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A Review on Different Types of Media and Their Effects on Tomato Seedling Production

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Abstract

Different types of media viz., cocopeat, perlite, vermiculite, sand, soil, FYM, rice husk, vermicompost, arka fermented cocopeat, mushroom substrate, etc. With different combination where the seeds are sown in protrays or in a field. The media effect the seedlings in promoting the growth with high germination percentage, better development of shoot and root, reducing the incidence of disease. The most economical treatment for seedling production is traditional practicing media (soil, sand and farmyard manure). Vermicompost alone promoted better growth of the seedlings, but are difficult to handle due to its weight.

Keywords: Media, cocopeat, perlite, vermiculite, germination percentage and tomato seedlings.

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1. Introduction

Tomato (*Solanum lycopersicum* L.), from family solanaceae, with chromosome number 2n=24, originated from western South America and Central America (Peru and Bolivia). India is the second largest producer of tomato in the world after China. Tomato is the world's largest consumed vegetable crop. It is most consumed vegetable after potato and onion. In India, tomato is the 2nd major vegetables producing among the vegetables. Area under cultivation of tomato area India is estimated to have 8,52,000 ha and with production of 19.39 million tonnes (NHB, 2018-19).

Tomato is a good source of vitamins (A, C, E) and minerals that are very good for body and protect it against diseases (Olaniyi *et al*., 2010). Particularly Vitamin A helps in the immune system and in circulation of blood while vitamin C helps to maintain body structure, bone structure and strengthen the teeth. It also helps in muscles contraction and relaxation. (Ali *et al.*, 2020). It has an important antioxidant compound, known as lycopene (Rai *et al*., 2013). Tomatoes are consumed in diverse way such as salad, sauce, drinks, sandwiches, raw etc. And several processed items like puree, paste, syrup, ketchup etc are used around the world particularly in fast food industry (Adhikari *et al*., 2017). Due to increasing populations the demand of tomatoes is increasing day by day. The supply and demand have a direct relation with tomato production (Fatemi *et al*., 2018).

Seedlings raised using portrays, germinate early and vigorous compared to the nursery beds. There is free pest, root development and better nutrient availability. Protrays are mostly used for growing vegetables.

The traditional methods used to improve the crop yield are fertilization and irrigation, however both methods have associated disadvantages like economic and environmental problems (Sivachandiran *et al*., 2017). Weak germination and emergence in direct seeding is the main problem in the field (Hassan *et al*., 2012). Problems like lanky seedlings, incidence of damping off and less germination in seedlings are also important factor associated with poor production.

The growing media may contain soil or soilless media. A soilless media is mainly composed of perlite, cocopeat, vermiculite, sand, rice husk, vermicompost and other material where the seeds are inserted. The best growing media should have the water holding capacity, proper aeration and adequate nutrition supply (Hartmann *et al*., 2011). In vermicompost there is the presence of nutrients such as nitrates, phosphates and exchangeable calcium and soluble potassium it also contains plant growth influencing materials produced by micro-organisms (Joshi *et al*., 2010). Whereas the Rice husk compost applications improved soil physicochemical properties and increased tomato yield. It also increased the field capacity, permanent wilting point, organic matter content, exchangeable Mg, K and available P contents, and decreased the BD, soil pH, Na and exchangeable Ca of the soil (Demir *et al*., 2015). Seedlings are grown in different media for the better growth and development. Different organic and

inorganic media viz. cocopeat, saw dust, rice husk vermiculite, perlite, hydroton, pumice, sand etc. It was found that these media are not easily, cheaply and locally available for users (Patil *et al*., 2020).

2. Different types of media

2.1 Cocopeat + vermiculite + perlite

Coir dust, or cocopeat, the mesocarp of the fruit, is a by-product of coir manufacturing and is a by-product of coconut processing and has been proposed as a possible alternative to peat in growth media due to its suitable physical and chemical properties. As a by-product of coir manufacturing, cocopeat has been unused or burnt in the open. In recent years, cocopeat has been considered as a viable replacement for peat in horticulture, due to environmental concerns and diminishing peat soil supplies (You *et al*.,1998; Arenas *et al*., 2002). The combination of cocopeat, vermiculite and perlite are the most common media used for growing seedlings in vegetables crops. It has advantages like disease and weed free, light in weight, quicker growth and high germination percentage. Cocopeat, vermiculite, perlite is good for better growth of seedlings as well as easy handling of portrays, cocopeat which is having natural rooting hormones and antifungal properties, vermiculite and perlite which improves water holding capacity, permeability and airflow in the media (Nissi *et al*., 2018). Among the three different growth media, coir pith was a good growth media with acceptable pH, electrical conductivity and other chemical attributes. It has the virtuous oxygen diffusion and provides support to fast growth of the seedlings due to availability of better nutrition with water in root zone of seedlings (Vivek *et al*., 2019). A study conducted in 2018 confirmed that coco peat in combination with vermiculite (25:75) and coco peat in combination with Perlite and vermiculite (50:25:25) produced maximum growth as well as good quality fruit in strawberry cv. Chandler (Raja *et al*., 2018).

