The Pharma Innovation Journal 2023; 12(1): 1364-1369

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(1): 1364-1369

www.thepharmajournal.com
Received: 09-11-2022
Accepted: 21-12-2022

**Reetika Sharma**
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Parshant Bakshi**
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Rakesh Kumar**
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Maanik**
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Manmohan Lal**
University Institute of Agricultural Sciences (UIAS), Chandigarh University-Gharuan, Mohali, Punjab, India

**Corresponding Author:**
**Reetika Sharma**
Division of Fruit Science, SKUAST-Jammu, Chatha, Jammu and Kashmir, India

# Effect of growing media on fruit crops: A review

**Reetika Sharma, Parshant Bakshi, Rakesh Kumar, Maanik and Manmohan Lal**

**Abstract**
As a result of growing urbanisation, industrialization, and iceberg melting, it is anticipated that the area of arable land under cultivation will significantly decline (a clear consequence of global warming). Production has once again crossed the threshold of soil fertility saturation despite adopting increased fertiliser treatment levels. Some factors, such as poor soil fertility, frequent drought conditions, unpredictable climate and weather patterns, an increase in temperature, river pollution, inadequate water management and waste of enormous amounts of water, and a decrease in groundwater level, pose a threat to the viability of traditional soil-based agriculture. Fruit crops, which have a larger production potential and better nutritional value than other horticulture crops, will be the greatest choice for achieving both food and nutritional security. Due to their huge area requirements, land scarcity is the main drawback of fruit growing. The recent new coronavirus 2019 (COVID-19) pandemic crisis has had a substantial influence on the sustainable supply of fresh foods, the food supply chain, and food prices. In view of this, urban horticulture and crop growing have risen to prominence as potential means of expanding urban green infrastructure to other regions. It is anticipated that as media consumption grows globally. The effects of a prospective increase in demand are explored in relation to the availability of common growing media components like peat, coir, wood fibre, bark, compost, perlite, stone wool, and tuffs, as well as less common but potentially accessible growing media constituents like sphagnum, water, and biochar. The impact of trends like the recirculation of drainage solution, the use of organic fertilisers, and advancements in remote growing is examined in relation to how irrigation, drainage, and support systems alter growth media demands. In conclusion, the world's rapidly expanding media market is very dynamic and has the potential to grow fourfold between 2017 and 2050, with Asia seeing the greatest per-continent use. Growing media can improve public health, quality of life, and the sustainable production of horticultural crops.

**Keywords:** Urbanisation, soilless cultivation, growing media and soil fertility

## Introduction
Growing media have proven to be effective for increasing crop output in the horticulture sector. They are designed to provide high porosity and water retention while offering sufficient aeration. It helps in adjustment of pH to 6.0 and promotes nutrient charge. Since it is the least expensive and most accessible, soil is frequently utilised as a basic medium. To supplement the soil with adequate nutrients for the seedlings, organic matter (such as vermicompost, vermiculite, perlite, and cocopeat) is added During the era of 80's, soilles cultivation approaches have become more popular and has been alleviated crop production of its dependency on soil because of saline soil, soil-borne diseases and pests, alkaline toxicity, low soil quality, high and low soil temperature factors are obstacles to obtaining yield from cultivation. The growing medium is crucial for seed germination because it provides essential nutrients for plant development in addition to serving as a support system. The seedling's quality is influenced by the medium's composition. An agent, mostly non-ionic in nature is added to peat and pine bark-based media in order to improve initial wetting and both can shows hydrophobic characteristics when the moisture content drops below 40 percent. Perlite and vermiculite are essentially used in the horticultural industry because they both provide drainage and aeration, have a large water holding capacity, and can release water as needed. They are widely accessible, non-toxic, safe to use, and moderately priced. They also have a pH that is a little bit neutral (especially perlite, which is neutral). Producers of growth medium and researchers anticipated that the market would develop along with the population increase because to the benefits of soilless growing and the projected rise in global population through 2050 (FAO, 2017b) [4]. The International Peatland Society (IPS) presented the authors with a challenge to transform this market expectation from an estimate based solely on population growth into a more complex forecast. The objective was to provide

