most variegated leaves have markings in shades of white, gray, and yellow, coloration is sometimes for more brilliant. Variegation is not confined to smooth leaves. The richness of colored patterns is often enhanced by leaf texture, which can either sharpen color contrasts or make them seem more mellow. Eg *Rhoeo discolor*, *Codiaeum sp*, *Begonia rex*, *Bromeliads*.

4.2. The beauty of flowers

4.2.1. Simple and Familiar Forms

Not all house plants produce flowers, but those that do are often surprisingly generous with quantity, size and color. And although forms are grown primarily for their foliage the annual or occasional bonus of the flowers can be well worth for. Eg *Clivias sp*, *Hippeastrum sp*, *Jasminum sp*, *Fuchsia sp*.

4.2.2. Unusual Blooms

In some plants the true flowers are less notable than the bracts surrounding them. These highly flamboyant modified leaves are the main feature of such plants as *Poinsettias* where nature, in fact, provided them to attract pollinating insects to flowers that would not attract them otherwise. Sometimes, though bracts and flowers have similar visual impact, but the bracts usually remain attractive long after the flowers have died. This is why such plants as *Aechmeas* and *Aphelandras*, *Beloperone guttata*, *Anthurium sp.*

4.2.3. The exotic world of Orchids

For intriguing color combinations and durability there is nothing like an orchid flower and although many orchids cannot be grown in normal rooms, those that can are other flowers can compete with their beauty. Eg *Cattleyas*, *Miniature Cymbidiums*, *Paphiopedilums* w. *Churchill*, *Cymbidium*, *Invergarry lews*.

4.2.4. When cacti burst into bloom

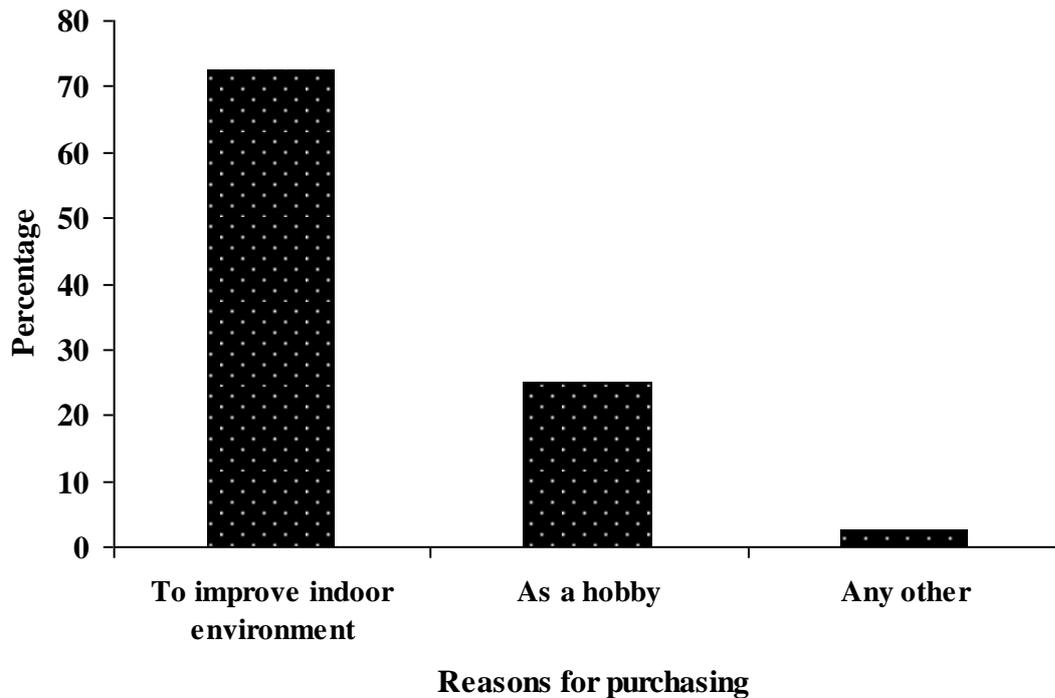
Contrary to popular belief, cacti bear flowers which are often beautiful and always stalk less, brilliantly colored, and long-lasting. The only drawback is that you may have to wait years before some types bloom. Eg *Epiphyllum*, *Aporocactus flagelliformis*, *Cleistocactus*.

5. Purpose of the Indoor Plant

Ramzan *et al.*, (2007) conducted a study and concluded that the highest percentage of respondents (72.5%) buy indoor plants for improving their indoor environment, 25% respondents adopted this as a hobby and 2.5 % purchased indoor plants due to some other reasons. Statistics has been given in Fig.1

| Use | Function |
|------------------------|--|
| Emotional and symbolic | Maintain a person's contact with nature. Mentally and emotionally carry a person to an naturalistic environment. |
| Sensual | Mood delineators .Sounds, odors, feelings stimulated, enhanced, gratified. |
| Architectural | Provide privacy. Screening of unpleasant views. Provide new vistas. Define space. |
| Engineering | Control traffic. Glare reduction. Acoustical control. |
| Aesthetic | Background. Sculpture. Line calligraphy. Softening architecture. Frame views. |

Fig 1. Reasons for purchasing indoor plants



6. Benefits of Interior Plantscape

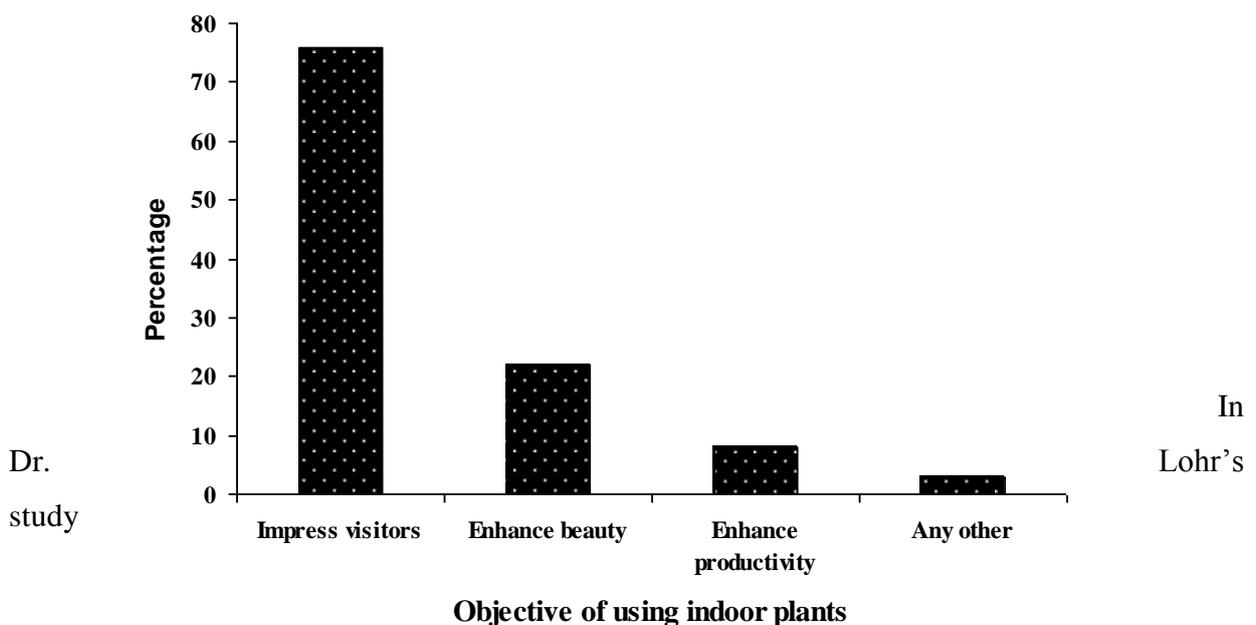
Indoor plants are the most efficient and cost effective means of removing air pollution, two plants per 100 sq ft or two plants per a small office keep the air pure and healthy (Wolverton *et al.*, 1989). Psychological impact of plants in shopping environment - The urban forest is an essential component of any viable retail space Interior Plantscape helps to create powerful business image (Wolf, 1996). In a plantscaped office, people recover from stress quicker (Helen, 2000). Productivity increased 12% when people performed tasks on a computer with plants, compared to people who performed the same task in a room with out plants (Lohr, 2000). Green workplaces help recruit and retain workers (Lohr, 2000). Workers who spend at least 4 hours per day on a computer show a significant improvement in their efficiency and concentration (Berg, 2001). Problem solving skills, ideation and creative performance all improve substantially in a workplace with plants (Ulrich, 2002).