2.2 Arka fermented cocopeat

Arka fermented cocopeat (AFC) is a substrate obtained by the bioconversion of coir pith in 30 days period. This technology has been standardized at ICAR-IIHR, Bengaluru. It is immensely popular for raising seedlings of vegetable crops. However, under soilless condition AFC has not been evaluated so far as a growing media. Among soilless culture AFC was found to be superior to the soil and commercial cocopeat substrates with respect to growth and quality parameters of the produce (Selvakumar and Rao., 2016). Seedlings grown in soil (on raised-bed in the field) and in pro-trays using arka fermented cocopeat revealed that in all the crops were superior, excepting ‘Indra’ capsicum and ‘Nidhi’ brinjal in the raised-bed. Better quality fruits were obtained from tomato plants grown on arka fermented cocopeat than the commercial cocopeat and soil (kotur., 2014).

2.3 Vermicompost

Vermicompost is produced by biodegradation of organic material through interactions between earthworms and micro-organisms. There is the presence of nutrients such as nitrates, phosphates vermicompost. Vermicompost contains plant growth influencing materials produced by micro- organisms (Joshi *et al*., 2010). Vermicompost is reported as having bioactive principles considered to be beneficial for root growth, root initiation, germination and growth of the plant, as also having a balanced composition of nutrients (Nissi *et al*., 2018). Organic matter from vermicompost may also improve nutrient availability and improve phosphorus absorption, and all these factors are favoured for seed germination, height of seedlings, root length, leaf area, fresh and dry weight of shoot and root. Porosity, drainage, water holding capacity and microbial activity are high in vermicompost. Height of the seedling, leaf area, fresh weight was highest in vermicompost conducted by nisshi and his coworker. Sheep-manure vermicompost as a soil supplement increased tomato yields and soluble, insoluble solids and carbohydrate concentrations (Gutiérrez *et al*., 2007). Even though vermicompost alone promoted better growth of seedlings, handling of protrays is difficult as vermicompost weights more. Vermicompost can be recommended as a fertilizer to improve tomato yield, fruit quality, soil quality and particularly for soils with no tomato planting history (Wang *et al*., 2017). The vermicompost treatments significantly increased seedling growth, also vermicompost caused a significant decrease in growth period of transplant and the minimum period (39.6 days) in the 10 wt% vermicompost. Application of 10 wt% vermicompost improved seedling growth (Fizabadi *et al*., 2016). The incorporation of vermicompost of pig manure origin into germination media up to 20% v/v enhanced shoot and root weight, leaf area, and shoot:root ratios of both tomato and French marigold seedlings, however amendment with vermicompost had little influence on pepper and cornflower seedling growth. Moreover, there was no effect on the germination of seed of any species (Bachman *et al*.,2008). Whereas

adding vermicompost to various container media significantly inhibited the infection of tomato plants by *Fusarium oxysporum* f. sp. *Lycopersici* (Szczech., 1999).

2.4 Rice husk

Rice husk is an important agricultural waste, produced in large quantity in rice husk producing countries like India as most of the population feeds on rice (Prakash *et al*., 2016). Improved of the growth parameters and yield due to rice husk addition it. Rice husk can be used in different methods viz., compost, ash and husk. Also, addition of rice husk reduced the growth of root-knot nematode. While rice husk compost applications in the greenhouses significantly reduced pH contents of soils, the RHC application increased the values of respiration rate and available phosphorus (P). (Demir *et al*., 2015) observed that RHC application to the soil in greenhouse generally improved soil quality, tomato yield and soil physicochemical properties. The tomato yields were higher in RHC treatments than in the control treatment. It was determined that RHC can be used as a soil conditioner to improve soil properties, sustain agricultural production and obtain high crop productivity. Recycling rice husk in agricultural lands by composting provides soil fertility and sustainability, and also makes a great contribution to the environment ecologically. Also, one of the methods of profiting from it was using as fertilizer for tomato harvest. The results show that the tomato was bloomed and gave greater weight crop, remove the humic acid contaminated the water, get rid of agricultural waste (RH), at the same time prepared a good and useful fertilizer for tomato harvest (Nsaifabbas *et al*., 2014). Carrot seedling emergence and yield parameters differed in rice husk-amended media under high tunnel and open field environments. The organic matter content, total nitrogen and CEC of the media increased with addition of rice husk. However, further increase of rice husk in the growth media beyond an optimum rate resulted in yield reduction (Baiyeri *et al*.,2019). Also, rice hulls do not affect plant growth regulation (Kumar., 2013). The tomato plants grown in 10, 15, 25, 30 and 35 per cent parboiled fresh rice hulls had significantly higher dry root weights than those grown in equivalent perlite containing substrates. However, 20 to 40 per cent perlite produced significantly higher dry shoot weights than the equivalent par boiled fresh rice hull containing substrate (Evans and Gachukia., 2004).

