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Research review on use of different rooting media in fruit crops

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Abstract
Rooting medium is any type of substrate that encourages root growth. This substrate normally comprises of different organic component and minerals. The best type of rooting medium depends on a grower's available materials and plant species. A rooting medium is any grow media used to start new plant, whether they are seeds or cuttings. Different rooting media like sand, soil, peat moss, coconut husk, vermiculite and perlite etc. are used for growth of new seedling or cuttings. But the success of rooting media is differing in place to place, material used and propagation method, etc.

Keywords: Rooting media and effect on fruit plants

Introduction
Growing media is defined as the mean where the roots of cultivated plants grow (Kampf, 2000) [18] and the primordial function is to give support to growing of plant (Kampf, 2000; Robert, 2000) [18, 41]. The suitability of the media depends on the species, type of cutting, season, used propagation system, and the cost and accessibility of the medium components (Macdonald, 1986; Ofori-Gyamfi 1998; Wilson *et al*., 2001; Hartmann *et al*., 2002; Fabbri *et al*. 2004;; Osaigbovo and Orhue, 2012) [29, 35, 49, 12, 9, 37] and also confirm by other researchers (Mehri, H. *et al*., 2013; Loach, 1988; Leakey *et al*., 1990) [31, 28, 26]. The growing media should be porous, uniform in texture, hold sufficient moisture and should be well drained (Sardoei *et al*. 2014) [43] which provides physical support, aeration and water (Kester *et al*., 1990; Larsen and Guse, 1997; Bhardwaj, 2014) [19, 25, 6]. According to Loach (1988) [28], the rooting media should be considered an integral part of the propagation system; percentage rooting and the quality of the roots produced are directly influenced by the medium. Mixtures such as perlite plus peat, coconut fiber or vermiculite have also given good results (Fabbri *et al*., 2004) [9]. The type of rooting media and their characteristics are of greatest importance for the quality of rooted cuttings (Khayyat *et al*., 2007) [21]. Soil-less media have become very popular among propagators because of their consistency, excellent aeration, reproducibility and low bulk density, which minimize the shipping and handling costs of the medium itself and of the produced plants (Mamba, Wahome, 2010) [30]. Commercial mixtures are habitually used because they are sterilized, easy to use and may even contain some fertilizer. Apart from the selection of proper ingredients, it is necessary to maintain the porosity of the potting mixture so that proper development of root takes place (Srivastava *et al*., 1998) [48]. The selection of the proper media components is critical to the successful production of seedlings (James and Michael, 2009) [16] because media play an important role in seed germination and directly affect the development and later maintenance of the extensive functional rooting system (Bhardwaj, 2014) [6]. Suitable growing medium provides sufficient anchorage or supports the plant, serves as a reservoir for nutrients and water; allows oxygen diffusion to the roots and gaseous exchange between the roots and atmosphere outside the root substrate (Abad *et al*., 2002) [1]. Mixtures such as perlite plus peat, coconut fiber or vermiculite have also given good results (Fabbri *et al*., 2004) [9]. In this paper, an attempt has been made to put forward review of works done by different scientists on the effect of different rooting media on cuttings and its survival.

Effect of rooting media on vegetative characters
The type of rooting media and their characteristics are of utmost importance for the quality of rooted cuttings (Khayyat *et al*., 2007) [21]. Although, effects of different pot mixtures on plant growth and development have been previously investigated (Douglas *et al*., 2000; Nowak,