People enjoy greater well-being in workplaces with plants (Fjeld *et al.*, 2002). Without plants workers were absent 3.6 more days because of poor air quality complaints (Bergs, 2002). Hallowell (2003) “Developing a spaces to facilitate employee intermingling can further a company’s strategic plan and help achieve sustainable goals.” Ramzan *et al* (2007) reported that majority of respondents 75.9% ascribed that indoor plants impress the visitors and enhance beauty and act as status symbol (Fig. 2)

6.1. Plants offer a means to decrease stress while enhancing productivity by twelve percent.

According to Wayne Hansen, a member of Cal-OSHA and an editor for JCAHO publications, human assets are the most valuable and expensive assets of any business. In terms of cost/square foot, the human asset is approximately 10 times the total building operating cost and nearly 100 times the energy cost. No matter how it is expressed, when a business can give rise to personal productivity, the business wins. It is widely known through the respected research done by Dr. Roger S. Ulrich of Texas A&M University, Helen Russell, Surrey University, England as well as the recent studies conducted by Dr. Virginia Lohr of Washington State University that plants significantly lower workplace stress and enhance productivity.

Fig 2. Main objectives of using indoor plants at different places



participants were 12 percent more productive and less stressed than those who worked in an environment with no plants. The study took place in a simulated office setting. Common interior plants were used in a computer laboratory with 27 computer workstations. A computer program to test productivity and induce stress was specifically designed for these experiments which incorporated one hundred symbols and time-measured readings of participants' reactions. They were presented in the same randomized sequence to each subject. Blood pressure readings recorded while using the program confirmed the program was effective in inducing stress.

Emotional states and pulses were also measured during the experiment. Plants present and plants not present were the only variables that participants experienced. When plants were

present, they were positioned so that a cluster would be in the peripheral view of each subject sitting at a computer terminal, but would not interfere with the subject's activity. In addition to demonstrating significant increases in their post-task attentiveness, subject reaction time in the presence of plants was 12 percent faster than those in the absence of plants. The results indicating an influence of plants on blood pressure are consistent with research conducted by Dr. Ulrich. Visual exposure to plant settings has produced significant recovery from stress within five minutes.

As many performance based incentives to enhance employee productivity also give rise to stress, this rare capability of raising productivity while lowering stress is extremely valuable. Progressive human resource executives are finding they cannot afford to ignore such an efficient method of human asset management.

6.2. Interior plants lower O&M (Operations and Maintenance) costs while contributing to 'Green Building' design considerations.

Plants cool by a process called transpiration, which, according to the U.S. Department of Agriculture, decreases air temperature in offices by ten degrees. A recent study out of Washington State University demonstrates that plant transpiration in office environment releases moisture, creating a humidity level exactly matching the recommended human comfort range of 30-60 percent. Similarly, the same study concludes that in an absence of plants, the relative humidity in offices runs below this recommended range. When the relative humidity of office air is too low, costly materials such as wood become damaged and crack. When the relative humidity is too high the condensation of windows and exterior walls can result in costly structural damage. According to the International Society of Arboriculture, the net cooling effect of one young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day.

According to literature from the Associated Landscape Contractors of America, proper selection and placement of plant materials can lower heating and cooling costs by as much as 20%. These statistics have become an important tool for today's environmentally efficient corporate designers and facility managers such as U.S. Energy Systems Inc. This growing energy company is enthusiastically endorsing the use of indoor plants. Susan Odiseos, V.P. of Corporate Communications states "We practice what we preach and find that our investment in interior plant services has had the expected outcome of improving indoor air quality, supporting a positive outlook in the workplace and increasing employee productivity." She continued "interior plants are a solid return on investment and a MUST for any corporation concerned with sustainable, 'green building' solutions." The advantages of outsourcing interior

landscaping services are readily apparent and can be measured in visual and bottom-line advantages to the property. Richard Greninger, managing director of Carr America Realty Corporation (with 326 buildings in fifteen markets) claims that through outsourcing these services, “live plantscapes have become a value-added distinguisher, defining our first class brand identity.”

6.3. Plants in the workplace attract, retain and enhance attitude of today’s selective employee.

Surveys conducted by Unifi Network, Westport, Conn. report numerous factors that assist in managing today's competitive workplace market. The data indicates that in order to attract and retain top employees, the workplace must include aspects of what inspires employees during “off” time. Gallop polls indicate that two thirds of the American working force cites gardening as their favorite hobby. Perhaps this “green thumb” passion explains *why* humanizing the workplace with green plants is a highly effective method to promote employee satisfaction. Copious studies such as those conducted by Dr. Ulrich and Dr. David Uzzell from Oxford University verify the positive effect plants have on employee perception and disposition. In the final analysis, marketing research (Krome Communications, 2000) confirms that employee attitude and retention is a top incentive for corporations to continue interior landscape contracts.

6.4. The dramatic aesthetic value inherent in indoor landscaping has continued to be the number one return on interior plant investments.

As reflected in *The 2001 BOMA/CEL Tenant Satisfaction “A-List Award”* (Building Owners and Managers Association), “Appearance and Condition of the Property” is a top category of evaluation among tenants. Similarly, studies out of England’s Oxford

Brookes University reinforce that while indoor plants continue to cost less than most alternative corporate décor choices, they offer a guarantee of positively enhancing perception and contributing to well being. The same set of studies conclude that people (clients or employees) perceive a building with interior planting as more expensive looking, more welcoming and more relaxed. Conversely the studies prove that people’s perceptions of a building are less positive in the absence of plants. Melissa Coley, V.P., Brookfield Financial Properties, is a corporate interior plant enthusiast. She asserts that the vast plantscapes throughout Brookfield’s property “provide a critical elegance to this bustling business setting of 40,000 corporate employees.”

6.5. It’s finally possible to have an energy efficient building *without* “Sick Building Syndrome” Plants help with bottom line savings on mounting sick leave expenses.

“Sick Building Syndrome” develops into a serious and expensive liability when these toxins become concentrated inside sealed office buildings. NASA reports that the syndrome is widespread in these energy efficient buildings. The problem is that these sealed energy efficient buildings have less exchange of fresh outdoor air for stale indoor air. This causes higher concentrations of toxic chemicals in indoor environments, brought about by emissions from a great variety of building constituents. As energy efficient construction becomes absolutely essential, ‘green building’ designers have become justifiably concerned about this indoor air quality (IAQ) dilemma. Perhaps one of the most troubling reports comes from research published by Bio-Safe Incorporated (New Braunfels, Texas). Their data confirms that energy efficient, sealed office structures are often 10 times more polluted than the air outside.

Research shows that plant-filled rooms contain 50-60 percent fewer airborne molds and bacteria than rooms without plants. For almost twenty years Dr. Billy C. Wolverton and his aids in the Environmental Research Laboratory of John C. Stennis Space Center have been conducting innovative research employing natural biological processes for air purification. “We’ve found that plants have been found to suck these chemicals out of the air,” he says. “After some study, we’ve unraveled the mystery of how plants can act as the lungs and kidneys of these buildings.” The plants clean contaminated office air in two ways. They absorb office pollutants into their leaves and transmit the toxins to their roots, where they are transformed into a source of food for the plant. In his book, *How to Grow Fresh Air: 50 Houseplants That Purify Your Home or Office* (Penguin, 1997), Dr. Wolverton details exactly how plants emit these water vapors that create a pumping action to pull dirty air down around the roots, where it is once again converted into food for the plant.

Wolverton has found that plants are especially needed in office buildings in which sick building syndrome is common. He goes so far as to suggest that everyone have a plant on his or her desk, within what he calls the “personal breathing zone.” This is an area of six to eight cubic feet where you spend most of your working day. Jay Naar, author of *Design for a Livable Planet*, suggests 15 to 20 plants are enough to clean the air in a 1,500 square foot area. Air Pollutant Removal by Plants over 24 hours is given in table 2.

6.6. Plants help reduce distractions due to office noise.

Strategically placed, plants quiet down an office. A small indoor hedge placed around a workspace will reduce noise by 5 decibels. The positive contribution of interior plants to sound absorption has been well documented in numerous studies including the work done by Dr. Helen Russell, Oxford, England and David Uzzell, University of Surrey, England. Although it would be difficult to measure the cost of productivity loss due to office noise pollution, one

doesn't have to go far to find examples! Almost anyone who works in an office can give account to being "annoyed" into a taking a break due to the common audible elements of a busy office. According to the Associated Landscape Contractors of America, landscape professionals are replacing stale cubicles for "tree walls" and other innovative plant groupings to reduce this costly "decibel distraction factor."

6.6.1. Plants and their acoustic benefits

Trees and shrubs have been used for many years to reduce traffic noise from busy roads. Research now shows that plants can also help to reduce background noise levels inside buildings. Some plant species are more effective than others and the benefits are most pronounced in buildings with hard, reflective surfaces.

