Biotica Research Today

Vol 2:7 686/689 2020

Media for Soilless Agriculture

How to cite this article?

Kannan *et al.*, 2020. Media for Soilless Agriculture. Research Today 2(7): 686-689.

Balaji Kannan[1], G. Thiyagarajan[1*], V. Sivakumar[2], M. Manikandan[3] and M. Nagarajan[3]

[1]Water Technology Centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu (641 003), India

[2]Coconut Research Station, Aliyarnagar, Tamil Nadu (642 101), India

[3]Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Kumulur, Tamil Nadu (621 712), India

Corresponding Author

G. Thiyagarajan

e-mail: thiyagu@tnau.ac.in

Keywords

Clay, Coir pith, Perlite, Wood saving

Article History

Received in 29th July 2020

Received in revised form 30th July 2020

Accepted in final form 31st July 2020

E-mail: bioticapublications@gmail.com

Abstract

Growing media and soil are porous and the properties of both are similar. An appropriate adaptation technique is required when soil related knowledge is transferred to media due to the differences in structure and root zone volume. Plants may be grown with their roots in the nutrient solution or in an inert medium, such as perlite, gravel, mineral wool, or coconut husk. The medium culture method has a solid medium for the roots and is named for the type of medium, e.g., sand culture, gravel culture, or rock wool culture.

Introduction

Soilless culture system has been used widely in protected agriculture to improve the growing environment and provide optimal water and nutrient supply for cultivated crops. Soilless culture can potentially improve cropping systems by optimizing the use of inputs, controlling diseases more efficiently and make it possible to increase crop production regardless of the climatic conditions. The composition of soilless substrates significantly affects plant physiology, yield and quality. The ideal soilless substrate has great total porosity, low bulk density, adequate aeration and high water holding capacity to facilitate root penetration and increase nutrient availability to the plants for multi-season applications (FAO, 1990).

Different Types of Media

One of the most obvious decisions hydroponic farmers have to make is which medium they should use (Thiyagarajan *et al.*, 2007). Different media are appropriate for different growing techniques.

Peat

Peat is formed by the accumulation of plant residues in less drained soils. The type of plant material and degrees of decomposition largely determine its value for use in a growing medium. It is classified as dark and light peat based on organic content. It is light in weight but has the ability to absorb 10 to 20 times its weight in water. Peat may be used for raising crops in poly bags, modules and troughs (Figure 1).

Calcined Clay

The clay is formed into round pellets and fired in rotary kilns at 1,200 °C (2,190 °F). This causes the clay to expand, like popcorn, and become porous. It is light in weight, and does not compact over time. Shape of individual pellet can be irregular or uniform depending on brand and manufacturing process. The manufacturers consider expanded clay to be an ecologically sustainable and re-usable growing

Figure 1: Dark Peat and Light Peat

medium because of its ability to be cleaned and sterilized, typically by washing in solutions of white vinegar, chlorine bleach, or hydrogen peroxide (H_2O_2), and rinsing completely.

A less popular view is that clay pebbles are best not re-used even when they are cleaned, due to root growth that may enter the medium. Breaking open a clay pebble after a crop has been grown will reveal this growth (Figure 2).

Figure 2: Calcined Clay

Rock Wool

Rock wool (mineral wool) is the most widely used medium in hydroponics. Rock wool is an inert substrate suitable for both run to waste and recirculating systems. Rock wool is made from molten rock, basalt or 'slag' that is spun into bundles of single filament fibers, and bonded into a medium capable of capillary action, and are in effect protected from most common microbiological degradation. Rockwool has many advantages and disadvantages. Advantages include its proven efficiency and effectiveness as a commercial hydroponic substrate. Disadvantages include its classification as a possible carcinogen (Figure 3).

Figure 3: Rockwool

Coconut Fiber (Coir Dust)

Coco Peat, also known as coir dust or coconut fibre, is the leftover material after the fibres have been removed from the outermost shell (bolster) of the coconut. Coir is a 100% natural grow and flowering medium. Coconut Coir is colonized with trichoderma bacteria, which protects roots and stimulates root growth. It is extremely difficult to overwater coir due to its perfect air-to-water ratio, plant roots thrive in this environment, coir has a high cation exchange, meaning it can store unused minerals to be released to the plant as and when it requires it. Coir is available in many forms, most common is coco peat, which has the appearance and texture of soil but contains no mineral content (Figure 4).