a forecast of the increasing media quantities required in 2050. Aspects to consider included a) combining existing data to create a more global estimate of volumes traded; b) accounting for restrictions in available volumes of single materials based on environmental concerns (for example, peat), availability (for example, coir), and user quality (for example, compost); and c) weighing the seemingly incongruous trends of population growth, stricter environmental demands, a healthier way of life, increasing meat consumption, and an increase in the number of vegetarians. The purpose of this review is to publish high-quality research articles addressing effect of growing media on cultivating horticultural plants in soilless culture and seeks to give contributions from a wide range of current important subjects in the horticultural sciences, physiology, root medium qualities, plant propagation, nutrition, and chemistry of plants, substrate hydrology, physics, composting, waste management, engineering, as well as all other study domains familiar with soilless culture and growth media.

**Effect of growing media on fruit crops**

**Mango (*Mangifera indica* L.)**

One of India's most popular fruits is the mango (*Mangifera indica* L.). Its cultivation is believed to have been practised in India for more than 4000 years. Mango is a member of the Anacardiaceae family and is indigenous to the Indo-Burma area. It has high levels of minerals, carbohydrates, and vitamins "A" and "C." The mango, known as "The King of Fruits" in India, holds a prominent position among the fruits cultivated there. Kaur, 2017 conducted an experiment on the influence of growing media on germination of seeds and growth of seedlings of different cultivars of mango and it was reported that growing media containing soil, sand and vermicompost in a ratio of 1: 1: 2 was noted to be the most efficient for improved germination of mango stones as well as growth of mango seedlings in terms of minimum days taken to germination of seed (15.52), maximum germination (95.50%), greatest percentage of survival (85.25%), maximum height of seedling (68.55 cm), highest leaf number (32.50), maximum girth of seedling (11.15 mm), highest root number (50.25), maximum tap root length (30.15 cm), and maximum root girth (5.50 mm). This is because vermicompost is added to potting media, which is extremely rich in readily available nutrients like nitrates, exchangeable P, K, Ca, and Mg and is also made up of significant amounts of humic substances. This increases the accumulation of photosynthates in functional leaves and encourages better seedling juvenile and reproductive growth. Prasana *et al.* (2013) evaluated the influence of different mixture of growing media on germination and seedling growth of mango cultivars under net house conditions and it was found that the minimum days taken to germinate (27.11) and maximum percentage of germination of mango stone (77.33%) were reported in growing media which are the combination of soil, sand and FYM in a ratio of 2: 1:1. This is because the presence of FYM allows the organic acids in the medium, containing organic manures, which helps in enhancing the nutrient availability. Therefore, more easily available moisture and some acids have made it possible for germination to occur in a minimum of days and with a higher percentage in germination. Nadeem *et al.* (2016) studied on propagating media affects mango seed germination. They observed that the lowest days taken to germination (19.67) and transplantation (27.88) and maximum shoot length (35.22 cm), were noted in seeds grown in farm soil, sand and FYM. It has been demonstrated that the addition of natural organic manure and the effects of thermal heating on soil microbiota that result in steam-induced changes in soil chemical properties modify the properties of the media and encourage the quick growth and development of plants. Gebregiorgs *et al.* (2021) [5] experimented on how different nursery potting material affected the germination and seedling growth of different mango cultivars and concluded that the maximum percentage in germination (97.8%), maximum height of plant (37.90 cm), maximum length of root (30.40 cm), highest root number (5.16) was noted in treatment combinations of local mango cultivar with full top-soil and is statistically at par with local mango cultivar in combination with top soil, FYM and sand in a ratio of 3:2:1, whereas the highest leaf number (18), maximum area of leaf (86.68 cm) and the maximum diameter of stem (0.75 cm) was reported in soil media composition of Top soil, FYM and sand in a ratio of 3:2:1. Similarly, soil media combinations at compositions of top soil, sawdust and sand in a ratio of 3:2:1 gave higher shoot number (2.44). This is a result of the nutrient availability provided by the various combinations of soil potting media, which may have helped to enhance the rooting zone soil physico-chemical properties and, as a result, increased nutrient assimilation, differentiation, and nutrient availability, which in turn led to an increase in the production of photosynthates and functional leaves. Lad *et al.* (2020) researched on the impact of several potting mixtures on the sprouting, survival, and development of softwood grafts of the mango variety Alphonso, they found that soil + FYM (3:1) had maximum sprouted percentage (93.33%), whereas the cocopeat + leaf manure + compost in a ratio of 1:1:2 noted maximum height of plant (124.79%), node number (2.27), leaf number (17.87), length of root (23.46 cm) and root dry weight (8.92 g), while the maximum survival percentage (82.67%), percent increment in girth of graft (39.89%), shoot number (1.67), area of leaf (678.46 $cm^2$) and relative growth rate (0.0237 cm/cm/day) was noted in cocopeat + leaf manure + compost in a combination ratio of 1:1:1. The maximum absolute growth rate (0.0747 cm/day) was reported in treatment soil, leaf manure in a combination ratio of 1:1 at 180 day after grafting. They came to the conclusion that the optimum soilless nursery media for developing softwood mango grafts of the cv. Alphonso variety was the medium with cocopeat, leaf manure, and compost in a combination ratio of 1:1:2. When compared to soil, growing media has a greater impact on seedling growth and development, according to a review of all studies on the subject.