6.6.1.1. Research

Tests carried out in the early 1990s by Rentokil Initial's Research and Development Department suggested that interior plants can absorb, diffract or reflect background noise in buildings, thereby making the environment more comfortable for the occupants. The effect appears to be dependent on plant type, planting, location and sound frequency. To investigate the potential acoustic benefits of interior plants in more detail, further research was carried out by a post-graduate student, Peter Costa, at South Bank University, London. Rentokil supported this work by providing access to computer data, technical advice, plant specimens and test sites. The study indicates that plants are generally more efficient at absorbing high sound frequencies than low. Good examples of this are *Spathiphyllum wallisii* (Peace Lily), *Philodendron scandens* (Sweetheart Plant), *Dracaena marginata* (Madagascan Dragon Tree) and *Ficus benjamina*. High frequencies cause the most irritation to building occupants so the benefit of having plants becomes clear. Absorption Coefficients (Costa, 1992) is given in table1.

7. Organizing space with plants

There is almost limitless choice of plants for indoor use and there are no rules for the kinds of plant that can be used to decorate a home. The selection is largely a matter of personal taste, but certain guidelines can prove useful. Scale and proportion also play an important role. The color scheme and type of furnishings should certainly be considered when you are choosing plants for a given position. Ramzan *et al* (2007) reported that majority of respondent 88.5% ascribed that they use indoor plants in their houses, while 5.5% used in offices 4% in shops and 2% at other places (Fig. 3).

Fig 3. Use statistics of indoor plants at different places

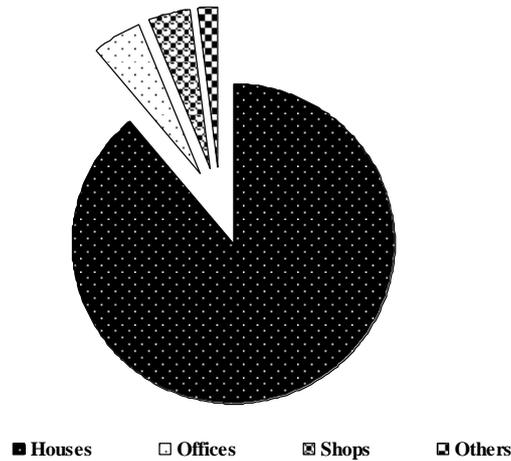


Table 1. Absorption Coefficients (Costa, 1992)

| Plant Species | Sound Frequency | | | | | |
|-------------------------------|-----------------|-------|-------|-------|-------|------|
| | 125Hz | 250Hz | 500Hz | 1 kHz | 2 kHz | 4kHz |
| <i>Ficus benjamina</i> | 0.06 | 0.06 | 0.10 | 0.19 | 0.22 | 0.57 |
| <i>Howea forsteriana</i> | 0.21 | 0.11 | 0.09 | 0.22 | 0.11 | 0.08 |
| <i>Dracaena fragrans</i> | 0.13 | 0.14 | 0.12 | 0.12 | 0.16 | 0.11 |
| <i>Spathiphyllum wallisii</i> | 0.09 | 0.07 | 0.08 | 0.13 | 0.22 | 0.44 |
| <i>Dracaena marginata</i> | 0.13 | 0.03 | 0.16 | 0.08 | 0.14 | 0.47 |
| <i>Schefflera arboricola</i> | - | 0.13 | 0.06 | 0.22 | 0.23 | 0.47 |
| <i>Philodendron scandens</i> | - | 0.23 | 0.22 | 0.29 | 0.34 | 0.72 |
| Bark mulch | 0.05 | 0.16 | 0.26 | 0.46 | 0.73 | 0.88 |
| Thick pile carpet | 0.15 | 0.25 | 0.50 | 0.60 | 0.70 | 0.70 |
| Plasterboard | 0.30 | 0.15 | 0.10 | 0.05 | 0.04 | 0.05 |
| Fresh snow, 100mm | 0.45 | 0.75 | 0.90 | 0.95 | 0.95 | 0.95 |

7.1. Grouping of plants

Some foliage plants look more attractive when displayed as single specimens, but many not only look best but grow better groups. A thriving plant community can be created by grouping a number of small pots on a window sill, in troughs, or with larger plants, at floor level. Some of the most pleasing displays consist of growing plants together in a container. The possibilities for attractive arrangements of compatible plants are endless. The only rule is that the grouped plants must be compatible-their needs must be similar. A satisfactory group can be

composed of closely related plants, such as different kinds of cactus and bromeliad, or it can be based on harmonious or contrasting colors, shapes, and textures.

Table 2: Air Pollutant Removal by Plants over 24 hours

| House Plants | Air Pollutant Removal by Plants over 24 hours | | | | | | | |
|----------------------|---|-----------|--------------|-----------|-------------------|-----------|-----------------|-----------|
| | Benzene | | Formaldehyde | | Trichloroethylene | | Carbon Monoxide | |
| | Initial ppm | % Removed | Initial ppm | % Removed | Initial ppm | % Removed | Initial ppm | % Removed |
| English Ivy | 0.235 | 90% | - | - | 0.174 | 11% | - | - |
| Peace Lily | 0.166 | 80% | 10 | 50% | 20 | 50% | - | - |
| Spider Plant | - | - | 14 | 86% | - | - | 128 | 96% |
| Chrysanthemum | 58 | 54% | 18 | 61% | 17 | 41% | - | - |
| Mother-in-law tongue | 0.156 | 53% | - | - | 0.269 | 13% | - | - |
| Golden Pathos | 0.156 | 53% | 18 | 67% | - | - | 113 | 75% |
| Madag Dragon Tree | 0.176 | 79% | 15 | 60% | 0.136 | 13% | - | - |
| Heart Leaf | - | - | 27 | 71% | - | - | - | - |

7.1.1. Adding color to groups

The placement of bright – colored foliage within any group of house plants takes skill and care. For e.g. Tissue- thin caladium leaves need humid warmth to stay healthy. If you can maintain such conditions, mingle caladium with speckled dracaenas on a bed of Sprawling *pellaea* for a truly incomparable display.

7.1.2. Adding flower to groups

A flowering plant, especially one that keep its blooms for long periods, will often add a welcome extra dimension to a group of foliage plants. Flowers can be used either to complement or to contrast with leaf colors. In particular, a few floral shapes and colors are very useful for transforming small foliage arrangements into table centerpieces in place of cut flowers. Such temporary flowering plants as *chrysanthemums* and *primulas* can serve the same purpose of course.

7.1.3. Contrasting shapes

The different shapes of indoor plants are most successfully accentuated when one shape is placed in striking just a position with an obvious opposite. Upright shapes associate with low rosettes, climbers with trailers.

7.2. Brightening small areas

In every interior places there are small space in need of brightening up with some kind of ornament. Plants are not only ornamental but alive, and there are plants to suit almost any situation, no matter how restricted. Flowering pot plants in particular can add color and vitality to an otherwise dead spot. For eg, dramatize distinctions. This tall *heptapleurum* is strikingly placed to associate with a small *Fittonia* and other low-lying objects for extra interest.

7.3. Using medium size areas

Almost room has two or three areas too small for a functional piece of furniture and yet too large to be ignored. It is these gaps, whether they are wall, floor, window, or corner spaces, that plant life seems virtually born to fill. This is not to suggest that every available space should be occupied. The best way to display medium size plants is probably on a plant table or in a planter box. Such tables and boxes are available in a range of sizes and shapes, from round to square to rectangular, and are often large enough to contain several compatible plants. For e.g. the *Brassaia* in the corner of this highly coordinated room, effectively breaks the monotony of the pattern.

7.4. Using large areas

Open- plan living rooms, studios, and offices are perfect settings for large plants and a floor-to-ceiling window can provide an almost open-air background for some such large, sculptured plant as a *Philodendron bipinnatifidum*, an orange tree, or a *Fatsy*. But beware of scorching sunlight. In more conventional settings graceful palms blend well with decorative or old fashioned arrangements.

Never crowd a room with large plants. One or two well-positioned specimens will be far more effective than an overwhelming collection. For eg. The dimensions of this modern, airy studio make a perfect setting for a single specimen plant.

7.5. Climbing and trailing plants

The common feature of trailing and climbing plants is their inability to grow upright without support. This characteristic makes them just right for decoration on the vertical plane. They can trail downward from wall pots, niches, ledges and shelves, or from freely suspended baskets. For e.g. To relieve the cold lines of an open plan landing, the foliage of a row of *Ficus* trails in front of colorful *Marantas* standing on top of lower-floor cabinets.

