The Scientific Agriculture
thescientificagriculture.com Agricultural Monthly E- Magazine E-ISSN: Applied

Vertical Gardening: A Recent Idea of Urban Gardening

The Scientific Agriculture (July 2022)
Volume 01, Issue 01, Page No. 23-30

Vertical Gardening: A Recent Idea of Urban Gardening

Vishal Srivastava[1]*, Dr. Deepak Kumar[2], Rohit Gangwar[3], Satvaan Singh[4] and Tejendra Kumar[5]

[1*, 3&4] Department of Floriculture, SVPUAT Meerut (U.P)
[2]Assistant Professor, Department of Soil Science and Agricultural Chemistry, Eternal University, Baru Sahib (H.P.) India
[5]Department of Horticulture, R.S.M. (P.G) College Dhampur, Bijnor (U.P)

Email Id: deepaksoilsci@eternaluniversity.edu.in

Introduction

Vertical garden is also known as green wall is the term of used to refer to all form of vegetated wall surfaces (Green roof organization 2008). The lack of urban vegetation as a result of human construction directly affects the quality of human life from a physical and aesthetic point of view. Construction of vertical gardens is recommended both indoors and especially outdoors in the building. Vertical gardening is a relatively new urban gardening idea, mainly suitable for small spaces for decorating walls and roofs of different styles. In this era of rapid urbanization, the horizontal space left for outdoor gardens is very limited. “liveable city" has emerged as the concept of a modern city celebrating the 21st century.

Need of vertical gardening in urban areas

Due to urbanization and industrialization, many environmental problems are associated with cities. Urban air pollution is a serious health problem in the world. Ignoring air pollution poses various health risks such as asthma, heart attack, bronchial infections, sinus infections, headaches, cancer, poor concentration, nausea, eye infections and many other illnesses increases**.** The Government of India has launched a program on behalf of Swatch Bharat Abyan as part of Prime Minister Narendra Modi's "Green India-Clean India" mission. The focus of the mission is to increase the number of trees in India to stop deforestation and reduce pollution. Vertical gardens allow plants to be

planted on walls and other non-horizontal planes.

Plate: 1. Clean India Green India

Vertical garden

Means plants are grow in the form of vertical section. Vertical gardens have existed since 1938, when Professor Stanley Hart white of the University of Illinois came up with the idea and created its patent. Patrick Blanc is a botanist and inventor of the vertical garden**.**

Plate: 2. Vertical Garden on Wall

History of Vertical gardens

In ancient Babylon, about 2,500 years ago, Nebuchadnezzar II built the Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World and the ancestor of modern green walls. Patrick Blanc, who coined the term "mur vegetal" (green wall), can be considered as the father of modern green walls (Dunnet and Kingsbury, 2010). During the 3rd BC to 17 AD, the Romans cultivated vines on the trellis in the garden and on the walls of the villa. In the 1920s, Britain and North America encouraged trellis structures and self-vines in homes and gardens.

Plate: 3. Hanging Gardens of Babylon (Imaginary image)

Classification of Vertical gardening system –

According to the method of growing, vertical gardens can be classified as

green facades and green walls/living walls (Dunnett and Kingsbury 2004; Köhler 2008, Ratih *et al*., 2016).

1) Green facades

2) Living/ Green walls

1) Green facades: The green façade is a type of green wall system in which vines or cascade ground covers are trained to cover specially designed support structures. Plants are grown on the ground or in elevated tanks, where they are watered and fertilized.

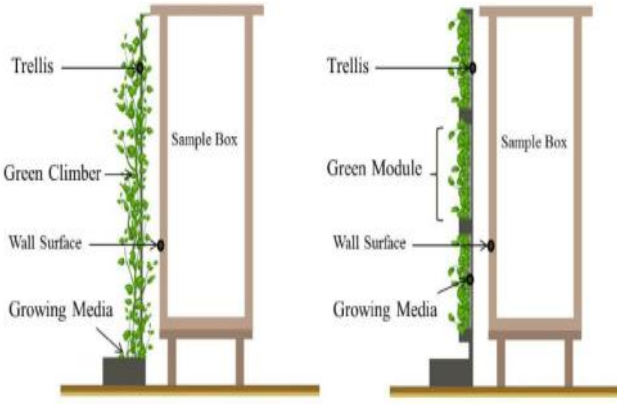


Plate: 4. Green facades

2) Living/ Green wall- A green wall system consisting of pre-green panels, vertical modules, or planted ceilings that are fixed vertically to a bearing wall or frame. These panels can be made from plastic, synthetic fibers and support a variety of plant species (eg ferns, ground cover plants, perennials and lush mixtures of edible plants).

