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Scanning of Research Work on different Growing Media in Floriculture

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Introduction:

With the advancement in floriculture, the popularity of growing media is rising and being refined by the horticultural industry as well the consumers to support better plant development.

Field soils being generally unsatisfactory for the production of plants in containers, primarily because normal soil does not provide the necessary aeration, drainage and water holding capacity required the need for an alternative arised. To overcome this situation several "soilless" growing media have been developed, that have the correct balance of physical, chemical and biological properties for the plants to be grown. Several growing media such as sand, peat, perlite, rockwool, sawdust, cocopeat, compost etc. singly or in combination are found suitable for growing high value crops like gerbera, carnation, rose, orchids, alstroemeria, lilium etc.

Soilless cultivation is recognized globally for its ability to support efficient and intensive plant production. (Barett *et al.*, 2016)

What is growing media?

A **growing medium** can be defined as a substance through which plant roots grow and extract water and nutrients, also referred to as "substrate" or "potting soil". Growing media are materials, other than soils in situ, in which plants are grown (CEN, 1999). They include all such materials that are used in the professional and hobby markets, whether produced by the growing media industry or by growers as own-mixes.

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Growing media constituents are the basic components of mixes, which are generally formulated on a percentage volume basis. Such materials include peat, composted biodegradable waste, composted bark, wood fibre, coir, perlite, vermiculite and others.
Growing media are often formulated from a blend of such raw materials, usually enriched with fertilizers, lime and sometimes biological additives in order to achieve the correct balance of physical, chemical and biological properties for the plants to be grown. Having the right growing media mix is as important for an optimal plant growth as water and fertilisers.

Plant species differ considerably in their need for water and nutrients, and therefore need different kinds of growing media to provide the best growing conditions.

Criteria for selecting media

• Serves as reservoir of plant nutrients.
• Sufficiently firm enough to encourage or support the plants.
• Provides aeration for exchange of gases.
• Should not shrink or expand easily.
• Should have good drainage, porosity, aeration, etc.
• Should be easily available and economic.
• Should be sterilized easily.
• Free from pathogens, pests and weed seeds etc.

The growing medium ensures that the plant can healthily grow by providing it with a range of essential element, such as:

- an optimum rooting environment for physical stability
- storage of air, water and nutrient for the roots
- accurate control over supply of nutrient, water, ph ,root temperature (Olympios *et al*,. 1999)

Table 1. Properties of growing media and their constituents that pertain to “quality”

PHYSICAL	CHEMICAL	BIOLOGICAL	ECONOMIC
structure and structural stability	pH	weeds, seeds and viable plant	availability

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		propagules	
water capacity	nutrient content	pathogens	consistency of quality
air capacity	organic matter	pests	cultivation technique
bulk density	noxious substances	microbial activity	plant requirements
wettability	buffering capacity	storage life	price

Rose & Haase (2000) indicated that some chemical and physical properties of medium such as cation exchange capacity, nutrient content, water holding capacity etc. can effect plant growth and nutrient concentrations.

- Physical Characteristics of Growing Media

The three most familiar measurements for physical characteristic are **bulk density (weight), water holding capacity and air porosity.** For the most part, peat-based growing media products have a low bulk density, since the majority are made with a base of Sphagnum peat moss and have higher water holding capacity. Bark-based media are heavy weight products that are suitable when high drainage and container stability are required. Both types of products typically have good air porosity in a range of 10 – 18% by volume, which is a good range for most growing media.

- Chemical Characteristics of Growing Media

Two important measurements for growing media are **pH and EC** (Electrical Conductivity). For general purpose growing media, the ideal pH range is between 5.2-6.2. Desirable EC for general purpose growing media is between 1.0-2.0 mmhos/cm.

Types of growing media

1. Soil based media - Soil is the basic material/ ingredient of the media. It forms the major portion in the combination of different media. Soil is cheaply available, economic and easy to handle.

2. Soil less media- Soil less growing media is of two types:

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- Organic growing media (derived from living things i.e. plants) eg. peat moss, bark, coconut coir, rice hulls, wood fiber, etc.

- Inorganic growing media (mined or man-made) eg. perlite, pumice, vermiculite, sand etc.

Some of these components hold water on their surface, while others hold water on their surface and within their structure, and others hold very little, if any water, such as perlite.

While these substrates can be used alone, mixtures of the substrates such as peat and perlite; coir and clay, peat and compost (Grunert *et al.,* 2008; Vaughn *et al.,* 2011; Nair *et al.,* 2011) are also be used widely throughout the world, the raw materials used vary based on their local availability (Schmilewski, 2009).