7.6. Decorative baskets

Of the many possible kinds of decorative container the hanging basket is probably the most useful. There are endless variations, and you can even make your own. The all-important consideration in preparing an indoor container of any type, however, is that it must obviously

be made water proof. Some hanging containers have chains and pulleys so they can be lowered for watering. For eg, Macrame rope hangers for individual pots can be bought, but do it yourself fans enjoy making them.

7.7. Plant supports

Plants that climb by means of aerial roots, such as *Philodendrons* and *Monstera*s, grow best when they have a soft, moist medium over which they can scramble. Many florists sell readymade moss poles for this purpose, but it is easy to make your own. Sown the pole and left it drain before pushing it into potting mixture. The stem to the pole at intervals until the clinging aerial roots have taken firm hold. Keep the pole moist by spraying it, or trickle water down through the top of the pole. For eg, To stimulate its natural habitat, grow a climbing philodendron up a moss pole. Trickle water down the pole every day to keep the moss thoroughly moist.

7.8. Room dividers

Potted- plant devices for separating one area of an open room from another can vary from a small group arrangement, terrarium, or bottle garden set on a low table to a tall, living screen of rapid climbers such as *Cissus antarctica*. A vital consideration is the shape and size of the room. In an average living room a floor-to-ceiling screen can merely serve to deny light to one small compartment. It is often much more effective to place single plants or two or three, in strategic positions. Even in a spacious room a massive plant display should create a backdrop rather than a leafy wall.

7.9. Using window areas

The light that comes into almost every home through windows is a necessity for the plants that grow in this artificial environment. But the intensity of the light varies greatly according to the time of year and the aspect. For eg, try to suit plant shape to window shape. This round, North facing window provides a graceful frame for a delicate maidenhair fern.

7.10. Plants in containers

The principle behind this; once humidity has been established in a sealed transparent container moisture from the soil and transpiration from the leaves of the plants condenses, runs back into the soil, and thus creates a self- supporting environment.

7.11. Miniature gardens

It can be anything from a small replica of an outdoor garden to a little group of dwarf plants in a dish. Virtually any kind of dish or tray will make a satisfactory container as long as it is deep enough to hold a shallow layer of drainage material topped with a slightly deeper layer of potting mixture.

7.12. Garden rooms

Grand conservatories are a thing of the past. Modern garden rooms where they exist are basically green, sunny, casually furnished extensions of the main part of the house. The ideal garden room is adjacent to the living room and is large enough to be full of plants without seeming to be too crowded to accommodate comfortable chairs. The chairs are made for lounging, with cushions covered in attractive fabric. In short, the room provides a relaxed environment for plants and people alike. To facilitate gardening there is a water tap concealed in a corner. The floors are covered with tiles capable of standing up to distend water. Larger garden rooms sometimes incorporate sunken pools and ornamental fountains. But such extras are luxuries. The garden rooms attributes that really matter are light, comfort, color, fragrance, and the rich beauty of growing plant life.

8. Special types

8.1. Terrariums

A terrarium, a garden in an enclosed glass or plastic container, is a delightful way to grow a collection of small plants. With proper care, a terrarium will create a humid atmosphere that protects tender, tropical plants that are difficult to grow in the normally dry atmosphere of our homes. Under controlled conditions, a terrarium can also be used to help start new plants from seeds and cuttings.

8.1.1. Selected Plants for Terrariums

Tall Plants (6" to 1 2")

Pilea cadierei, *Syngonium podophyllum*, *Pilea microphylla*, *Asparagus spp.*, *Begonia spp.*, *Dracaena sanderiana*, *Iresine herbstii*, *Tripogandra multiflora*, *Aspidistra elatior cvs.*, *Aglaonema spp.*, *Codiaeum variegatum*, *Dracaena surculosa*, *Euonymus japonicus 'Microphyllus'*, *Adiantum spp*

Short, Rounded Plants (<6")

Begonia Rex, *Ajuga reptans*, *Cryptanthus spp*, *Asplenium nidus*, *Tetranema roseum*, *Pelargonium spp*, *Ophiopogon japonicus 'Minor' and 'Nanus'*, *Peperomia spp*, *Hypoestes phyllostachya*, *Sansevieria trifasciata 'Hahnii'*.

Short, Prostrate Plants (1" to 3" tall, spreading)

Ficus pumila, *Columnea microphylla*, *Hedera helix cvs*, *Plectranthus spp*, *Selaginella spp*, *Philodendron spp*, *Herniaria glabra*, *Callisia elegans*.

8.2. Hanging basket garden

Hanging baskets can add a new dimension to your landscape. Often the open, vertical space of the indoor garden, carport, terrace, patio, balcony, and porch or under trees goes

unused. In these areas, hanging baskets help create a delightful atmosphere by giving color and interest to open spaces or bare walls. They are most useful to gardeners whose planting areas are limited. Creative gardeners will discover unusual containers and unlimited ways to use hanging baskets around the house and garden. Many beautiful and exotic plants are suitable for cultivation in suspended baskets or planters. Plants of drooping growth habit are preferable, because their pendulous stems, falling over the sides of the container, display flowers and foliage to best advantage. Drooping plants also hide the container, making the plant, rather than the container, the outstanding feature. Upright-growing plants, other than orchids and bromeliads, are not used to best advantage when planted by themselves in baskets.

8.2.1. Suitable Basket Plants

Flowering: *Abutilon megapotamicum*, *Allamanda*, *Achimenes*, *Begonias* (of drooping growth), *Browallia*, *Cascade Chrysanthemum*, *Cascade Petunia*, *Clianthus* (*C. dampieri* and *C. puniceus*), *Campanula* (*C. isophylla* and *C. primulinum*), *Flame Violets* (*Episcias*), *Fuschias*, *Impatiens sultanii*, *Lantana* (dwarf, trailing) and *Lipstick plant* (*Trichosporum lobbianum*).

Cacti and succulents: *Burro tail* (*Sedum morganianum*), *Carrion flower* (*Stapelia nobilis*), *Ice plant* (*Mesembryanthemum crystallinum*), *Thanksgiving*, *Christmas* and *Easter Cactus* and *Wax plant* (*Hoya carnososa*).

Foliage: *Asparagus fern* (*Asparagus plumosa* and *A. sprengeri*), *Coleus*, *English* and other types of *ivy*, *Ferns* (native and exotic species), *Kangaroo vine* (*Plectranthus australis*), *vining Philodendron*, *Pothos*, *Smilax*, *Spider plant* (*Chlorophytum elatum*), *Rhipsalis* spp., *Tradescantia* species and *Zebrina pendula* (both *Wandering Jew*), *Vinca major* and *common mint*.

8.3. Window garden

It refers to that kind of gardening where plants are grown with in the room just opposite or close to the window or on the window sill outside. This is a novel method of gardening and is ideally suited for congested cities and flat- dwellers. In large cities, space is a problem and the conventional method of gardening such as planting in trees, may not be possible, where window gardening opens an opportunity for the garden lovers.

8.3.1. Plants for window garden

- It should be selected depending on
- One's taste
- Weather conditions, spread
- Height of the plants
- Availability of sun light

North window sills- shade loving plants – E.g. *Anthurium*, *Begonia rex*, *Cordyline*, *Cyperus*, *Ficus*, *Hedera*, *Peperomia*, *Syngonium*

South window-light require plants – E.g. *Aechmea, Billbergia, Calathea, Coleus, Geranium, Hoya, Kalanchoe*

Hanging baskets – E.g. *Asparagus, Hedera, Scindapsis, Tradescantia, Zebrina* and ferns like *Adiantum, Nephrolepis*.

Window receiving a lot of sun

- Cacti and succulents
- Flowering annuals
- Dwarf flowering shrubs (*Beloperone, Pentas, Pachystachys*)
- Bulbous plants (*Hippeastrum, Haemanthus, etc.*)

Annual Plants

a. Sunny situation

Winter annuals: *Antirrhinum, Carnation, Dianthus, Phlox, Verbena, Pansy, Nasturtium, etc.*

Summer and rainy season annuals: *Zinnia, Sunflower, Balsam, French marigold, Portulaca, Gomphrena.*

b. Shady and semi shady situation – E.g. *Salvia, Pansy and Begonia.*

c. Creepers – E.g. *Tradescantia, Hedera helix, Juniperus prostrate, Morning glory.*

d. Perennial Plants: *Lantana sellowiana, Verbena, Russelia juncea, Coleus, Piles caderi Alternanthera, Duranta variegata and Acalypha*

8.4. Window boxes garden

Modern houses and flats have window- boxes. Window box is a rectangular structure constructed outside the window. A colorful scene may be enjoyed from inside or outside.