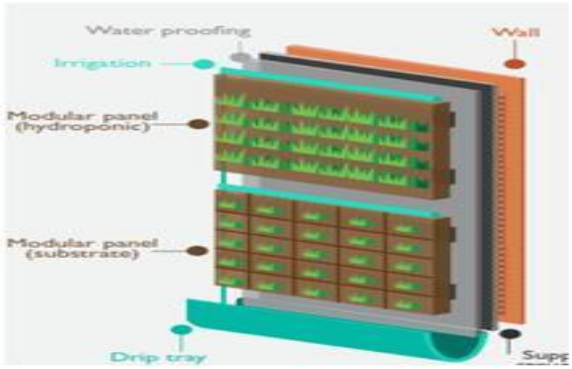


Plate: 5. Green wall

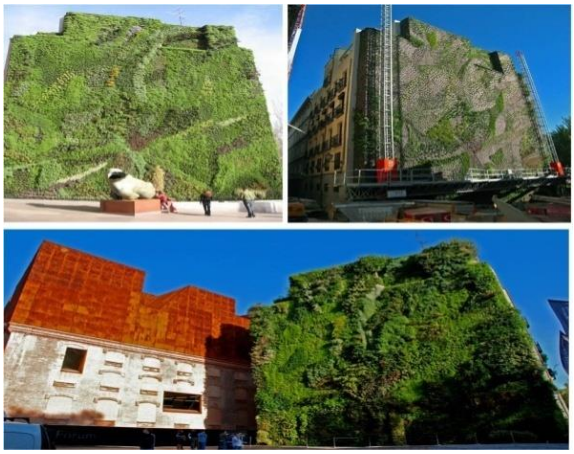
Two types of living/green wall:

i) Modular green wall- The Vertical Garden Module is made of recycled poly propylene material. It has an attractive look, is extremely durable in nature, and is easy to install. It provides an immediate solution for garden design in your place of residence.

Plate: 6. Modular green wall

ii) Vegetated mat wall- Developed by Patrick Blanc, this system consists of two layers of synthetic fibers with pockets filled with plants and growing medium. The fabric wall is supported by a frame and fixed to the building

wall with a waterproof membrane. Nutrients and water are supplied by the irrigation system at the top of the wall.



Vegetated mat wall

Suitable plants for living wall system:

- The plants chosen for the walls of the vertical garden should be dense, compact, well-formed, slow-growing and evergreen with a healthy root system, attractive, graceful and pleasing to the eye.
- When choosing a plant, you need to consider the pattern of exposure to sunlight.
- To create a vertical green wall in a sunny place, you need to choose a drought-tolerant plant. If you grow in the shade or indoors, or under a pergola or verandah, you should choose a shade-loving plant.

Plants for outdoor/Exterior green wall:

Herbaceous perennials	Shrubs	Grass like foliage forms
Alternanthera green	Ficus species	Dianella tasmanica
Alternanthera sessilis	Plumbago auriculata	Ophiophogon
Mentha spp	Plumbago indica	Pandanus tectorius
Duranta variegate	Trachelospermum	Pennisetum setaceum
Asparagus densiflorus		Phalaris arundinacea

Plants for Indoor Green Walls/ Shaded areas –

Herbaceous Perennials	Shrubs	Succulents
Anthuriums	Cordyline terminalis	Zebrina pendula
Aralia	Ficus spp	
Begonia	Rhoeo discolor	
Philodendron selloum	Schefflera	
	Setcreasea purpurea	






Growing media

Requirements:

- Weightless media
- High water holding capacity
- High nutrient holding capacity
- Good Porosity
- Neutral pH
- Cocopeat, Perlite, Sphagnum moss, Vermiculite, Vermicompost, Shredded bark and leaf moulds are the common media combinations used.

General Considerations for Green Walls:

- Watering: Suitable time
- Careful selection of windy areas (succulents and tough plants)
- Timely applications of fertilizers
- Pruning if necessary
- Keep the structure clean
- Disposing the water from drainage system
- Remove dried leaves

Advantage of Vertical Gardening

1. It acts as a natural insulation for hot and cold air, saving energy in the building:

Indirectly, living walls reduce the need for air conditioning and energy consumption of city buildings by cooling the city. Green walls can

reduce the wall temperature by up to 15°F, resulting in significant air conditioning saving (Baumann 1986, Doornach 1979).

2. Improved air quality and Increases O_2 and Reduces CO_2 levels:

The advantage of vertical gardens is that they improve the air quality in the urban areas inside and outside the house. This is because plants are a natural filter, Plants take carbon dioxide out of the air and replace it with the oxygen it needs very much.