**Citrus (*Citrus sp*.)**

Citrus fruits, which are members of the Rutaceae family, are among the most popular fruits worldwide. Citron, grapefruit, limes, lemons, oranges, tangerines, and limes are all included. These fruits are enriched with a variety of nutrients, including minerals, vitamins, fibre, and phytochemicals, which have important effects on human health. The rootstock significantly affects the scion's growth and development, as well as the fruit's nutrition, yield, and quality, and its ability to withstand environmental and biological stresses. Consequently, when establishing citrus orchards, rootstock selection is quite important. Citrus seedling’s growth is influenced by a number of factors, including cultivation methods, various rooting medium growth regulators, and their combinations. Because substrates with the proper aeration, moisture, and nutrients help

in the formation of excessive roots that are crucial for the growth of high-quality plants, the rooting medium should be composed in a way that meets the chemical and physical needs of crops to maximise their growth and development. The effects of various growing medium and Gibberellic Acid ($GA_3$) concentrations on rough lemon (*Citrus Jambhiri*) seed germination and its growth characteristics were examined by (Qadri *et al*., 2021) [15]. They found that growing media with a mixture of sand, silt, and leaf manure produced seedlings gave maximum height (36.0 cm), maximum stem diameter (5.7 mm), highest number of leaves (7.9), highest number of roots (9.6), the maximum number of roots (4.6) and root weight (30.4 g). This is due to growing medium that sustains adequate aeration and moisture content for optimal seedling growth, particularly for root anchorage and development. According to Umer *et al*. (2021), the amount of seedling weight decreased after the soil was reduced (by 59.25%) and cocopeat was used (by 77.84%), and six months after the treatment, mycorrhizal inoculation significantly increased the plant height and stem diameter of citrus seedlings. It was observed that the seedling's enhanced phosphorus (P) intake was related with their better growth. Cocopeat, on the other hand, has a lot of P along with other nutrients. Patel *et al.* (2019) [13] evaluated the influence of different growing media and foliar sprays of organics on acid lime vigour and seedling growth, and they found that red soil + FYM + vermicompost (1:1:1) had the maximum percentage of germination (82.11%), height of seedling at 120, 150, and 180 DAS (29.38 cm, 38.53 cm, and 47.00 cm, respectively), number of leaves (22.48, 30.29, and 36.34), and (2.10 mm, 2.70 mm and 3.12 mm, respectively). However, red soil + FYM + vermicompost (1:1:1) was shown to have the maximum survival rate (75.26%) and the lowest death rate (24.73%) at 180 DAS. This is as a result of the positive effects of this media composition on water holding capacity, porosity, soil aeration, and supplying significant amounts of nutrients, particularly nitrogen and micronutrients for good plant growth and better nutrient availability leading to immense production of photo synthetically functional leaves, ultimately improving girth of seedling and development of plant. Singh *et al.* (2016) experimented on the impact of various growing media on shoot and its characteristics of lemon and observed that the maximum length of sprouts per cutting (8.51cm in rainy season and 4.78 cm in spring season), maximum survival percentage of cutting (79.45 in rainy season and 85.00 in spring season) and average number of leaves per cutting reported in media combination of soil, sand and cocopeat, whereas, average diameter of shoot (2.39 mm in rainy season and 1.70 mm in spring season) and average length of longest roots (9.20 cm in rainy season and 5.93 cm in spring season) were maximum in medium composition of soil and cocopeat. This is because cocopeat-based media provide the plant with adequate anchorage or support, act as a storage space for nutrients and water, and, when sand is added, allow oxygen to diffuse to the roots and allow gaseous exchange between the roots and atmosphere outside the root substrate, increasing root diameter and facilitating root penetration of the soil. According to Malakar *et al.* (2019), the lowest days taken to sprout (16.83 days) was reported in the treatment ($C_3$ Hardwood cutting + $M_1$ Sand + $G_0$ IBA 0 ppm). Further, $C_3$ Hardwood cutting + $M_4$ Cocopeat + $G_1$ IBA 500 ppm) gave the better results with respect to percentage of sprouted cuttings (47.22 per cent), number of sprouts (4.6, 24.00 and 7.40) at 30, 60 and 90 DAP respectively. These findings concluded that the growing media shows tremendous effect on producing high quality cuttings of citrus species.