8.4.1. Types of window boxes

- Fiber-glass box
- Pottery box
- Iron boxes
- Cast cement and asbestos boxes
- Wooden boxes (teak and oak timbers)

8.4.2. Plants for window boxes

Aglaonema, Caladium, Calathea, Diffenbachia, Peperomia, Coleus blumei, Impatiens wallerina, Aechmea fasciata, Begonia

8.5. Window rock garden

A Window rock garden specialist build a miniature rock garden in the window box ready with peaks, a pool, winding paths etc. Here, rocks should be embedded in the soil. Using too many rocks in such a small space should be avoided.

8.5.1. Suitable Plants for window rock garden;

Sedum, Pinks (*Dianthus chinensis*), *Haworthia* (Dwarf sp.), Sweet alyssum, *Saxirager* (temperate), *Portulaca*, Pansy etc.

8.6. Bottle garden

Bottle gardens have got tremendous importance for indoor decoration. It has brought the garden beauty into our room. The idea of this garden was developed by London physician named Nathaniel Ward. Bottle garden has fascination and also requires much attention to construct it. It used for table decoration inside the room.

8.6.1. Suitable plants for the bottle gardens

Fittonia, *Episcia*, Miniature varieties of *Aglaonema*, Ferns, *Cryptanthus*, *Pilea* *Pellionia* and *Peperomia*

8.7. Table garden

Plants are selected and arranged in an artistic way so that it becomes possible to create a delightful scene inside the room. Table garden provides a scope to express one is artistic aptitude and aesthetic sense. Table garden may be kept in the suitable corner of the room. It should be removed occasionally outside and can be kept in the verandah or balcony to provide sunlight to the plants whenever required.

While keeping table garden in the room for decoration, it is placing must be given thoughtful consideration. For sunlight they should be kept near window.

8.8. Dish or bowl garden

Both glazed and earthenware dishes or bowls are commonly used for growing the plants. The dishes should be about 10 cm deep and must have holes at the bottom for drainage of water. The size should not be too large. Succulents can be combined with shells, bits of glass and other objects to create fantastic container gardens.

8.8.1. Suitable plants for dish garden

Flowering cactus like *Heliocereus*, *Brozicactus*, *Rebutia*, *Lobivia*, *Notocactus*, *Mammillaria*, *echinopsis* and *Paradia* are generally used here.

8.9. Vertical garden

- ✓ It has developed in Switzerland and it is not normally found in Indian gardens.
- ✓ It is a best form of gardening for apartments, cities, fences, porches, balconies etc.
- ✓ Hanging pots or baskets is also another form of vertical gardening.

8.9.1. Benefits of Vertical Gardening

- ✓ It is the best way to use empty spaces
- ✓ You can grow more plants in a limited space
- ✓ Vertical gardening helps provide proper air circulation to the plants
- ✓ Vertical gardening also helps get sufficient shade to your room
- ✓ More than all these they add to your privacy

8.9.2. Suitable plants for vertical garden

Annual: Morning glory, sweet pea, nasturtium

Perennial: Clematis, Bougainvillea, Climbing roses, Wisteria, Trumpet vine, Climbing hydrangea, Ivy, Jasmine and Passion flower.

Sun loving dwarf and hailing flowering plants: *Alyssum, Pansy, Nasturtium* and so on

Shade loving foliage/ flowering plants: *Semperflorens begonias, Rex, African violets, Fitonia peperomia, Oxalis Zebrina pendula* etc.

8.10. Gardening in tubs or urns

- ✓ It gives immense pleasure to the garden.
- ✓ These are meant for display in the Terrace, Roof garden, Backyard, Veranda, and on the Door steps.
- ✓ They are portable and it can be used temporary decoration indoors
- ✓ Wooden/cement- suited for hot sunny position

8.10.1. Criteria in selecting a tub

- ✓ To ensure that it holds sufficient amount of soil.
- ✓ It has provision for proper drainage.
- ✓ It should be quite aesthetic in look

8.10.2. Types of Plant

- ✓ Large annuals (African marigold, Chrysanthemum, Sun flower, Hollyhock etc)
- ✓ Herbaceous perennials and bulbous plants (*Canna, Bird of paradise, Datura, Vinca rosea, Impatiens sultanii, Fuchsia, Geranium* etc)
- ✓ Shrubs, ferns, ornamental palms and trees.

8.10.3. Advantages

These are movable and can be shifted from one place to another for display

8.10.4. Topiary

- ✓ It offer a good opportunity for exhibiting topiary and espaliering work

✓ *Clerodendron inermi, Duranta, Bougainvillea, Camellias juniper, Thuja etc.*

8.11. AeroGarden™ Petunia Flowers Seed Kit

The world's first-ever in-home kitchen gardening system offers a cost effective and environmentally friendly way to enjoy farm-fresh, delicious, nutrient-rich produce, while promoting planetary health and sustainability. Using advanced Aeroponic technology, where plants grow in a 100% humid growing chamber without soil, the AeroGarden™ provides a year-round supply of homegrown, pesticide-free herbs and flowers, grown using 100% natural nutrients.

8.11.1. The AeroGarden™ Technology

a. Built-in Plant Lighting System - The AeroGarden™ is the first indoor, soil-free growing system that includes lights, which means no sunlight is required and you can place it absolutely anywhere – even in a pantry or a darkened hallway. The AeroGarden™ uses a compact fluorescent Grow Bulb specially designed for fast, healthy plant growth in the AeroGarden™. This bulb employs a unique European fitting to discourage the use of other bulbs that may be a fire hazard and will certainly be less effective at growing plants.

AeroGarden™ bulbs are extremely energy efficient and should be replaced after 6 months of continuous use in order to maintain their peak effectiveness and maximize plant growth. The AeroGarden™ grow light system is automatically controlled by a built-in, control panel computer. The lights go on and off automatically, giving your plants exactly as much light, and darkness as they need, at the push of a single button. There is even a button that allows you to temporarily turn off the lights whenever needed such as when entertaining.

b. Plug 'N Grow™ Bio-Dome™ Seed Systems - Each Seed Pod has a dome that creates a perfect, mini-greenhouse environment for young seedlings. The pod label helps optimize humidity for germination and identifies your plants. Inside is the pre-seeded grow sponge which balances the amount of water and air the young seedling receives. Each Seed Pod's placement in the AeroGarden™ is mapped inside the Seed Kit box and is determined by the plant's light requirements and proximity to other plants.

c. Aeroponic Optimizing Chamber - This inside area creates a near-perfect rainforest growing environment and is where the magic of aeroponics takes place. Because it detaches from the rest of the system, you can use it, temporarily, as a centerpiece. Or, imagine having a make your own salad party with your salad, tomato and basil gardens lined up on the kitchen island! The Grow Surface has holes for growing up to 7 plants at once. It is easily removable for simple cleaning between garden plantings.

The Aeroponic Optimizing Chamber holds a pump that lifts water and nutrients to the Surface Deck, which then flows down over the plant roots, bathing them in an oxygen rich and nutritionally perfect solution. The View Door is where you add water and nutrient tablets, but also gives you and your family the fun, educational and unique experience of being able to watch the roots of your plants grow from under the Surface Deck. Finally, the “Fill To Here” mark clearly indicates how much water to add. The AeroGarden™ takes approximately 14 cups of water and you can use tap water. If your home uses well or softened water, however, it is recommended that you use purchased or filtered drinking water instead as excess mineral content can impact the nutrient solution and plant growth.

8.11.2. Control Panel

a. Water Level Low Light - When additional water is needed, the "Water Level Low" light will blink. Water can be added anytime and it is not necessary to wait for the light to come on. When the plants mature, they may need water added as often as twice a week. When water is required, add water to the "Fill to Here" mark inside the Aeroponic Optimizing Chamber.

b. Lights ON/OFF - This button is used to temporarily override the built in light timer. Once pushed, the light will stay OFF or ON until the next time the built-in timer is set to go ON/OFF. This button is also used to set the ON/OFF timer of the lights to the desired time period when setting up the AeroGarden™ system. In case of power failure, the battery back-up system stores the light timer settings and will resume to your settings once power is returned to the system. Lighting times are specific to each Seed Kit, but generally the lights are on for 16 - 17 hours and off for 7 - 8 hours per day to maximize plant growth.

c. Seed Kit Selection - When you have initially inserted the Bio-Dome™ seed pods from your Seed Kit press the "Select" button to reach the desired plant type you are growing. Once selected, this button is not used again until a new Seed Kit is installed. Depending on the plant type selected, the AeroGarden™ pump will automatically turn on and off at pre-programmed intervals to provide the nutrient rich solution to the plant roots.

d. Add Nutrients - When the AeroGarden™ is first set-up, two "Starting Nutrients" are placed in the Aeroponic Optimizing Chamber. These are nutrients formulated to provide optimum germination and initial growth. After two weeks the "Add Nutrients" light will blink and two "Sprouting Nutrients" tablets are added. After another two weeks and every two weeks thereafter, two "Growing Nutrients" are added. Each time you add nutrients, water is added to the "Fill to Here" mark to provide proper nutrient concentration and the reset button is pressed to restart the nutrient timer and turn off the blinking lights.