Considered in very general sense, planting one wall of any house which situated 50 houses on the street is equal to plant 50 trees on this street (Erdogan and Aliasghari Khabbazi 2013).

The NASA Clean Air Study owner Irsi Bardulla has been led by the National Aeronautics and Space Administration (NASA) in association with the Associated Landscape Contractors of America (ALCA). Its results suggest that certain common indoor plants may provide a natural way of removing toxic agents such as benzene, formaldehyde and trichloroethylene from the air, helping neutralize the effects of sick building syndrome (NASA).

3. Saves water and requires less effort to water: - One of the greatest advantages of vertical gardens is the use of water. Irrigation is very efficient as it is done using a drip irrigation system or a hydroponic cultivation system as a starting point. The drainage is collected in a dedicated bathtub at the bottom of the garden and drained there. Alternatively, you can recycle it and return it to the garden. This means that virtually all water is used by plants and produces very little waste.

4. Decrease voice level: - The soil and plants used for plant placement in vertical gardens have a sound absorbing function. Therefore, it helps to reduce the voice function that occurs in both the buildings and the surrounding area. The green walls provide noise protection that significantly reduces external noise and vibration (upto 40 DB) in our homes and workplaces. A small indoor hedge placed around a workspace will reduce noise by 5 decibels (Dunnett and Kingsbury 2004, Jacobs 2008, Wong *et al* 2010).

5. Urban Heat Island Effect: - The heat island (UHI) is a metropolitan area that is considerably warmer than the surrounding rural areas, especially late in the afternoon and at night in winter. To avoid confusion with global warming, scientists call this phenomenon the "urban heat island effect". There are several reasons that can explain the heat island effect, but the main reason is urban overexploitation. Green walls are the most popular way to cool the city. Green walls make buildings it significantly reduces this effect by cooling, countering the heat island effect, and absorbing large amounts of heat through the evaporation process.

6. Social impact: - social impacts like psychological impacts, Aesthetic impacts, Health impacts, Job opportunities, urban agriculture and Economic impacts.

i) psychological impacts - Horticulture has a therapy field regulating human-plant relationship to reduce stress, fear, anger, blood pressure and muscle tension (Brown *et al*., 2004). A study showed that green plants in the working places reduce absence of the employees by 5-15%. The plants in the classrooms reduced the stress level and increased productivity of the students by 12% (Butkovich *et al*., 2008).

ii) Aesthetic impacts - The undesired effects of artificial and aesthetically poor appearance can be reduced in vertical gardens. Urban aesthetics can be enhanced by vertical horticultural practices, the deformed structural surfaces can be covered with vegetation, and the cityscape can be updated.

iii) **Health impacts -** From a physiological perspective, vertical gardens might have an impact of reducing heart rate and stress (Peck *et al*., 1999). It is reported that symptoms such as headache might be reduced by at least 20% (Bringslimark *et al*., 2009).

iv) **Job opportunities -** New business and job opportunities are created in the market when the local governments and private sector started vertical garden practices for urban memory and identity in the institutional green market.

v) **Urban Agriculture** - Rapid urbanization and rural decline are negatively impacting agricultural land. New food production technologies are being tested due to population growth and urbanization. One of these is vertical farming, which results from the reduction of horizontal space.

vi) **Economic impacts -** Profitability is the main factor behind the use of technology. An economic analysis is performed on the investment cost of a technology and its lifetime profitability.

Factors to consider for a successful start-up Internal vertical structure:

There are several factors for successful establishment of vertical structure like as-

(i) Irrigation
(ii) Selection of soil
(iii) Light (light intensity, light quality and duration)
(iv) Temperature
(v) Humidity

Limitation:

1. To grow a vertical garden, you need a sunny place.
2. If the height is too high, it can be very difficult to maintain. Do not make it higher than you can reach.
3. The support system needs to be strong enough to support all weights.
4. The bearing wall must be able to withstand a lot of moisture. You can also use a polyethylene layer to create a moisture-proof layer between the vertical garden and the wall.

Conclusions –

- Vertical gardening basically means growing ornamental plants on vertical surfaces such as homes, offices, hospital walls, and large facades of buildings.
- In many urban areas of this era, horizontal space is a gardening constraint, so installing a vertical garden is a viable option for incorporating greenery into homes and buildings. There is no doubt.
- Vertical green walls can be installed along highways, subways, railroad tracks, airports, etc. to reduce the negative effects of noise pollution.

  Vertical gardening helps cool and insulate the building, reducing the need and cost of high voltage air conditioning.