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Effect on combinations of growing media for cultivation of horticultural crops in troughs, grow bag and pots: A review

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Abstract
Growing media plays major role in cultivation of a crop. There are different combinations of growing media which is used in the cultivation of horticultural crops in troughs, growbags and pots for better utilization of resources. Soil based media is also used in pot culture as it is easily available and economical in use. Soil with sand and FYM is a good combination of media. In some cases FYM along with vermi compost is used for better results. Cocopeat is now becoming an alternative growing media especially in case of cultivation in pot culture inside protected structures and in urban areas. This cocopeat media is used mainly with perlite, vermiculite but also used extensively in combination with organic matter like FYM, vermicompost which acts as good source of nutrition for the growth of crop. In this purpose review of literature on effect on combinations of growing media for cultivation of horticultural crops has been done and compiled to report for further modification and better use.

Keywords: Cocopeat, FYM, perlite, soil

Introduction
Land is a valuable but rapidly depleting resource. The per capita availability of land is becoming less. Continuous cultivation of crops on a field results in poor soil fertility, which in turn shortens the opportunities for natural soil fertility build up by microbes. Soil fertility status has attained a saturation level, and productivity is not increasing further with increased level of fertilizer application. Besides, poor soil fertility in some of the cultivable areas, less chance of natural soil fertility build-up by microbes due to continuous cultivation, frequent drought conditions and unpredictability of climate and weather patterns, rise in temperature, river pollution, poor water management and wastage of huge amount of water and decline in ground water level are threatening food production under conventional soil based agriculture (Sengupta and Banerjee, 2012) [12]. Moreover, cultivation practices in any kind of soil whether it is productive or unproductive requires a lot of effort right from plowing to harvesting. This requires not just once but after each and every crop. Media is a substrate that provides physical support, moisture and aeration to the growing plant, which also play a vital role in growth and development of plants. The important potting media are soil, sand, vermiculite, peat, cocopeat, perlite, compost and FYM (Kala *et al.*, 2017) [5]. Plastic troughs and grow bag cultivation can help people grow plants with or without the use of soil. Very less amount of soil is required in plastic troughs and grow bags as compared to cultivation on land, a good quality soil in combination with Farm Yard Manure (FYM), compost and vermin-compost can be used. In case of soilless media coco peat, vermiculite and perlite can be used in standard combinations. Other than these materials there are many other substrates or media which can be used in these troughs and grow bags for cultivation of crops. Soil-less culture is becoming more relevant in the present scenario, to cope-up with challenges. In soil-less culture, plants are raised without soil. Soil less culture can be defined as “any method of growing plants without the use of soil as a rooting medium, in which the inorganic nutrients absorbed by the roots are supplied with the irrigation water”. The fertilizers required to supply essentially containing nutrients for the maximum production of a crop to be supplied are dissolved in the appropriate concentration in the irrigation water and the resultant solution is referred to as “nutrient solution” (Savvas *et al.*, 2013) [11]. Although soilless culture has its own advantages but there are some limitations and

problems which restricts its adaptation in large scale as stated by McCall and Nakagawa (1970) [9] that two factors have limited soilless methods of production; first, economic considerations and second, commercial growers' unfamiliarity with the management of growing without soil. In soilless culture, inert material is used as substrate and chemical fertilizers are applied but according to different researches organic matter and high cation exchange capacity increases the absorption and storage of nutrient, water and also by creating suitable conditions for plant growth (Patel and Padhiar, 2015) [10]. In recent decades, supplying nutrient solution to plants to optimize crop nutrition (fertigation or liquid fertilization) has become routine cultural practice, not only in soilless culture but also in soil-grown greenhouse crops. Hence, the drastically restricted volume of the rooting medium and its uniformity are the only characteristics of soilless cultivated crops differentiating them from crops grown in the soil (Savvas, *et al.*, 2013) [11].

Growing Media

There are many types of growing media which are used in troughs, grow bags and pot cultivation practices of horticultural crops. In all kinds of growing media combinations of different substances is implied to achieve most suitable media. These media are mainly of two kinds first is soil based and second is soil less.

1. **Soil based media:** Soil is widely used even in case of potted cultivation as soilless media requires specific cultivation practices and regular monitoring of media for the required outcome. Sometime in soilless media addition of organic matter is required to find its full potential. There are many researches which have used soil based media. Some of them are discussed here. In soil based media sand, FYM and vermicompost is mainly used in combination with soil. It has different texture and effect on the growth of a crop. Preparation of soil based media is shown in Fig.1.

Fig 1: Preparation of soil based media

a. Soil+Sand+FYM: Combination of this media is widely used for the nursery raising and cultivation of crops in troughs, grow bags and pots. There are many combinations which are used for the preparation of this media. Some of them are given here to find the best suitable media.