9. Environment for house plants

9.1. Lighting

Lighting is the most important factor in indoor gardening, and often the biggest financial investment. Outdoors, the sun provides more than enough light energy for plants, but growing seasons and conditions vary widely in different parts of the country. Plus, many people simply don't have the space for an outdoor garden. As long as you have adequate light, an indoor garden can provide you with fruits, vegetables and herbs year round...regardless of what is happening outside.

9.1.1. Types of Grow Lights

The main types of lighting for indoor gardens are fluorescent and high intensity discharge (HID).

9.1.1.1. Fluorescent Lights

Fluorescent lights are excellent for starting seeds or rooting clones. Fixtures and bulbs are inexpensive, and the low heat output lets you put those just inches away from your delicate plants. The disadvantage of fluorescent bulbs is the low light intensity--they can grow a plant that is 8-10" tall but then the light simply can't penetrate any further. If the plant grows taller and you keep raising the bulb, lower sections of the plant will not receive adequate light. Using a "full spectrum" fluorescent bulb will give your plants all the necessary wavelengths of light.

9.1.1.2. High Intensity Discharge (HID)

High Intensity Discharge, or HID, lights have revolutionized the indoor gardening industry in the last 20 years. These bulbs require special ballasts (transformers) and sockets to operate. Many types of light bulbs fall into the HID category, but the two best choices for plant growth and maintenance are Metal Halide and High Pressure Sodium.

9.1.1.3. Metal Halide (MH)

Metal Halide lamps are the best single source of artificial light for indoor gardening. Their balanced light spectrum, similar to the tropical sun, contains the important blue and red wavelengths that plants need for rapid growth. You can grow your plants from start to finish under a metal halide lighting system. MH lamps come in 175, 250, 400, and 1000 watt sizes.

9.1.1.4. High Pressure Sodium (HPS)

High Pressure Sodium lamps emit light which is heavily concentrated in the red and orange region of the spectrum. This heavy red light promotes excellent fruit or flower production (as much as 30% more than a metal halide lamp), but the lack of blue spectrum light can sometimes make a plant stretch or become "leggy" during the vegetative growth stage. This

type of light is ideal for supplementing sunlight in a greenhouse or sunroom. A High Pressure Sodium system is the most efficient HID light because it has the highest number of lumens per watt (roughly 10-15% more than a metal halide bulb of the same wattage.) HPS lamps come in 150, 250, 400, 600, and 1000 watt sizes. The ideal lighting system would include both a Metal Halide and a High Pressure Sodium lamp. This would produce extremely fast growth as well as increase flowering by 40 percent. To avoid the expense of purchasing two separate lighting systems you can use a conversion bulb.

9.1.1.5. Conversion Bulbs

High Pressure Sodium Conversion bulbs are specially designed to run off Metal Halide ballast but they put out more lumens, more red spectrum light, and they run off less electricity. Start your crop under the MH bulb and then switch to the HPS conversion bulb when it's time for flowering. Bulbs that convert MH into HPS come in 175, 250, 400, and 1000 watt sizes. Metal Halide Conversion bulbs allow you to take the opposite approach: grow your plants under the conversion bulb during the vegetative stage, then switch to your regular high pressure sodium bulb for flowering. HPS to MH conversions are only offered in the 250, 400, and 1000 watt sizes.

If you only want to deal with one bulb through all stages of growth, another option is to use an enhanced or "corrected" bulb. High Pressure Sodium Son Agro bulbs are engineered to provide 30% more blue spectrum light than a standard HPS bulb. These are available in 160, 270, or 430 watts. Agrosun Halide bulbs, exclusively from Hydro farm, are engineered to provide more red spectrum light than a standard halide bulb. The Agrosun Classic provides 38% more red light, and the Agrosun Gold provides 49% more red light. These are available in 175, 250, 400, or 1000 watts.

9.1.1.6. Bulb Replacement

Replace metal halide bulbs after 1 to 1 1/2 years of use, and replace high pressure sodium bulbs after 1 1/2 to 2 years of use. The bulbs will continue to light beyond this point but have lost as much as 30% of their lumen output while still consuming the same amount of electricity. When replacing your bulb, it is critical to get the right one for your ballast and reflector configuration.

9.1.1.7. Light Movers

You can use an automatic light mover to increase the coverage area and efficiency of your light without using any more electricity. Since the light is always in motion and does not rest above any part of the garden, you can move the light closer to the plants and take

advantage of maximum light intensity. As the reflector moves, it directs light into the garden at many different angles, giving you excellent penetration through the plant canopy and ensuring strong development at lower levels. AHL carries a variety of linear and circular light movers to accommodate almost any garden.

9.1.1.8. Reflective Mylar

Another way to get the most from your light is to hang reflective Mylar around the sides of your garden. This highly reflective polyester film redirects light back to the plants instead of absorbing and wasting it. This salvaged light often strikes the plants at a different angle, helping to increase the efficiency and penetration of a stationary grow light. Mylar can be as much as 98% reflective, while flat white paint is only 80% reflective.

Higher light intensity (>1000 fc) – E.g. *Pedilanthus*, *Begonia semperflorens*, *Coleus blumei*, *Hedera helix* etc...

Medium light intensity (500-1000 fc) – E.g. *Anthurium andreanum*, *Dracaena*, *Monstera*, *Peperomia*, *Pilea*, *Sansevieria*, *Syngonium sp.* etc...

Low light intensity (50-500 fc) – E.g. Foliage *Anthurium*, *Adiantum*, *Nephrolepis*, *Pteris*, *Sansevieria*, *Aglaonema modestum*, *Maranta* etc...

9.2. Potting Mixes

Foliage plants do best in potting mixtures containing high levels of organic matter such as peat. The following mixes are suggested for growing plants:

- | | |
|---|--|
| A) 2 parts peat, 1 part perlite, 1 part coarse sand | C) 1 part peat, 1 part coarse sand, 1 part pine bark |
| B) 2 parts peat, 1 part coarse sand | D) 1 part peat, 1 part pine bark, 1 part perlite |

Cacti and other succulents do best in mixes which contain coarse sand. A good mix for succulents is 2 parts soil, 1 part peat, 1 part perlite, and 1 part coarse sand. Generally, soil obtained from the yard (native soil) is not ideal for container grown plants. This soil needs to be improved with peat, bark, perlite or sand to improve its ability to hold water and nutrients. To kill harmful fungi and bacteria, insects and weed seed, spread moist soil in a tray or pan and bake at 200°F for 20 minutes, stirring every 5 minutes. Packaged potting mixes can be bought at local nurseries and garden supply dealers. These materials are convenient and often have been sterilized to kill disease organisms and weed seed.

9.2.1. Preparing Artificial Mixes

Artificial mixtures can be prepared with a minimum of difficulty. Most mixes contain a combination of organic matter, such as sphagnum peat moss or ground pine bark, and inorganic material, like washed sand, vermiculite, or perlite. Materials commonly used for indoor plants are mixtures consisting of sphagnum peat moss, vermiculite and perlite.

Sphagnum Peat Moss is readily available baled or bagged. Such materials as Michigan peat, peat humus, and native peat are usually too decomposed to provide necessary structural and drainage characteristics and should be avoided. Most sphagnum peat moss is acid in reaction, with a pH ranging from 4.0 to 5.0. It usually has a very low fertility level.

Vermiculite is a sterile, lightweight, mica product. When mica is heated to approximately 1800°F, its plate like structure expands. Vermiculite will hold large quantities of air, water, and nutrients needed for plant growth. Its pH is usually in the 6.5 to 7.2 range. Vermiculite is available in four particle sizes. For horticultural mixes, sizes 2 or 3 are generally used. If at all possible, the larger-sized particles should be used, since they give much better soil aeration. Vermiculite is available under a variety of trade names. Vermiculite collapses with time and loses its positive characteristics. Avoid insulation grade vermiculite.

Perlite is a sterile material produced by heating volcanic rock to approximately 1800°F. The result is a very lightweight, porous material that is white in color. Its principal value in medium mixtures is aeration. It does not hold water and nutrients as well as vermiculite. The pH is usually between 7.0 and 7.5. Perlite can cause fluoride burn on some foliage plants, usually on the tips of the leaves. The burn progresses from the tip up into the leaf. Fluoride burns can be prevented by adding 1 1/2 times the recommended amount of lime when mixing the medium. Artificial mixtures are usually very low in trace or minor elements; therefore, it is important to use a fertilizer that contains these trace elements.

