

Suitable Growing Media for Roof Top Gardening

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Any garden in the roof of the building is termed as rooftop garden. Rooftop gardening is gaining popularity recently since it offers numerous benefits, such as enhanced air quality, energy efficiency, establishment of green spaces in metropolitan areas, hydrological benefits, temperature control, decorative benefit and can also be utilized to grow fresh fruits, vegetables and herbs. For nutrition and optimum health, an adult need about 90g of fruits and 300g of fresh vegetables on daily basis. Due to decreased land availability brought on by rising urbanization, industrialization, warming, and population development in recent years, it has become challenging to supply the daily recommended amount of fruits and vegetables. In order to boost productivity and output during the "green revolution," which was implemented to fulfill the country rising food demand, injudicious use of pesticides and fertilizers resulted in residual pesticide and other chemicals in the finished crops, raising health-related hazards. In metropolitan cities majority of the vegetables and fruits are transported from distant areas, as the horticultural produce are perishable in nature the freshness and the quality of the produce is compromised and the PPE packed fruits and vegetables sold at multi-complexes are even costlier. To overcome these problems urban residents are showing interest to grow several fruits and vegetables in their roof top garden.

The success of roof top gardening largely depends on the selection of the right kind of growing media and several challenges such as confined space, weight constraints and exposure to adverse weather conditions should be overcome to grow a crop successfully. Growing media is a substance or a combination of substances that gives developing plants nutrients, water, air, and physical support as well as serves as a conduit for the root system of the plant. Growing media should have good physical, chemical, biological properties so that it provides all

the essential nutrient to the plant during the entire crop growth and development period. The physical properties of a media include water holding capacity, porosity, bulk density and aeration based upon these factors water availability varies. The chemical properties such as media pH, electrical conductivity, fertility and cation exchange capacity determines the mineral nutrients available to the plants. The biological characteristics, like the presence of helpful microbes, determine the rate of mineralization and decomposition of organic matter, which in turn promotes vigorous plant growth. The major considerations for selecting a suitable growing media are listed below:

- **Lightweight and Porous:** As rooftops are designed to support a specific amount of load and exceeding this weight limit can lead to structural damage therefore it is essential to procure lightweight growing medium that doesn't compromise the structural integrity of the building. Porosity is a crucial factor to consider for the luxuriant growth and development of plants as a porous material supplies an ideal air and water balance. The best options are potting mixtures or soilless blends, which often include components like perlite, vermiculite, or coconut coir. These components not only lighten the growing medium's overall weight but also increase its porosity, allowing for efficient water drainage and aeration.
- **Water Retention and Drainage:** Rooftop gardens have unique water management needs. They are constantly exposed to harsh winds and intense light, which may rapidly dry out the soil. On the other side, heavy precipitation could lead to waterlogging. Therefore, finding the ideal balance between water retention and drainage is essential. In order to keep plants moist during dry spells

and to prevent root rot, a good growing medium must be able to drain effectively. Compost or additional organic matter has the potential to retain water better, while perlite or coarse sand increase drainage.

- **Nutrient-Rich and pH balanced media:** Plants obtain nutrients from the growing media for growth and development. Therefore, it is essential to choose a nutrient-rich and balanced pH media. This can be achieved by regularly amending the growing media with organic compost or slow-release fertilizers. Most rooftop garden plants thrive in a slightly acidic to neutral pH range.
- **Container Gardening:** If weight restrictions or structural concerns are significant issues on rooftop, container gardening may be a suitable alternative. Container gardens provides an opportunity to choose specific growing media tailored to the needs of each plant, and it can be easily moved to optimize sun exposure or protect against adverse weather conditions.
- **Inert growing media:** The growing media should be free from any weed seeds, soil borne diseases causing insects, pests and nematode.

Traditional Growing Media

Despite the fact that soil is widely accessible and primarily utilized as a growing media by most of the growers, placing soil in a container result in growing conditions that are completely different from those of unrestricted field soil. Due to the restricted root growth that occurs when plants are cultivated in containers or pots, the growing media used to raise the crop should have a balanced composition of all nutrients and water. The soil-based growing media is unfavourable for crop growth because it contains weed seeds, pathogens that can cause disease, pests, and when the same soil is used repeatedly, it loses fertility and microbial diversity. When compared to soil-based growing media, soilless growing media are lighter, raise produce of higher quality, yield more food, have less of those nutrients leached out, are free

of soil-borne pests, diseases, and weeds, and are more affordable.

Modern day growing media for roof top gardening

With the advancement in research on crop production under various growing systems several types of growing media have emerged to be suitable and highly profitable for growing different crops. As these growing media provides good mechanical support, optimum level of nutrients and water during the entire crop growth and development period. Easily accessible and widely used growing media for roof top gardening are:

- **Cocopeat:** It is a completely organic medium made from shredded coconut husks. It is a hormone-rich and fungus free medium used for speed germination of seeds and rooting. Finely shredded and steam sterilized, coconut coir offers plants an ideal rooting medium that also offers protection against root diseases and fungus. Unlike peat moss, which rapidly depletes from overuse, cocopeat can be reused. It does not have any nutrient so it should be used in combination with several composts and manures.
- **Vermicompost:** is the product of earthworm digestion and aerobic decomposition using the activities of micro- and macro-organisms at room temperature. Vermicompost is rich in nitrogen (2-3%), potassium (1.85-2.25%) and phosphorus (1.55-2.25%), micronutrients, beneficial soil microbes and contain plant growth hormones & enzymes.
- **Compost:** is a mixture of ingredients used as plant fertilizer and to improve soil's physical, chemical, and biological properties. It is commonly prepared by decomposing plant and food waste, recycling organic materials, and manure. The resulting mixture is rich in plant nutrients and beneficial organisms, which helps in mineralization and decomposition of organic matters.