Gama *et.al.* (2015) [3] conducted an experiment to investigate the effect of soil media on seedling growth of two tomato cultivars (Makis F1 and Nirvana F1) on different soil media. Soil media treatments were used either alone or in combination (Farm Yard Manure (FYM), compost, canal silt, FYM + compost, FYM + canal silt, compost + silt and FYM + compost +silt). Soil media containing mixture of equal proportion of FYM, compost and canal silt are recommended for raising tomatoes seedling as their combination improved both germination and subsequently growth compared to soil media used alone. FYM is not recommended to be used alone in raising tomatoes seedlings since it has high concentrated nutrients which lower seedling growth.

Bhasotiya (2014) [2] carried out an investigation which comprised of five seed sources and eight combinations of three potting mixtures with different ratio and found the treatment combination of S_5T_7 (Mehsana Division seed source and potting mixture of Soil: Sand: FYM @ 2:1:2) noted significantly maximum seedling growth parameters (shoot length, collar diameter, number of leaves per plant, fresh and dry weight of seedlings and seedling survival percentage) whereas treatment combination of S_5T_8 (Mehsana Division seed source and potting mixture Soil: Sand: FYM @ 1:2:2) noted highest root length.

Singh and Bahadur (2007) [14] studied to standardize nursery raising technique for onion. The treatments comprised combinations of soil, sand, FYM and vermicompost. Altogether, 14 treatments were applied in a Randomized Block Design (RBD) with three replications. Among all the treatments, the combination of soil 2 parts, sand 1 part and FYM 2 parts, significantly influenced growth and health of seedlings and produced the maximum seedling height (11.42 cm), stem diameter (0.33 cm), root length (10.86 cm), shoot fresh weight (6.96 g), root fresh weight (3.22 g), total seedling fresh weight (10.18 g), shoot dry weight (3.95 g), root dry weight (1.53 g) and total seedling dry weight (5.48 g). Highest benefit: cost ratio of 3.72 was also seen in this treatment combination.

Patel and Padhiyar (2015) [10] carried out a research to study the "Clonal propagation of Mentha using different media" at the Medicinal and Aromatic Plants Nursery, ACHF, Navsari Agricultural University, Navsari. The planting medium was Cocopeat, Vermicompost, Vermiculite + Cocopeat (1:1), Cocopeat + Vermicompost (1:1), Vermicompost + Vermiculite (1:1), Soil mixture (Red soil + Sand + Vermicompost) (1:1:1), Control - Soil mixture (Yellow soil + Sand + Vermicompost) (1:1:1). It is concluded that (Red soil or yellow Soil + Sand + Vermicompost) (1:1:1) was the most effective treatment in all respect of shoot and root growth characters of Mentha in 75% net house under South Gujarat conditions. In all the parameters studied a soil mixture of Yellow soil + Sand + Vermicompost (1:1:1) exerted the similar effect to that of treatment of soil mixture (Red soil + Sand + Vermi Compost – 1:1:1) and found equally effective for growth of mentha stolons/cuttings. Least results were obtained with coco-peat medium.

Sharma *et al.* (2004) [13] evaluated different potting materials using soil, sand and FYM in different ratios for raising Acacia auriculiformis seedlings in nursery. Soil, sand and FYM at a volumetric ratio of 2:1:2 was found to be best among the tried combination for raising acacia auriculiformis seedlings. Tiwari and Saxena (2003) [16] reported significantly higher dry weight of shoot and root of Dalbergia sissoo seedlings in the potting mixture of soil, sand and FYM (1:2:2) i.e. 78.9 g and 50.4 g, respectively.

b. Soil+Sand+FYM+Vermicompost: Soil, sand and FYM is also used along with vermicompost in potting mixtures. It has its own advantages as vermi compost is a good source of balanced nutrients for plants.

Kala *et al.* (2017) [5] found that the potting media comprising of Soil: Sand: FYM: Vermicompost (2:1:0.5:0.5, v/v/v) recorded highest values in terms of all yield attributing characters and yield. The study indicated that most desirable

and presentable potted plants of Chrysanthemum can be raised by using soil: sand: FYM: Vermicompost (2:1:0.5:0.5, v/v/v) as growing media.

Kameswari *et.al.* (2014) [6] indicated that maximum values for plant height, plant spread, number of branches per plant, duration of flowering, flower weight, spray length and number of flowers per plant in the media containing Cocopeat + Sand + FYM+ Vermicompost; the maximum flower diameter, however, was found in T_3 (Soil+ Sand+ FYM+Vermicompost (2:1:0.5:0.5)). Chemical analysis of the soil indicated that T_3 (Soil+ Sand+ FYM+ Vermicompost) was found to be superior over T_7 (Cocopeat + Sand + FYM+ Vermicompost) in terms of nutrient content.

2. **Soilless media:** Many types of soilless media is now used in the cultivation of horticultural crops in potted system. Cocopeat, perlite, vermiculite, rockwool, clay pellets are some of them.