9.3. Garden soil

Potting mixes with garden loam should be avoided, as loam is highly variable from shovel-full to shovel-full, and must be pasteurized in the kitchen oven (not microwave). This process of pasteurizing your own soil can be difficult and smelly. Bagged commercial soil, on the other hand, may be an acceptable alternative to commercial mixes and artificial soilless mixes. Bagged potting soil is sterile, but may have water-holding or drainage problems (which may be indicated by fungus gnats), as well as high levels of soluble salts. Because of the heterogeneous nature of soil, different lots from the same manufacturer may perform

differently. Experiment with different commercial potting mixes and soils to determine which is best for your situation. The key to a good potting media is good drainage. Commercial mixes should contain 1/2 to 2/3 perlite and vermiculite.

9.3.1. Mixes for specific plants

Most foliage and flowering plants can be successfully grown in the media mixes previously highlighted, with some modifications in certain cases. Specific nutrient needs can be readily met with soluble or slow-release fertilizers as recommended on the product packages. Plants such as African Violets, Cacti and Succulents, Orchids, etc., that are more sensitive to specific proportions of media components, can easily be grown in commercial mixes specially prepared for these plants. Though their costs may be somewhat more expensive than standard mixes, it can be well worth the costs.

9.4. Containers

Containers used for growing plants are made from clay, glazed clay (ceramic), plastic, metal or wood. Clay pots are porous and allow water to evaporate through the side and, therefore, require more frequent watering than glazed clay, plastic, metal or wooden pots. For that reason, most beginners, who have a tendency to over water, are usually more successful with clay pots. The size of the container depends on plant size. Plants are grown in many kinds of containers :(left to right) glazed clay (ceramic), plastic, clay, metal and wood. And where it will be facing home. Containers too large or too small present an awkward appearance. The container must be large enough to provide space for root growth for at least one year.

9.5. Temperature

Most plants grow best when day temperatures are of (18 to 24°C) and (16 to 18°C) at night. A sudden change in temperature can injure plants. Temperatures below 10°C) may cause some plants to wilt and drop their leaves. Do not place your plants in very hot or cold spots such as near heating or cooling vents, on top of television sets, or near doors in winter.

9.6. Humidity

The air in the home is usually too dry for growing plants. Most homes have humidity below 40 percent. Plants grow best at a relative humidity of 40 to 60 percent. You can help increase humidity by setting plants in a tray with 2 or 3 inches of wet gravel. Water evaporating from the tray increases the humidity around plants. Keeps the water about 1/2 inch below the top of the gravel so the bottom of the plant pot is not sitting in water, because this will cause waterlogged soil, which may result in root damage.

9.7. Watering

One common cause of plant death is improper watering. When plants are over watered, the soil remains saturated and root systems are unable to function properly because of lack of oxygen. Plants should be watered when the potting mixture becomes dry to the touch. Stick your finger into the mix up to the first joints; if it is dry at the finger tip, you need to water.

Water plants when the potting mixture feels dry to the touch. Through the sides of the pot will need to be watered more often than those growing in nonporous glazed or plastic pots. Also, plants in small pots will need water more often than those in large pots. When watering, water thoroughly by applying enough lukewarm (room temperature) water until a small amount runs out of the bottom of the pot. Saucers or pans with catch water should be emptied within 20 to 30 minutes. Containers without drainage holes should have a layer of coarse gravel placed in the bottom to allow a space for excess water. Another method of using containers without drainage is the "double potting" technique. Pot the plant in a container that has drainage. Place a layer of gravel in the bottom of the container without drainage holes to allow space for excess water. Hole and is one inch less in diameter and shorter than the container without drainage. Place several inches of gravel in the bottom of the outer pot and place the potted plant on the gravel layer.

9.8. Fertilizer

Many problems with growing plants indoors are often blamed on insufficient fertilizer. However, poor growth is often a result of some other reason, such as poor light. Most indoor plants grow slower than plants grown outdoors or in a greenhouse. As a result, indoor plants do not need as much fertilizer as outdoor or greenhouse plants. Also, rapid new growth is often undesirable as plants may outgrow their locations. Interior plants under active growing conditions should be fertilized every 2 or 3 months. During winter months, or under low light, the plants should not be fertilized as often. Many fertilizers are available for indoor plants and can be purchased in a variety of forms: water soluble powders and pellets, liquids, tablets, sticks and time-release pellets.

9.9. Grooming

The foliage of most plants grown indoors tends to collect dust and should be cleaned monthly. Plants with hairy leaves, such as African violets and gloxinias should not be wet, while the foliage of most others may be cleaned with a moist soft cloth. Clean foliage is favorable for healthy growth, and it keeps plants looking attractive. Frequent cleaning helps

control insect and mite problems. P l a n t s should be checked periodically and dead leaves and flowers removed. Some plants require periodic pruning to keep them attractively shaped and at a size that makes them pleasant to have around. Different types of plant stands also used for interior plantscaping.

9.10. Repotting plants

As the foliage of a plant grows, the root system gets larger; eventually filling the container and the plant becomes "pot-bound." When this happens, plant growth is restricted until repotting provides more room. Fast-growing plants need repotting every year. Repot slow-growing plants every 2 or 3 years. Water the plant to be repotted and allow it to set for several hours. Place your hand on the potting mix so the base of the plant is between the index and middle finger, then invert the pot. Next, tap the rim of the pot on the edge of a table until the root ball slides out of the pot into your hand. Pull matted roots apart and cut away entangled roots .Select a pot which is slightly larger than the pot in which the plant was growing. Place a small piece of broken clay pot or gravel over the drainage hole and cover the bottom of the pot with enough potting mix to bring the top of the root ball within one inch of the pot rim. Place potting mix around the soil ball and firm gently.

9.11. Putting Houseplants Outside for the summer

When the weather warms in the spring, houseplants can be put outside. Don't be too anxious to move your houseplants outdoors, even a good chill can knock the leaves off tender plants. Check with your local Extension agent to find out what the last frost date is in your area. Monitor houseplants spending the warm months outside. Move plants to calmer spots if leaves are being wind damaged. If pots dry out rapidly, move plants into some protection from wind or shade, or repot if needed. Inspect your houseplants for signs of insect damage. Pest control is much easier and safer while the plants are outside for the summer than after you bring them in this fall.

Houseplants that have been outside all summer should be allowed to make a fairly slow transition to indoor conditions. Quick changes in environment can result in yellowed foliage and leaf drop. To avoid injury, bring plants indoors before temperatures dip below 55° F; do not wait for frost warnings. Check for insect pests before you move the plants; it is easier to get rid of pests while plants are still outside. Rinse the plants' leaves, and soak pots in water for 15 to 20 minutes to drown most soil-dwelling pests.

9.12. Acclimatization

Tropical plants grown in full sun have leaves (so-called sun leaves) which are structurally different from the leaves of plants grown in shade (shade leaves). Sun leaves have fewer chloroplasts, and thus less chlorophyll. Their chloroplasts are located deep inside the leaves and the leaves are thick, small, and large in number. Shade leaves have greater numbers of chloroplasts and thus more chlorophyll, are thin, large, and few in number. To reduce the shock which occurs when a plant with sun leaves is placed in shade, gradually reduce the light levels it is exposed to. This process is called acclimatization. The gardener should acclimatize plants when placing them outdoors in summer by gradually increasing light intensities, and reverse the process again before plants are brought indoors in the fall. For newly purchased plants grown in high-light conditions, acclimatize them by initially locating them in a high-light (southern exposure) area of your home and gradually moving them to their permanent, darker location over a period of 4 to 8 weeks.

9.13. Problems

9.13.1. Cultural

Improper care may result in unattractive plants. Some of the common symptoms and conditions which may cause this are:

1. **Brown leaf tips or margins** may be caused by too much fertilizer, lack of water or excessive fluoride found in irrigation water, potting media or fertilizers.
2. **Leaf yellowing and dropping** are caused by air pollution, low light intensity, chilling, lack of water, over watering, or poor water drainage.
3. **Slow growth or light green or yellow foliage** is caused by too much light, lack of fertilizer, root rot or poor root system.
4. **Small leaves and spindly growth** are caused by too little light.
5. **Small leaves and stunted growth** may be caused by lack of fertilizer or lack of water.
6. **Small new leaves and leaves curled** under may be caused by too much light.

9.13.2. Insects

Common insect pests that harm house plants are

1. **Mealy bugs** - Soft-bodied insects covered with a white cottony material. They damage plants by sucking juices from the plant.
2. **Aphids** - Very small green, pink, black, yellow or blue insects. Aphids suck plant juices and cause new growth to curl and become distorted.