- **Rice husk or hull:** Rice husks are the hard protective coverings of rice grains, which are separated from the grains during milling process. Rice husk is an abundantly available waste material of rice and it contains about 30%–50% of organic carbon. It has good water retention capacity and can be used as growing media in combination with several composts and manures.
- **Sawdust:** Sawdust (or wood dust) is a by-product or waste product of woodworking operations such as sawing, sanding, milling and routing. It is composed of small chippings of wood.
- **Vermiculite:** This compound contains both potassium and magnesium. It holds a lot of water and aids in drainage and aeration of the soil, though it is less durable than some other mediums, such as sand and perlite.
- **Perlite:** The most common types of media used in containerized systems of soilless culture are perlite (Boodley & Sheldrake, 1977). Perlite granules are very light and originate from a silicone mineral that forms in volcanoes. This medium is available from merchants in small to large bags for addition to growing mediums to increase drainage and aeration in the soil.
- **Peat Moss:** Peat moss retains moisture in growing mediums. Many brands of prepackaged potting soil include peat moss for use in container plants that require excess moisture. Tropical plants require extra moisture and warmth to and flourish.
- **Sphagnum Moss:** Its properties allow wide usage in correcting overly moist and overly dry soil alike. Heavy soils such as clay enjoy aeration and drainage with sphagnum moss so that the excess water may drain off and the clay does not absorb as much water. Light sandy soils benefit from sphagnum moss because it will retain moisture and nutrients by not allowing water to run off.

- **Sand:** A sedimentary material consisting of small, often rounded grains or particles of disintegrated rock, smaller than granules and larger than silt. The diameter of the particles ranges from 0.0625 to 2 mm.
- **Gravel:** is a loose aggregation of rock fragments. Gravel occurs naturally on Earth as a result of sedimentary and erosive geological processes; it is also produced in large quantities commercially as crushed stone.

Suitable Growing Media for Hydroponics

Recently hydroponics cultivation is gaining popularity in roof top gardening. Hydroponics is the technique of growing plants using a water-based nutrient solution rather than soil, and can include an aggregate substrate, or growing media, such as vermiculite, coconut coir, or perlite. In comparison to traditional soil-grown crop production hydroponics it provides several benefits such as:

- Up to 90% more efficient use of water.
- Production increases 3 to 10 times in the same amount of space.
- Many crops can be produced twice as fast in a well-managed hydroponic system.
- Decreasing the time between harvest and consumption increases the nutritional value of the end product.
- Indoor farming in a climate-controlled environment means farms can exist in places where weather and soil conditions are not favourable for traditional food production.
- No chemical weed or pest control products are needed when operating a hydroponic system.

Presently a wide variety of alternate porous materials are utilized in hydroponics as growing media, including inorganic mediums like mineral wool, growstone, perlite, and sand, as well as organic media like coconut coir, peat, and pine bark. Apart from these the different types of growing media which acts as a cushion for vegetable cultivation are:

- a. Foam mats (polyurethane):** polyurethane foam is used as cushioning for a variety of consumer and commercial products, including bedding, furniture, automotive interiors, carpet underlay and packaging.

Table 1: Different types of growing media for vegetable cultivation

| Media composition | Crop | Reference |
|--|---------------------|------------------------------------|
| Cocopeat: vermicompost(1:1) cocopeat: perlite: vermicompost (2:1:1), cocopeat: perlite: vermicompost (1:2:1), cocopeat: perlite: vermicompost (1:1:2), | Bell pepper | Lari <i>et al.</i> , 2014 |
| Cocopeat+vermicompost(70:30), sand+ vermicompost (70:30) | Bell pepper | Nidhi. (2018) |
| topsoil: rice husk: poultry manure (4:0:1), topsoil:rice husk:poultry manure (3:1:1) | Carrot | K. P. Baiyeri <i>et al.</i> , 2019 |
| Composted sawdust + Composted rice hull +Cured pig dung +Top soil, composted rice hull + composted sawdust + cured pig dung + top soil | Carrot | Utobo <i>et al.</i> , 2017 |
| Cocopeat + saw dust (1:1 v/v), cocopeat: vermiculite (1:1). | Tomato | Subramani <i>et al.</i> , 2020. |
| <i>Miscanthus</i> shreds | Capsicum and tomato | Krasaka <i>et al.</i> , 2018 |
| Husk charcoal growing media | Lettuce | Puraba <i>et al.</i> , 2020 |

- b. Oasis (plastic foam):** green blocks of sponge-like foam. Oasis is a trademarked name for wet floral foam, the spongy phenolic foam used for real flower arranging. It soaks up water like a sponge and acts both as a preservative to prolong the life of the flowers and a support to hold them in place.

- c. Hydrogel:** Hydrogel is basically a water absorbing polymer, classified as cross-linked, absorbing aqueous solutions through hydrogen bonding with water molecules. Agricultural hydrogels are referred to as water retention granules because they swell to many times their original size when they come in contact with water.

Conclusion

Rooftop gardening is gaining popularity in urban household as it is rewarding and an environment friendly way to utilize urban space, but success hinges on selecting the right growing media. Many businesses manufacture and deliver various types of growth media to customers' doorsteps in an effort to close the gap between the demand and supply of the appropriate growing media. It is necessary to raise knowledge of the effectiveness of various growing media and their financial engagement. Urban inhabitants can cultivate fresh fruits and vegetables at home scale with excellent understanding of the selection of appropriate growing media to suit the daily nutritional needs of the family.

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