Fig 2: Preparation of cocopeat media

a. Cocopeat without organic matter: Cocopeat is an inert matter which does not has any nutritive value itself and all the nutrition is provided externally by water soluble fertilizers or any other sources. Cocopeat is used in combination with perlite, and vermiculite in which no organic matter like FYM, vermicompost is mixed and it performs differently as compared to cocopeat with organic matter (Fig.2). In some cases cocopeat alone is used as growing media.

Lekhpal (2017) [8] conducted irrigation management with six irrigation levels in tomato with Cocopeat media under protected cultivation. The result showed that I_1 (0.8 IW:CPE) was found best irrigation level from water use efficiency point of view.

Kameshwari *et al.* (2014) [6] revealed that analysis of the potting media showed that all the combinations had sufficient amount of nutrients essential for plant growth except the treatment with Cocopeat alone. The lowest plant height of 25.72 cm was recorded in T_4 where coco peat was used alone as shown in Fig. 3. The least plant spread (15.89 cm) and correspondingly the less number of branches per plant (7.39) was noticed when only coco peat was used as a potting media without any organic manure.

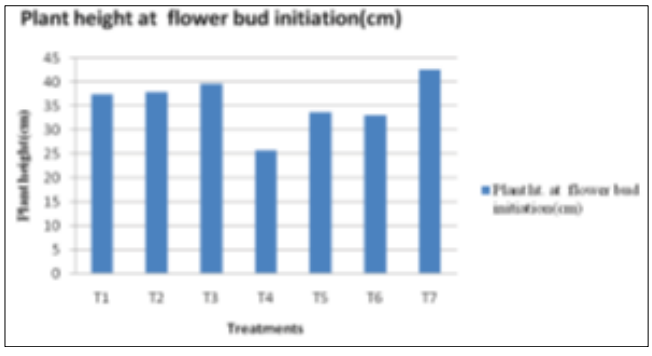

Fig 3: Plant height in cocopeat alone

Khalaj *et al.* (2011) [7] studied the effect of different substrates on growth and yield of Gerbera. Treatments were as fallowing: fine sand, peat + fine sand (25%+ 75%), peat + fine sand (50% + 50%), perlite + peat (75% + 25%), perlite + peat (50% + 50%), perlite + peat (25% + 75%), perlite + peat + expanded clay (25% + 70% + 5%), perlite + peat +expanded clay (50% + 25% + 25%), perlite + peat + expanded clay (25% + 50% + 25%), perlite + expanded clay (50%+ 50%), cocopeat, cocopeat + perlite (75% + 25%), cocopeat + perlite (50% + 50%), coco peat + perlite + expanded clay (50% + 25% + 25%), plants were fertilized with a same nutrient solution. They reported that the growing medium containing perlite + peat + expanded clay (25% + 70% + 5%) was the best treatment.

***Source*:** Soumya and Usha, 2015 [15]

Fig 4: Cultivation in Soilless media

b. Cocopeat with organic matter: Pure Cocopeat do not poses any nutritive value because it is made from coco husk which is found from the coconut.

Soumya and Usha (2015) [15] evaluated tomato in soilless culture, the experiment comprised of two pot culture experiments. First experiment was to standardize the growth media for soilless culture. The experiment consisted of eight treatments, namely, Coir pith + FYM (1:1), Coir pith + FYM (1:2), Coir pith compost + FYM (1:1), Coir pith compost + FYM (2:1), Coir pith compost alone, Neopeat + FYM (1:1), Neopeat + FYM (1:2) and potting mixture (1:1:1 soil, sand and FYM), replicated thrice. Coir pith compost +FYM (2:1) was found to be the best soil less media for tomato cultivation in grow bags (Fig.4).

Albaho *et al.* (2013) [1] investigated the suitability of some locally available materials in Kuwait. Four combinations of media were used as substrates *viz*. M1- 38 35% peat moss/40% perlite/25% vermicompost, M2-25% peat moss/25% perlite/25% vermicompost/25% coco peat, M3-100% coco peat and M4- 50% perlite/50% peat moss as control. Experiments were carried out in a cooled greenhouse. Experiments with cucumber cultivar "Banan" revealed that the growing media M1 and M2 are the best substrates for use in the growbag technique.

Ikram *et al.* (2012) [4] used different potting media in different combinations of FYM, poultry manure, sand, leaf compost and coconut coir in equivalent ratio in tuberose. Coconut coir + FYM contributed to the maximum values of plant height, leaf area and spike length.

Conclusions

On the basis of this study it can be concluded that different types of growing media is widely used for the cultivation of horticultural crops in troughs, grow bags and pots. A combination of soil with FYM or vermicompost is a good source of growing media as well as nutrition for plants as it is easily available and economical. Also concluded that the cocopeat in combination with any organic matter performs

better than the cocopeat alone which may because of nutrition provided by the organic matter to the media.

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