Strojny, 2003; Samartzidis *et al*., 2005) [8, 34, 42]. Singh and Mann (1976) [46] planted the seedlings of Trifoliate orange (*Poncirus trifoliate)* in seven different planting media *viz*. soil, silt, FYM, soil + FYM (1:1), soil + FYM (1:3), silt + FYM (1:1), silt + FYM (1:3) and after eight and twelve month they found maximum number of leaves 29.5 and 48.8, respectively, in soil treatment. According the Bhagat and Saraswati (1988) [5] the 100 per cent sprouting was observed in River silt while maximum shoot length (22.03 cm and 32.27 cm) was in soil + FYM (1:1) medium and maximum number of leaves (159.66) and leaf area (458.56 cm^2) were obtained in soil + FYM (1:1) ratio medium. In mulberry Sharma in 1993 [44] found semi-hardwood cuttings in FYM + Soil (1:1) produced maximum sprouting, leaf number and leaf size which was (15.50), (7.00) and (61.87 cm2), respectively while maximum shoot length (12.46 cm) was obtained in FYM + soil + sand medium. In Cashew (*Anarcadium occidentalis*) and African breadfruit (*Treculia africana*) percentage total seedling emergence and seedling vigor were better in medium 1:2:3 (Baiyeri (2003) [4]. Sand + peat (1:1) proved to be a superior potting medium followed by sand + peat + spent compost of Button mushroom (1:1:1) for growth of rough lemon (*C. jambhiri*) nursery stock (Khan *et al*. (2006) [20]. Parasana *et al*. (2013) [39] found Soil + Sand + Farm Yard Manure (2: 1: 1) was most effective for better germination (77.33%) of mango stone as well as growth of mango seedlings mango (*Mangifera indica* L.). The maximum height of seedlings i.e. 44.33, 47.93 and 51.13 cm was recorded in Soil + Sand + Farm Yard Manure (2:1:1) media at 60, 120 and180 DAS, respectively. Similarly at 60, 120 and 180 days also, Soil + Sand + Farm Yard Manure (2:1:1) media produced significantly maximum number of leaves per plant i.e. 8.78, 12.11 and 15.22, respectively. The highest number of shoots and number of leaves (5.16 and 25.44, respectively) were recorded for *Berberis thunbergii* cuttings in the sand medium. Longest shoot (1.60 cm) was obtained with *Myrtus communes* cuttings, when cultivated in soil conditioner compost. The largest number of leaves (25.44) was counted from *Berberis thunbergii* cuttings, when cultivated in the local compost, with no significant differences with soil conditioner compost for the same species (Mohammed, 2013) [33]. Panchal *et al*. (2014) [38] found at 90, 135 and 180 DAP, treatment combination M2P1 (Soil + Sand + Vermicompost) (1:1:1) + IBA(1000 ppm) showed significantly maximum plant height (9.50, 15.56 and 20.55 cm), number of leaves per plant (8.78, 16.33 and 21.33), number of branches per plant (1.56, 2.56 and 4.67), leaf area per plant (16.22, 19.00 and 21.44 cm2) and stem dry weight (1.66, 2.68 and 4.30 g). Mishra (2014) [32] found the maximum plant height, number of branches and leaves per air layer were noted with soil or peat soil + FYM + sand, followed by soil or peat soil + FYM (1:1) without sand.

Effect of media on rooting

Herath *et al*. (1978) [13] observed, *Vitis labrusca* cv. Improved Isabella, rooted well in sand (65.2-69.0% rooting) and in a medium made up of equal parts of sand and topsoil (63.0-82.2% rooting). In jack fruit (*Artocarpus heterophllus* Lam.) Chatterjee and Mukherjee, 1980) [7] observed vermiculite proved to be the best rooting medium with 86 per cent rooting and sand proved to be poor with 70 per cent rooting in cuttings. Shelton and Moore (1981) [45] obtained the highest rooting in cuttings of bush blue berry (*Vaccinium conymbosum*) cv. Blue Crop and Collins (84.2%) in vermiculite (pH 6.2) followed by 2:1 peat/sand mixture (77.9%) with pH 4.4 and 1:1 peat/sand (76.5%) with pH 4.6. In litchi (*Litchi chinensis* L.) Lenka and Das 1981) [27] concluded the highest rooting (32.8%) was obtained in cuttings treated with IBA at 3000 ppm and the best medium was second grade perlite 0.5-1.0 mm. Pokomy and Austin (1982) [40] reported that the softwood terminal cuttings of wood ward and Tifblue blue berry (*Vaccinium ashei*) rooted better in media containing milled pine bark alone or mixed with equal part of perlite than in sphagnum peat moss alone or mixed with peat. Gemma *et al*. (1982) [11] reported that a natural rooting co-factor found in Hakuto peach cuttings reached maximum levels 4-7 days before roots formed, the level of this co-factor was greater in cuttings treated with IBA than in untreated cuttings. Extracts from fresh leaves of *Prunus pauciflora* (*Pseudocerasus*) promoted root formation on *P. pauciflora*. In another experiment *P. pauciflora* cuttings prepared with an oblique cut at the base rooted better (78%) than cuttings prepared with a horizontal base, peeled or cut in other ways (8.66%). Bhagat and Saraswati (1988) [5] obtained maximum root numbers in pomegranate cuttings under FYM + soil i.e. 37.16 while maximum root length (25.68 cm) was recorded in medium soil+FYM+sand (1:1:1). Kosina (1989) [23] reported that IBA treated cuttings of the 9 cultivars of peach taken between 15 and 25 June, rooted successfully (88.9%) in a peat: sand (1:3) substrate under mist. Rooted cuttings were over wintered in peat beds in the open. Sharma (1993) [44] found semi hardwood cuttings of mulberry gave the highest root number (16.00) and root length (15.50 cm) in FYM + soil. Hoffman *et al*. (1995) [14] found blue berry cuttings gives maximum percentage of rooting in sand: compost (2:1) under intermittent mist. Kishore *et al*. (2001) [22] observed sawdust was a superior rooting medium for root initiation in Kiwi fruit hardwood cuttings, but subsequent root and shoot development was better in sand. Antunes *et al*. (2003) [3] observed the highest rooting percentage of fig cv. Roxodevalinhos hardwood cuttings in the soil: sand medium in the absence of stratification. Lakra (2004) [24] obtained maximum root number (11.90) in leaf mould + sand (1:1) while, FYM + soil (1:1) had maximum root length (11.18 cm) in case of passion fruit. Most significant effect on rooting percentage and root numbers was obtained on 5 January and 4 February in vermiculite and 19 February in vermiculite + sand, respectively Ansari (2013) [2]. Mishra (2014) [32] found the highest rooting percentage in success of air layers in kagzi lime in soil or peat soil + FYM + sand (1:1:1 ratio) followed by soil or peat soil + FYM (1:1) without sand.