Some of the components of a growing media are:

BARK: The tough protective outer sheath of the trunk, branches, and twigs of a tree or woody shrub. Bark is sometime used as the sole constituent in orchid cultivation or as a constituent in potting mixes for tree nurseries and floriculture. Only certain barks are suited as growing media constituents. Bark is also used as a mulching material. It can be effectively used as organic component in an artificial growing medium for container grown floriculture crop (William, 1918). Tiwari and Kumar in 2011 studied the effect of growing media on growth and flowering of Cymbidium. They concluded that treatment T1 (Pine Bark) gives better results for various growth and flowering characterstics of gerbera, whereas T2 (Oak bark) was found to be at par with T1 (Pine Bark).

CLAY: This material is often added in the form of dried granules or as a powder. Clay has a high ability to bind water as well some nutrients. It therefore influences the water characteristics of the growing medium. It can also partly act as a nutrient buffer, making it possible to add more fertilizer without reaching to high salinity levels. Clay addition to media promotes growth and yield of greenhouse crop. (Ehret *et al.,* 1998)

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COIR PITH: Coir is obtained by mechanical processing of the husk of coconuts. It is primarily imported from the Far East (Sri-Lanka, India, Philippines). Cocopeat is considered as a good growing media component with acceptable pH, electrical conductivity and other chemical attributes (Awang, 2009). This material has good wettability characteristics and is often mixed with other constituents in mixes for sowing, propagating and potting. Sometimes also used as the sole constituent of grow bag mixes in vegetable and flower cultures. It can be reused for up to 4 years (Preethi *et al.*, 2018) Thakur in 2005 studied the effect of growing substrates on growth and flowering of Rose cv. 'First Red' under protected conditions. He concluded that G3 (Soil: FYM: Cocopeat) gives better results in case of plant height, flower bud length, flower size.

GREEN COMPOST: A material produced from organic waste materials such as tree branches, leaves, grass clippings and plant residues. These residual materials are decomposed by microorganisms under controlled conditions. Plants do not grow in 100 % compost, and the material must be diluted with e.g. peat.

PEAT: Peat is obtained from remains of aquatic, marsh, bog, swamp vegetation found under water. It is formed when partially decomposed plants accumulate under water in areas with low temperatures and low oxygen and nutrient levels.

- Peat moss- - Peat moss is most commonly used coarse grade peat in horticulture and it is derived from sphagnum or other mosses. Its colour varies from light tan to dark brown
- Reed-Sedge peat- This peat is mainly derived from remains of grasses, reeds, sedges and other swamp plants and is reddish brown to almost black in colour
- Peat humus- It is an advanced state of decomposition of either reed-sedge peat. It is dark brown to black in colour and has less moisture holding capacity.
- Sphagnum moss- Sphagnum moss is dehydrated remains of acid-bog plants from the genus Sphagnum and is commercially used horticulture peat.

PERLITE: A material that is manufactured from naturally occurring hydrated volcanic rock (perlite), expanded by heat to form a cellular structure. Usually mixed into growing media in order to improve the flow-ability of a growing media mix, increase the air content and

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improve the water uptake. In a study, conducted with six different media containing different perlite/cocopeat ratios, it was seen that flower dry weight was higher in higher perlite containing pots, but higher leaf K and Ca concentrations where determined in the plants growing in higher coco peat levels (Lee *et al.,* 1999).

VERMICULITE: Vermiculite is a natural micaceous mineral that expands with the application of heat. Vermiculite is a suitable growing medium for hydroponics and is good soil conditioner. Vermiculite has excellent exchange and buffering capacities as well as the ability to supply potassium and magnesium. Although vermiculite is less durable than sand and perlite, its chemical and physical properties are very desirable for container media.

RICE HULLS: Hard protecting coverings of grains of rice and are obtained in the rice manufacturing industry. Rice hulls can be added to mixes to improve air capacity. It is a constituent of lower importance. The growth and flowering of Celosia cristata were the greatest when grown in a mixture of 70% cocopeat: 30% burnt rice hull, indicating that certain chemical and physical properties of cocopeat can be improved through incorporation of burnt rice hull and its positive effect was clearly reflected in the growth and development of Celosia cristata (Awang *et al.*, 2009).

SAND and GRIT**:** Are used in growing media to improve the flowability of the mix as well as to add weight where needed. These materials can also improve the water movement in the growing medium to some extent. Fine sands (0.05mm – 0.25mm) do little to improve the physical properties of a growing media and may result in reduced drainage and aeration. Medium and coarse sand particles are those which provide optimum adjustments in media texture. Potting media treatment combination consisting from Soil: Sand: FYM: Vermicompost (2:1:0.5:0.5 v/v) were found best for pot mum chrysanthemum production over treatments (Kala *et al.*, 2020).