**Banana (*Musa sp.*)**

The two most widely grown fruits worldwide are bananas and plantains. They are grown in 130 different nations, primarily in the southern hemisphere's tropical and subtropical areas. The quality of the seedlings and their ability to produce under field conditions are influenced by the growth medium's composition. According to Chamling and Bhowmick (2021) [1] observed that combination treatments of (Sand + Vermiculite + Vermicompost; 1:1:1) showed a significant results in survivability in field (93.33%), height of plant (210.37 cm), suckers in number (5), the maximum leaf number (17), and girth of pseudostem (67.13 cm), the maximum yield attributes, such as the maximum hand weight (2.79), diameter of fruit (38.33 mm), highest fingers per bunch (190.00) and weight of pulp (90.20 g). For the primary biochemical characteristics relevant to fruit quality, the combination treatment of sand, vermiculite alongwith vermicompost (1:1:1) obtained the maximum TSS (19.00%) and maximum ascorbic acid (13.33 mg $100g^{-1}$). This is due to the fact that sand and vermicompost, both of which were common components in their potting composition and both of which had higher values for major characters contributing to the yield, were among the qualities that were most crucial to the performance and survival of the plantlets in their external environmental conditions. The plant receives all the nutrition, defence, and root potential consequences it requires from vermicompost, and when it is coupled with sand, it can be prevented from becoming clayey and hard. This enhances the soil's texture and encourages adequate drainage, which aids in root growth, which is necessary for a solid foundation, higher nutrient absorption, and improved survival and yield under field conditions. Parkhe *et al.* (2018) studied on impact of various potting mixture on hardening of tissue culture plantlets of banana and its performance in field and they noted that the maximum plant height (185.68 cm), maximum pseudostem circumference (23.90 cm), number of functional leaves (13.83), leaf area (238.93 $dm^2$), number of suckers (2.75), chlorophyll content (1.405), survival percentage (93.50), of plantlets were observed throughout in secondary hardening in garden soil along with FYM in a combination ratio of 3:1. This is because of the ability of FYM to enhance the biological characteristics of soil may be the cause of its improved performance. Sand, on the other hand, might be the source of adequate aeration. Therefore, garden soil combined with FYM and garden soil in addition to vermicompost may have contributed to stronger root grip, enough aeration, and adequate organic matter. Esakkimuthu and Arumugamshakila, 2017 carried out a study on influence of different growing media on growth parameters of Banana and noted that the pseudostem height (33.66 cm), pseudostem girth (5.33 cm) and leaf number produced by sucker (4.46) were favourably influenced by the treatment FYM with combination of VAM. In case of production of roots, Rice hull combined with VAM was observed to be the best treatment. Furthermore, percentage of survival (90.87%) of plants was higher in the treatments in which FYM was used as the growing medium along with VAM. This is due to the reason of FYM which enhanced the growth media's pH, ability to hold water, organic matter content, and microbial activity. Better growth is achieved by the crop plants having access to more chemical components as a result of the breakdown of