Perlite

Perlite is a volcanic rock that has been superheated into very light weight expanded glass pebbles. It is used loose or in plastic sleeves immersed in the water. It is also used in potting soil mixes to decrease soil density. Perlite has similar properties and uses to vermiculite but, in general, holds more air and less water. If not contained, it can float if flood and drain feeding is used. It is a fusion of granite, obsidian, pumice and basalt (Figure 5).

Figure 4: Coconut Fiber (Coir Dust)

Figure 5: Perlite

Pumice

Like perlite, pumice is a lightweight, mined volcanic rock that finds application in hydroponics (Figure 6).

Figure 6: Pumice

Vermiculite

Like perlite, vermiculite is another mineral that has been superheated until it has expanded into light pebbles. Vermiculite holds more water than perlite and has a natural "wicking" property that can draw water and nutrients in a passive hydroponic system. If too much water and not enough air surround the plants roots, it is possible to gradually lower the medium's water-retention capability by mixing in increasing quantities of perlite (Figure 7).

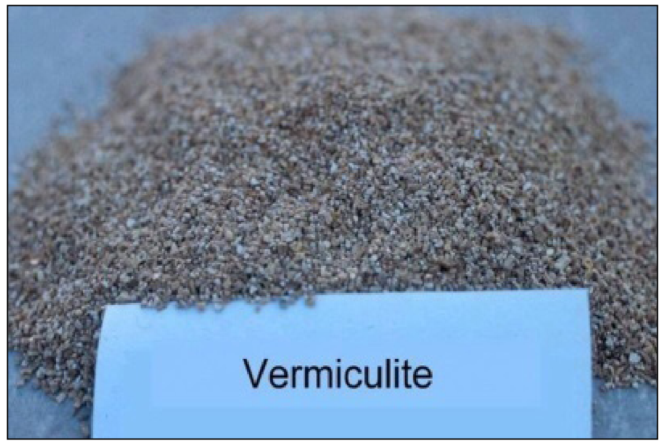

Figure 7: Vermiculite

Rice Hulls

Rice hulls are a bi-product of the rice milling process. They are extremely light in weight. Rice hulls are very effective in drainage. The particle size and resistance to decomposition of rice hulls and sawdust are similar (Figure 8).

Figure 8: Rice Hulls

Sand

Sand is cheap and easily available. However, it is heavy, does not hold water very well, and it must be sterilized between uses (Figure 9).

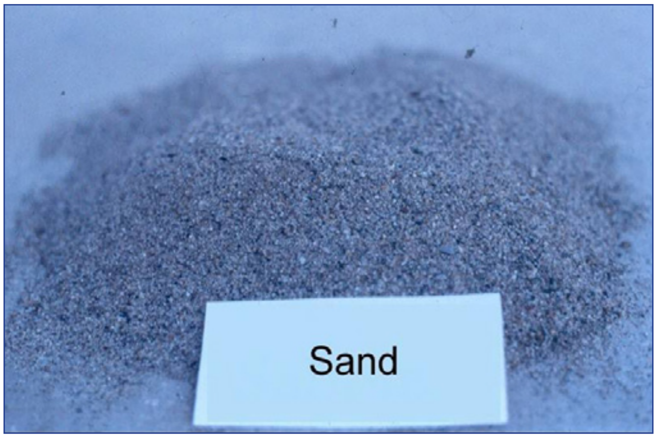

Figure 9: Sand

Wood Shaving

Wood fiber, produced from steam friction of wood, is a very efficient organic substrate for hydroponics. It has the advantage that it keeps its structure for a very long time.

With pest problems reduced, and nutrients constantly fed to the roots, productivity in hydroponics is high, although plant growth can be limited by the low levels of carbon dioxide in the atmosphere, or limited light exposure. To increase yield further, some sealed greenhouses inject carbon dioxide into their environment to help growth (CO_2 enrichment), add lights to lengthen the day, or control vegetative growth, etc (Figure 10).

Figure 10: Wood Shavings

Conclusion

Physical properties of soilless culture media greatly affect plant growth and productivity. Media particle size can substantially improve plant growth and quality. Fine particle size media has higher water holding capacity and less aeration when compared with coarse media. Air porosity and the available water are an essential prerequisite to successfully control plant growth. Soilless media composition has considerable effects on plant growth, development, nutrient content, quality and yield. The ideal media should have fundamental physical, chemical, and biological properties that will improve nutrient availability and plant growth and provide an anchor for the plants.

References

FAO Plant Production and Protection Paper No. 101, 1990. Soilless culture for horticultural crop production. FAO, Rome, pp. 188.

Thiyagarajan, G., Umadevi R., Ramesh, K., 2007. Hydroponics. Science Tech Entrepreneur.