Effect of media on success and survival of rooted cuttings in nursery and field

According the Singh and Singh (1973) [47] Lemon cuttings varieties Eureka and Seedless gives maximum survival percentage (95.5%) with IBA 2000 ppm in sand + compost medium. In jackfruit (*Artocarpus heterophllus* Lam) Chatterjee and Mukherjee (1980) [7] observed vermiculite gave the best survival (58.00%) after one year and sand proved to be the worst (43.00% survival) after one year. The highest percentage of marketable cuttings of bush blue berry (*Vaccinium corymbosum*) cv. Blueray, Blue Crop and Collins was obtained on peat (65.50%), followed by two per cent peat/sand mixture (64.30%) Shelton and Moore (1981) [45]. Survival rates of 70-93 per cent were obtained in two node stem cuttings of peach using vigorous young stock plants, two node cuttings and soil mix-soil + peat+ vermiculite (1:1:1), subsequent growth appeared similar to seedling growth (Okie, 1984) [36]. Bhagat and Saraswati (1988) [5] reported that river

silt was the best medium for the maximum percentage of success (76.66%) as well as survival percentage (64.99%) of pomegranate cuttings than other media. According Sharma (1993) [44] in semi hardwood cuttings of mulberry, maximum success percentage and survival percentage was obtained in FYM + soil that were 47% and 41%, respectively. Firoz *et al*. (1997) [10] found the highest success rate (79.1 and 80.2%) of sour cherry was found with the medium containing 50 per cent sand + 50 per cent cowdung, followed by 50 per cent soil + 50 per cent sand and 33 per cent sand + 33 per cent soil + 33 per cent cowdung. Baiyeri (2003) [4] observed the percentage survival of African breadfruit after mild moisture stress was highest in medium top soil, poultry manure and river sand (1:2:3). Lakra (2004) [24] obtained maximum root number (11.90) in leaf mould + sand (1:1), while, FYM + soil (1:1) had maximum root length (11.18 cm) in passion fruit and also reported maximum success percentage (55%) in nursery and maximum field survival (85.3%) in semi-hardwood cuttings planted in the medium, FYM + soil (1:1). Parasana *et al*. 2013) [39] found the maximum survival (79.19%) of germination and seedling growth of mango (*Mangifera indica* L.) was recorded in Soil + Sand + Farm Yard Manure (2:1:1). Irshad *et al*. (2014) [15] recorded maximum survival percentage (22.46%) in Kiwi fruit in Silt: Garden soil: FYM at the ratio of 2:1:1. Mishra (2014) [32] observed the maximum (87.8 to 93.3%) rooting in air layering of kagzi lime with the rooting media having a mixture of peat soil + FYM with or without sand in1:1:1 ratio and highest survival percentage (82%) found in soil or peat soil + FYM + sand in 1:1:1 ratio, while, minimum (54.33%) was observed in soil. Panchal *et al*. (2014) [38] observed the minimum mortality (7.33, 12.00 and 21.00%) was noted with Soil + Coco peat + FYM (1:1:1).

Economics of Propagation

Jha (1991) [17] studied the air layering of custard apple and found maximum benefit: cost ratio of 2.11 was noted in treatment T6 (sawdust and IBA 5000ppm). Lakra (2004) [24] found the maximum benefit: cost ratio was recorded in FYM + soil (1:1) i.e. 2.53 with a net return of Rs.4842/- for 10 sq.m area. Minimum net return (Rs.-3033/-) and benefit: cost ratio (0.56) was observed in peat moss.

Conclusion

On the basis of above mentioned review it is conclude that rooting media, not only affects the percentage of cuttings rooted, but also the quality of roots produced and rooting medium has four basic functions: (i) It holds the cuttings in place, (ii) It supplies moisture to the cuttings, (iii) It supplies oxygen to basal portion of cuttings, (iv) It also provides nutrients. But the success of rooting is depending to environmental factors and medium to be used.

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