2.5 Mushroom substrate

Spent mushroom substrate, the by-product of the commercial production of the button mushroom *Agaricus bisporus*, has been identified as an alternative to peat, as a growing media substrate component (Eudoxie *et al*., 2011). The quality and effectiveness of substrate mushroom compost (SMS) was evaluated as a complete substitute for promix (PM) in the germination, growth and development of tomato seedling. When varied proportions of discarded *A*. *subrufescens* compost were used in an experiment, all of the parameters in the development of tomato seedlings decreased. The use of discarded *A*. *subrufescens* compost for seedling production resulted in increased total tomato yield, according to the findings. Because of the higher quality of collected fruit, these results showed that discarded *A*. *subrufescens* compost had a lot of promise for use in organic tomato cultivation (Lopes *et al*., 2015). Spent mushroom substrate should be considered as an alternative for the widely used but expensive and resource-limited peat in greenhouse cultivation (Zhang *et al*., 2012). Regarding the most suitable SMS-based substrates for plant growth, any substrate could be used for tomato seedling production. However, all SMS-AB- based (*Agaricus bisporus*) substrates and the media containing low dose of SMS-PO (*Pleurotus ostreatus*) and SMS-50 were adequate for growth of courgette and pepper (Medina *et al*., 2009). Crisphead lettuce seedlings grew and developed best in a substrate containing 42 to 48 percent spent mushroom substrate, resulting in vigorous marketable plants. The addition of spent mushroom substrate to high-quality lettuce seedlings yields high-quality marketable heads, and this quality improvement can be achieved (Marques *et al*., 2014).

2.6 Soil/ Sand and Farm yard manure

These are the traditional practicing media alone and in combination. Seedlings that grow alone in soil and sand does not provide enough nutrient to the plants, seedlings are not healthy and the germination are not uniform and germination percentage is low. Whereas with the combination of farm yard manure it improves the soil structure, fertility and often prevent nutrient deficiencies. Traditional practicing media does not produce higher yield, whereas the most economical treatment for seedling production is traditional practicing media (soil, sand and farmyard manure in 1:1:1 ratio) (Muhammad *et al*., 2016). Among the different growing medias M3 i.e., Soil + Sand + Farm Yard Manure (2: 1: 1) is found to be the most effective for better germination of mango seedlings

(height, number of leaves, length of root and shoot, stem girth, fresh and dry weight of seedlings as well as survival per cent of seedlings) (Parasana *et al*., 2013). In terms of seed germination (49.0 percent), seedling growth, and chemical properties of the seedlings, the soil with pH 8.1 mixed with sand and farm yard manure at a 2:1:1 ratio produces the highest germination percentage, root length. (Masilamani *et al*., 2013). Vermicompost-grown black pepper cuttings were much taller and had more leaves than potting mixtures (Soil, sand and Fym) (Thankamani *et al*.,1996).

2.7 Rockwool

Rockwool is a substrate use in hydroponic operations, it is a man-made media, as it is formed when Basalt rock and chalk are melted together at extreme temperatures. The result of this process is a substrate similar in texture and appearance to steel wool, with a dense structure consisting of long strands of fibres. Rockwool can be chopped and used as a mixed substrate component, can be incorporated into the soil, or can be used for mulching of the soil (Borosic *et al*., 2009). Due to an increase in fruit number, double-cluster plants produced 40 percent more fruit than single-cluster plants, despite the fact that the fruit were smaller in size. Fruit yield was not significantly different between plants cultivated in mini rock wool blocks (MRB) and plants grown in larger blocks. In the cultivation of limited-cluster hydroponic tomatoes, MRBs and RPM bench liners work well together (Logendra *et al*., 2001). However, the standard size of rockwool is expensive. Higher contents of ascorbic acid and total soluble sugars were found in tomato fruits collected from inoculated plants, grown on rockwool (Kowalska *et al*., 2015). In soilless circumstances, *P. aphanidermatum* strains cause root degradation, plant mortality in rockwool culture, and growth decrease in hydroponic culture. One strain of *P. aphanidermatum* considerably lowered the yield of cucumber cultivated in rockwool under conditions comparable to those used in commercial cultures (Moulin *et al*., 1994).

CONCLUSION

Among the media mention above the most economical treatment for seedling production is traditional practicing media (soil, sand and farmyard manure) whereas rockwool is the most expensive. Handling of portrays is difficult in vermicompost due its weight. Perlite, vermiculite, cocopeat in combination with vermicompost are easy to handle. Better quality fruits were obtained from tomato plants grown on arka fermented cocopeat than the commercial cocopeat and soil.

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