WOOD FIBRES: Fibres that have been obtained by mechanically or mechanically-thermally fraying of un-treated wood and/or wood wastes. Wood fibres are fibrous in structure, porous, loose and elastic. They have low bulk density, very high air capacity (good drainability) and

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very low water capacity (Schmilewski, 2017). Wood fibres are used in mixes for pot plants, trees, shrubs, etc. and used in combination with peat and other constituents. Wood fiber materials produced from the extensive secondary processing of pine wood chips are a potential partial alternative to peat and perlite (Harris, 2017).

SPENT MUSHROOM: *Spent mushroom substrate* is made from the waste remaining after the harvest of mushrooms. In a study, Birben *et al.* (1999) indicated that begonia plant growing in spent mushroom compost had higher N and K comparing to plant growing in peat substrate.

LEAF MOULD: Leaf mould is a form of compost produced by the fungal breakdown of shrub and tree leaves. It is generally too dry, acidic, or low in nitrogen for bacterial decomposition. Leaf mould is essentially a soil conditioner. The addition of leaf mould increases water retention in soils by over 50%. It improves soil structure and provides a fantastic habitat for soil life, including earthworms and beneficial bacteria. Reshma in 2002 studied the effect of growing media on growth and flowering of Chrysanthemum (*Dendranthema grandiflorum*). She concluded that T8 (Leafmould+Municipal Solid Waste) gives better result for growth and flowering of chrysanthemum.

CHARCOAL: Charcoal is the blackish residue consisting of impure carbon obtained by removing water and other volatile constituents from animal and vegetation substances. Charcoal is produced by slow heating of wood, sugar, bone char or other substances in the absence of oxygen. The resulting soft, brittle, lightweight, black, porous material resembles coal and is 85% to 98% carbon with the remainder consisting of volatile chemicals and ash. It is commonly used as potting medium for growing Orchids.

Recommended Growing Media

Growing media are often formulated from a blend of different raw materials in order to achieve the correct balance of air and water holding capacity for the plants to be grown as well as for the long-term stability of the medium (Bilderback *et al.*, 2005; Nair *et al.*, 2011).

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There is no growing medium that can be labeled as the "best" since each particular medium has both advantages and disadvantages. The composition of a growing medium should be largely determined by the crop being produced. However there are some media formulations which may be used as a base.

The following is a list of several of the most commonly used soilless mixtures:

Sr.no.	Flowers	Growing Media Used (In Different Combinations)	References
1	Rose	Perlite, Zeolite and Cocopeat	Maloupa *et al.*, 2001
2	Tulip	Soil, Saw dust, Poultry manure, Sheep manure	Jhon *et al.*, 2005
3	*Dendranthema grandiflora*	Sand, Soil, FYM, Leafmould, Sawdust, Municipal solid waste	Reshma, 2002
4	Oriental lily	Sand, Sawdust, Vermiculite, Moss	Sharma *et al.*, 2007
5	Freesia	Leaf mould, Mushroom compost, Poultry manure, control	Ali *et al.*, 2011
6	Alstroemeria	Sand, Soil, FYM, Rhododendron forest soil, Rai forest soil	Singh, 2013
7	*Gerbera jamesonii*	Coco peat + growing medium	Aswath *et al.*, 2004
8	*Dianthus caryophyllus*	Soil, FYM, Sand, Cocopeat, Sawdust	Suman *et al.*, 2004
9	Vanda	Brick pieces, Charcoal, Coir dust	Jawaharlal *et al.*, 2001
10	Cymbidium	Soil, sawdust, cocopeat	Singh, 2013

Advantages of growing media:

- High yields can be achieved on a limited area

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- Better control over Irrigation and fertilization
- Easier disinfection
- Recycling of drainage water is possible
- Growing media can be used as an alternative to an inadequate soil.

Disadvantages:

- Nutrient holding capacity of growing media is low
- Buffer capacity is low and therefore changes are rapid
- Drying out-Peat moss, coconut coir, sand, compost, perlite and vermiculite comprise most soilless potting mixes, and none of these hold water for long
- Environmental Impacts- Peat moss, a standard ingredient, comes from sensitive wetland ecosystems, which are destroyed to extract the spongy organic matter from beneath the water's surface.

Conclusion:

Use of growing media is proved effective for higher production of floricultural crops, due to their good water holding capacity, aeration and more uptake of nutrients. Several growing media such as sand, peat, perlite, rockwool, sawdust, cocopeat, compost etc. singly or in combination are found suitable for growing high value crops. Possibly, Soilless cultivation is the most intensive cultivation system utilizing all the resources efficiently for maximizing yield of crops and the most intense form of agricultural enterprises for commercial production of greenhouse plants.

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