organic materials. Sebayang *et al.* (2018) [20] studied on impact of various planting media on the growth of banana suckers and reported that height of Barangan banana plants aged 2, 4 and 6, the maximum (18.24 cm, 23.91 cm and 27.91 cm respectively) WAP was reported in soil without mixture, but at the age of 8 (90.24 cm) WAP is one othe best growth was observed in soil, droppings of goat, sand in a combination ratio of 2: 1: 1. This is because goat excrement affected the addition of organic matter to the soil and decreased soil weight. Low soil weights will foster the development of plant roots and, inadvertently, facilitate nutrient absorption. Another consequence of goat dung is that due of its granular nature, it has the ability to enlarge soil pores.

**Guava (*Psidium guajava*)**

Both historically and commercially, guavas are propagated through seeds. However, due to the process of segregation as well as recombination, the genetic purity is not maintained. Plants that are sexually propagated bear their fruit later than those that are asexually propagated, and certain varieties having distinctive features that cannot be kept or multiplied through seed propagation. It is challenging to standardize superior cultivars because of these obstacles. Clonal propagation is obviously the best method for preserving fruit quality and preventing the segregation. Cuttings from prominent mother plants can be used to propagate plants that are true to type in one growing season. Various plant species have different rooting habits; some plants readily and easily start rooting while others take much longer to do so after being damaged. In current situation, it is clear to standardize the propagation method, when the planting material is limited as a result of the massive increase of land. In an experiment examining the effectiveness of guava cutting under various growing media and plant cutting, it was discovered that the silt media had significantly maximum number of root (28.78 ± 3.99), length of root (24.95 ± 5.00 cm), leaf number (4.88 ± 0.53), sprouts number (3.79 ± 0.64), length of shoot (26.86 ± 4.63 cm), length of sprout (19.09 ± 3.05 cm), diameter of stem (5.30 ± 0.65 mm), dry weight of guava cutting (139.25 ± 14.92 mg), fresh weight of guava cutting (877.57 ± 27.26 mg) and percentage of survival (83.33 ± 16.33%) (Qadri *et al.*, 2018) [16]. This is because a rooting medium with good porosity will allow nutrients to be absorbed quickly, boosting growth. The silt media having low bulk density, better aeration and good drainage produced noticeably more response than other media. Sharma *et al.* (2020) [23] studied on the effect of media on growth of seedling in Guava cv. L-49 under protective condition and reported that when cocopeat was used as the medium, guava seedling germination took place in the fewest days when they were sown at the start of the fortnight in August, and the most leaves appeared in the first two weeks of September. It could be due to its effect on the apical meristem, which increased the production of the nucleoprotein essential to increasing and temperature also plays a vital role in physiological conditions, cocopeat's higher water-holding capacity, and its high lignin-cellulose content. Rani *et al.* (2015) [18] observed that the softwood cutting of guava performed better in the media combination of vermiculite, sand with FYM (1:1:1) showed highest rooted cuttings (78.69%), number of new shoots per plant (10.42), maximum height of plant (26.49 cm), maximum number of leaves per plant (25.08) and maximum stem thickness (1.14 cm). The higher number of shoots is due to more available potassium and magnesium contained in the vermiculite as it has high nutrient holding capacity than perlite. Rani *et al.* (2018) [19] studied on the impact of rooting media on production of shoot and survival of terminal cuttings in Guava cv. Taiwan Pink and concluded that cocopeat gave the best results in terms of rooted cuttings percentage, shoot dry weight per cutting, leaf number per cutting, leaf area per cutting, total leaf chlorophyll content and survival percentage of rooted cuttings. This is so that the aeration condition of the medium is improved by the ability of cocopeat to incorporate coarser material. In order to supply $O_2$ to the growing roots and remove $CO_2$ that is released to the environment by roots and soil-dwelling microorganisms, aeration is necessary for the gaseous exchange between the soil and atmosphere. This improves plant respiration and increases plant survival.