3. **Scales** - Circular, oval, oblong or pear-shaped insects with a waxy covering. Scales can be found on leaves, twigs, and branches. They cause damage by sucking plant juices.

4. **Spider mites** - Greenish, yellowish, reddish or colorless pests. Mites are 1/50 inch long and damage plants by sucking their juices. Heavily infested plants are covered by fine webbing.

5. **Whitefly** - Adults 1/16 inch long white and resemble a tiny moth. Nymphs (immature stage) are 1/16 inch in length, pale green and flat and oval in shape. They are found on the underside of leaves and cause damage by sucking plant juices.

9.13.3. Controlling Insects

Carefully examine all plants you buy to be sure they are free of pests. New plants should be kept away from other plants for at least a month. Spraying plants with a forceful stream of room temperature water every 2 weeks will remove many insects before they have a chance to become a problem. Spray the underside of the leaves where most pests are found. This procedure is best done outdoors or in a sink.

9.13.4. Diseases

Plants grown indoors have few diseases. Most problems are caused by poor growing conditions. Rotting of roots and stems of plants can usually be traced to over watering.

10. Conclusion

Interior plants undoubtedly have been, and continue to be, an important component of the American office environment and also practiced in India. Research is beginning to scientifically document the benefits of interior plantings to human comfort, well-being, and productivity (Fjeld *et al.*, 1998; Shoemaker *et al.*, 1992), but this research area clearly requires more study. If researchers can continue to provide concrete evidence that interaction with plants is directly linked to improved human health and well-being, information could provide further justification for the use of interior plants in a variety of indoor work settings (Lohr and Relf, 1995), as a result; all aspects of the interior plant industry, including production, sales, design, maintenance, will have the potential to expand their markets (Brown, 1990). Ultimately; the improved working environment created by interiorscaping will contribute to an enhanced quality of life for employees.

Interior plantscaping requires knowledge of plants and love for nurturing them in better ways.

References:

- Interior Plantscaping – Richard L. Gaines, AIA
- The Indoor Garden – Margaret K. Hunter, Edgar H. Hunter , AIA
- Nelson Hammer, ASLA - Interior Landscapes: An American Design Portfolio of Green Environments (1999).
- Paul Cooper landscape architect -Interiorscapes
- Aasha, K.1986. Effect of varying light intensities on the growth and development of indoor foliage and flowering plants. M.Sc. Thesis. Kerala Agricultural University, Thrissur, Kerala.130p.
- Bergs, J. 2002. The Effect of Healthy Workplaces on the Well- being and Productivity of Office Workers. *Proceedings of Plants for People International Symposium Floriade, Netherlands.*
- Conklin,E. 1978. Interior plantscaping. *J. Arbopricult.* 4: 73-79
- Desai, B.L. 1961. *Planning and planting designs of home gardens.* ICAR. New Delhi.
- Field and Xenia, 1965. *Window Box Gardening.* Pan books Ltd., London.
- Fjeld, T., B. Veiersted, L. 1998. The effect of indoor foliage plants on health and discomfort symptoms among office workers. *Indoor Built Environ.*7: 204- 209.
- Gaines, R. L. 1977. *Interior Plantscaping,* Architectural Record Books, New York.
- Harris and Cyril, C. 1973. *House plants and Indoor Gardening.* Octopus books Ltd., London.
- Hartley, D. E. 1981. Light Requirement for Foliage Plants. *Foliage Digest* 4(11): 12-13, 16.
- Lohr, V. I. and Pearson- Minns, C. H. 2000. Physical discomfort may be reduced in the presence of interior plants. *Hort. Technol.* 10: 53 - 58p.
- Lohr, V. I. and Pearson- Minns, C. H. and Goodwin, G. K. 1996. Interior plants may improve worker productivity and reduce stress in a windowless environment. *J. Environ. Hort.*14: 97-100.
- Manakar, G. H.1997. Interior plantscapes: installation, maintenance and management. Prentice Hall, New Jersey. 342p.
- Nambisan, K. M. P.1992. *Design Elements of Landscape Gardening,* Oxford and IBH, New Delhi. 124-136.

- NASA, 1994. Foliage plants for removing indoor air pollutants from energy efficient homes. *Econ. Bot.* 38: 224-228
- Pearson, H.E. 1949. Effects of Waters of Different Qualities on Some Ornamental Plants, *Proceeding of American Society for Hort Science* 53: 532-542.
- Poole, R.T. 1990. Potting Mixtures for Foliage Plants, *Interiorscape* 9 (4): 54-55.
- Randhawa, G. S. and Mukhopadhyay, 1986 *Floriculture in India*, Allied publishers. New Delhi. 287-304
- Ramzan, M. Qasin, A. and Muktar, R. 2007. A study on uses and management of indoor plants in Pakistan. *Int. J. Agri.* 9(3): 517-518.
- Relf, P. D. 1990. Psychological and sociological response to plants: *Implications for Horticulture. HortScience* 25:11-13
- Scrivens, S. 1980. *Interior Planting in Large Buildings*. The Architectural Press, London.
- Shoemaker, C.A. Randall, K. Relf, P.D. 1992. Relationship between plants, behavior, and attitudes in an office environment. *Hort. Technol* 2: 205-206.
- Swarup, V. 1996. Indoor gardening. ICAR, New Delhi. 81p.
- Trivadi, P.P. 1989. *Home Gardening*. ICAR, New Delhi. 287p.
- Ulrich, R. S. 2002. Health benefits of gardens in hospitals. *In: Proceedings of plants for people*. International symposium, Florida, Netherlands.
- Wolverton, B.C. Johnson, A. and Bounds, K. 1989. Interior landscape plants for indoor air pollution abatement. Final report, NASA, John C. Stennis Space Centre. 21p.
- Wyon, D. P. 1996. Indoor environment effects on productivity. *In: Proceeding of IAQ 96- Path to Better Building Environment*.
- Wyon, D. 1998. Individual control at each workplace for health, comfort and productivity. *J. Environ.* 4: 235-237

Interiorscaping of Kempegowda International Airport, Bangalore, India

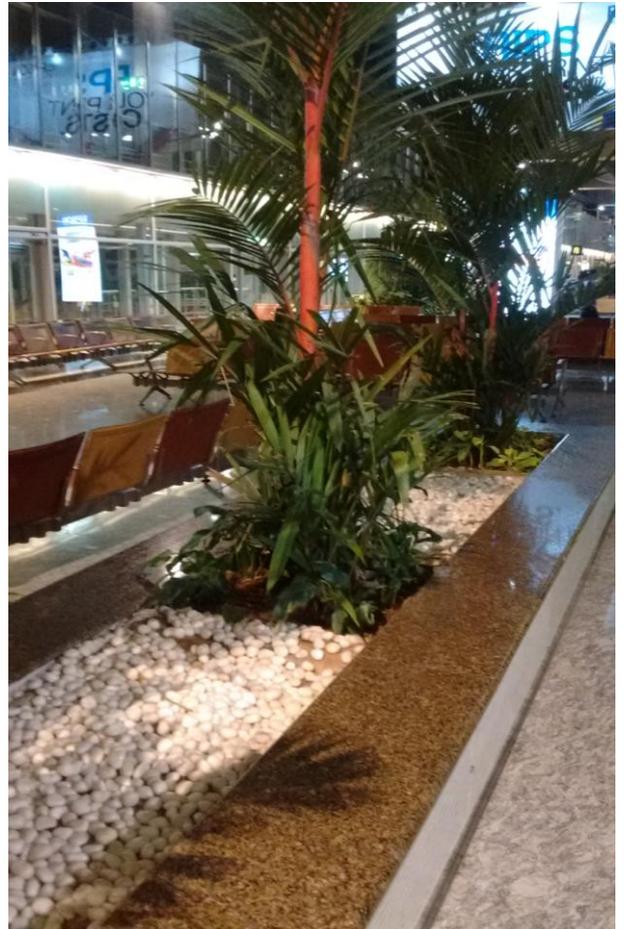


Fig.: Clockwise from top: A shallow wooden container used for grouping of diverse plants (*Sansevieria trifasciata*, *Spathiphyllum wallisii* and *Anthurium andraeanum*). Palms with decorative pebbles in the container (*Cryostachys renda* and *Rhapis excelsa*). A specimen plant (*Dracena*). Photographs by Rahul Nashipudi.

Interiorscaping of Kempegowda International Airport, Bangalore, India (contd.)



Fig.: Clockwise from top: A cluster of indoor plants (Cordyline combined with Areca palm) at the axis of conveyor belt. Mini palmscape in waiting cum commercial space (different palms). Tub/ container garden in the transfers area (*Phyllodendron*, *Anthurium*, *Dracena* etc.). Photographs by Rahul Nashipudi.