**Papaya (*Carica papaya* L.)**

The papaya, also known as a papaw or papita, is a fruit that originated in tropical America and has gained popularity because of its quick growth, maximum yield, lengthy fruiting period, and high nutritional content. Additionally, it has been used to prepare vegetables, fruits, and papain at an early stage. It is currently a crop that can be quite profitable. The papaya plant has several intricate forms, including male, female, hermaphrodite (bisexual flower), and others. The type of substrate being used, environmental factors, etc., have an impact on seedling vigour. Papaya growers struggle with issues like slow, inconsistent, and partial germination as well as significant initial seedling mortality. This improves the germination rate and results in papaya seedlings that are healthier. The best propagation method is through seeds. Re-establishment in the field and the ultimate yield of a papaya orchard are influenced by the seedlings quality and it should be purchased from a registered nursery. The seedling's vigour determines the plant's vigour. Thus, care must be taken starting at the nursery stage in order to increase the vigour of the seedlings. When choosing a papaya potting medium, consider factors such as how physically stable it is, whether it interferes with plant nutrition, how light it is for simple transport, and how much soil-borne disease it can prevent. When seedlings are uplifted for transplanting, a suitable media should have the ability to intact with the root zonal system. Jiya and Wilson, 2020 studied the influence of growing media on seedlings of papaya and stated that treatment Soil + Pond Soil + Cocopeat in a combination ratio of 1:2:1 was noted better in days taken to germinate (9.00), percentage of germination (95.00), leaves per seedling (16.00), seedling length (17.10), seedling girth (7.53), seedling vigor index (1989.00), seedling fresh weight (27.00), seedling dry weight (8.66) and root dry weight (0.94). This is because the media composition has a conducive impact on the soil porosity, the soil's ability to retain water, and the availability of large amounts of nutrients, particularly nitrogen and micronutrients for better root and shoot growth as compared to soil. Dash *et al.* (2019) [2] investigated on the different growing media impact on seed germination and seedling growth of papaya cv. Pusa Nanha and noted that the maximum seedling vigour (94.27%), maximum stem girth (7.42 mm), maximum leaf number (8.90), length of root (10.81 cm), maximum shoot fresh weight (3.76 g), maximum root fresh weight (1.02 g) and maximum shoot root ratio (4.19) as recorded under Pond soil (10%) + Vermicompost (30%) + Vermiculite (30%) + Perlite (30%). This is because vermiculite and perlite, both of which give better aeration and drainage,

absorbs large amounts of water and release it when requires. They have a somewhat neutral pH (particularly perlite, which is neutral), are commonly available, negligible toxic, safe to use, and reasonably priced. They are also sterile and disease-free. Similar to compost, vermicompost is a combination of living earthworms, their cocoons, organic matter, humus, and other creatures and helps to give nutrients to the seedlings.

**Strawberry (*Fragaria* × *ananassa*)**

The strawberry belongs to the Rosaceae family and the genus Fragaria. It is a good source of dietary fiber, carbohydrates, potassium, vitamins, and other nutrients. They are also distinctive and have a highly enticing flavour and taste. In the winter and early spring, it is marketed. It is said to be a profitable fruit because it sells for high prices. One of the fruits that responds best to soilless cutivation methods. The growing media is a better source and also show effectiveness on plantlets, plant density, and fertigation that determine strawberry yields in soilless cultivation. The yield, the number of fully developed leaves, the dry weight of the shoots and roots, and the quantity and length of roots were all affected by the growth medium. These morphological characteristics were associated to yield. Growth medium also had an influence on accumulations of nutrients by plants, such as the increase the concenteration of available forms of phosphorus (P), nitrogen (N), and potassium (K) in the root zonal area as well as all other micronutrients except for boron (B). Shahzad *et al.* (2018) [22] conducted a study on different types of growing media and also different dimensions of plant spacing for the better production of strawberry and concluded that the highest chlorophyll content (12.53), highest yield (626.03 g), highest TSS value (8.45 $^{0}$Brix), greatest fruit width (28.16 mm) and maximum fruit length (39.14 mm) were observed in soil along with peat moss. The study found that even in soil-based cultivation, peat moss enhanced strawberry fruit output and quality. The use of organic soil additives, which are promoted in this study, does not gave assurance about the sustainability of organic farming. Strawberry production needs to produce better output with better benefit cost ratio, which would be be lucrative in terms of size of fruit and also its quality by protecting the environment, conserve resources through sustainable usability, and be run in a socially as well as economically responsible manner. Thakur and Shylla, 2018 studied on growing media impact on plant growth and yield of strawberry and revealed that the plant height (29.19 cm), leaf number (18.31), area of leaf (135.08 cm2), length of root (19.16), number of runners (40.00), the yield per plant (203.32 g) were observed under perlite along with farmyard manure as compared to control. Raja *et al.* (2018) was carried out a study on influence of different medias on strawberry growth and its quality cv. chandler in soilless culture system. The results revealed that the growing media (coco peat + vermiculite) in a ratio of 25:75 gave the maximum length of petiole (16.77 cm), spread of canopy (42.75 cm), diameter of crown (2.10 cm), fresh weight of shoot (17.16 g), dry weight of shoot (4.36 g), fresh weight of root (16.53 g), dry weight of root (5.13 g), number of leaves (17), total leaf area (1542cm$^2$), fruit weight (10.76 gm), diameter of fruit (27.48 mm), length of fruit (29.89 mm) whereas the growing media (Coco peat + Perlite + Vermiculite) in a ratio of 50:25:25 showed maximum height of plant (28.36 cm), length of shoot (23.13 cm), length of root (32.40 cm) and TSS (10.8 B°) and lowest acidity (0.86%) in comparison to control (Sand). This is a result of the greater exchange of elements, particularly cations, within the growing media and optimum distribution of moisture, which enhances uptake of nutrients in root zonal area which ultimately, helps in increment of plant height and were efficient for strawberry cultivar growth in terms of the plant's above and underground parts of plants. Sharma and Godara (2016) [24] experimented on effect of soilless growing media and sizes of container on shoot growth of strawberry cv. Sweet Charlie. and concluded that maximum number of leaves (10.45 and 15.42), petiole length (9.19 cm and 9.18 cm), spread of plant (27.43 cm and 30.24 cm), plant height (15.26 cm and 16.27 cm) and diameter of crown (17.44 mm and 18.10 mm) were reported in (cocopeat + perlite + vermicompost in ratio of 3:1:1), whereas, minimum growth was observed in control (soil). Lakshmikanth *et al.* (2020) revealed that the plant height (29.13 cm), number of trifoliate leaves per plant (27.80), plant spread in N-S and E-W direction (31.27 cm and 30.21 cm, respectively), number of crown per plant (4.56), area of leaf (108.26 cm$^2$), runners per plant (6.13), plant dry weight (38.50 g) at harvest, net income (₹1,22,183 / 1032 m$^2$) and benefit to cost ratio (2.04) was noted maximum in treatment $T_4$ i.e soil + cocopeat + vermiculite + vermicompost in 1:1:1:1 ratio on volume basis. This is owing to the fact that higher micronutrient, macronutrient, carbohydrate (%), and protein (%) contents as a result of vermicompost increased sugars content. Additionally, potassium (K) encourages the accumulation of sugar in strawberries, and N, P, and K balance were discovered to be crucial for the appropriate accumulation of sugar. The increment in enzyme activity results in accumulation of total sugars and finally produced greater sugars to acid ratio.

**Conclusion**

Therefore, it appears likely that growers will utilise a wider range of materials in growing media in the future. These materials will have been developed by manufacturers using models based on in-depth analyses of their primary chemical and physical characteristics, tailored to the needs of particular crops and production systems. Finding reliable and sustainable sources of suitable materials, comprehending their properties so they can be used properly in blends, and ensuring growers have enough knowledge of them to be able to make any necessary changes in nursery practices to irrigation, crop nutrition, or machinery use, for instance to get the best results will be the challenges. Following a review of the literature enable us to conclude that growing media play a significant role in influencing the qualitative and quantitative aspects of the economic significance of the fruit crop.

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