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Selection of suitable growing substrate for vegetable nursery production in a greenhouse

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Abstract
The study was carried out in VNR Seeds Pvt. Ltd., in village Gomchi near Nandanvan of Raipur district in Chhattisgarh. Different substrates used are 100% cocopeat, 100% peatmoss, Mixture of 50% cocopeat and 50% peat moss and mixture of 60% cocopeat and 40% vermiculite. After 25 days of seed sowing growth of seedlings in tray with 100% cocopeat we found that the average stem width 3.33 mm, stem length 108 mm, leaf width 42.33 mm, and leaf length 56.66 mm. In cocopeat the sturdy plant development is found. In 100% peat moss the result found is average stem width 3 mm, stem length 91.33 mm, leaf width 33 mm and leaf length 53.33 mm and in mixture of 50% cocopeat and 50% peat moss, average stem width is 3.16 mm, stem length 100.33 mm, leaf width 42.33 mm and leaf length is 49.66 mm. In mixture of 60% cocopeat and 40% peatmoss, average stem width is 2 mm, stem length 64 mm, leaf width 35.66 mm and leaf length is 48 mm. These observation shows that growth of seedlings in tray with cocopeat is better in comparison to other substrates, therefore we considered as better growing substrate among all substrates we used.

Keywords: Cocopeat, leaf length, peat moss, seedlings, vermiculite

Introduction
Soil is the natural habitat for plants which supplies support, nutrients and water. However, where good soil is not available, where maintenance of favourable soil conditions is too expensive or where growth of high-value out-of-season crops is contemplated, there growing plants without fertile soil may be desirable. Good plant development depends to a large part on the growing medium used. The term 'growing medium' is amongst others used to describe the material used in a container to grow a plant. The terms 'substrate' (Schroeder, Sell, 2009; Vaughn *et al*., 2011) [12, 15] and 'rooting medium' (Blok, Verhagen, 2009) [4] are also used as synonyms. Successful greenhouse and nursery production of container-grown plants is largely dependent on the chemical and physical properties of the growing media (Fitzpatrick, 2001; Wilson *et al*., 2003) [6, 16]. If a plant develops a good root system in a well-balanced substrate, this does not mean that the plant is pampered and will not adapt to the harsh life outside a nursery. In fact, the opposite applies. To survive in the harsh environment of a field, often without additional watering and fertilizing, a plant needs a well-developed and strong root system.

Nursery crop production is among the fastest growing agricultural sectors. Nursery production inside a greenhouse is increasing day by day. But with the increase in production many of the problems that have been reported in the formulation of growing substrates were related to salt concentrations, water retention and nutrient release rates, all of which are critical in crop production. Therefore for a particular crop a suitable growing media or substrate is required. With keeping this all in mind, objectives of our investigations is to select a suitable growing substrate for greenhouse vegetable production.

The choice of a low-cost, good-quality growing substrate is vital to organic greenhouse vegetable production. Growing media are made of engineered materials designed to provide ideal physical and chemical characteristics for the root environment. In greenhouse agriculture, it is important that the substrate has good structural characteristics so it can hold up to frequent irrigation, root growth, drastic changes in temperature, pH and EC over the life of the crop.

Materials and Methods

Study Area: The study was carried out in VNR Seeds Pvt. Ltd., in village Gomchi near Nandanvan of Raipur district in Chhattisgarh. In order to manipulate temperature, controlled environment in greenhouse was used. Good nursery hygiene is essential if disease free seedlings are to be produced for transplanting in the field. In some circumstances it may be advisable to treat the seed for diseases by using a seed coating treatment if this has not already been done by the seed supplier.

Technical Specification

Variety	Brinjal (VNR-212)
Scientific name	Solanum melongena
Sowing period:	June – October
Harvest:	42-45 days
Seed quantity per acre:	65-70 gm
Sowing distance between rows:	60-90 cm
Sowing distance between plants:	45-75 cm

Procedure of work

Substrate preparation

Different substrate used are-

- 100% cocopeat
- 100% peatmoss
- Mixture of 50% cocopeat and 50% peatmoss and
- Mixture of 60% cocopeat and 40% vermiculite

Firstly all the substrate was soaked in water for 12 hour, one day before seed sowing. One kg of cocopeat absorbs 7-8 times of water from its weight. Peat moss has ability to absorb 10- 20 times of water from its weight. Vermiculite absorbs 5-7 times of water.

Sowing of material

The brinjal seed (variety, VNR-212) were sown in this substrate on 2nd August 2015. Four plastic trays, one having 221 cells (17 rows, 13 columns) are used for seed sowing. Each cell is 2" × 2" in size. Soaked substrate are placed in different tray in different proportion as required. It is irrigated with cold water to decrease the temperature of substrate. Not too much apply the water.

Covering of containers & placing in germination room

After sowing the seeds, trays were covered with polythene sheets and placed in germination chamber at 25^0C. Here it is kept for 3 to 4 days until seedlings come out from seeds.

Removing from germination room& placing into greenhouse

When first radicle comes out of size approx. 1-2 cm then removes it from germination room and rapidly transfers it into the greenhouse for better growth of seedlings in controlled environment. The temperature and relative humidity is maintained at 30 ^{0}C and 35% respectively.

Irrigation: After getting two cotyledon leaves, irrigate fully. The seedling was under irrigation. Water used for irrigation was drawn from a water tank. Use only quality water low in salt. Disease organisms may survive in water, so the source of the water must be considered carefully. Water should not be recycled due to the risk of infecting plants with diseases.

Fertigation

When first true leaf is started to seen, means this is the end of germination stage and it is the time to start fertigation. Fertigation is provided three times a day. Ratio of NPK which is used for fertigation is 2:1:3.

First observation of seedlings

First observation of seedlings was taken on 17th August 2015, 15th days after sowing the seed. Stem width, stem height, leaf width, leaf length, number of leaves and colour of leaves is observed and reading is taken (Table 1).

Second observation of seedlings

Second observation of seedlings was taken on 27th August 2015, 8th days after first observation. Stem width, stem height, leaf width, leaf length, number of leaves and colour of leaves is observed and reading is taken (Table 2).

Physical and chemical properties of soil-less substrate

The substrate properties that influence seedling growth can be divided into physical properties (water-holding capacity, porosity, plasticity and bulk density) and chemical properties (fertility, acidity and cation exchange capacity).

Table 1: Bulk density and porosity of some growing substrate widely used in greenhouse and nursery crops.

Substrate	Bulk density (kg/m3)	Total porosity (%v/v)
Peat moss	60-100	90-95
Dark peat	100-150	85-90
Vermiculite	90-150	90-95
Perlite	80-120	85-90
Rockwool	80-90	94-97
Cocopeat	118-126	94-96
Ideal	190-700	50-85

Table 2: Cation exchange capacity and pH value of some substrates

Material	Cation Exchange	pH values	Water Holding Capacity	Weight	Cost
Soil	Poor	4.5-6.0	Poor	Heavy	Low
Peat moss	Fair	3.5-4.0	High	Lightweight	Medium
Bark	High	4.0-5.0	Medium	Medium to Heavy	Low
Sand	Poor	4.5-6.0	Poor	Heavy	Low
Perlite	None	6.0-8.0	Poor	Very Lightweight	High
Vermiculite	High	4.0-5.0	Good	Very Lightweight	High
Compost	High	4.5-6.0	good	Medium	Low

Results and Discussion

Growth of seedlings in different substrate

100% Cocopeat

The seeds were sown in this substrate on 2nd August 2015. Four plastic trays, one having 221 cells (17 rows, 13 columns) are used for seed sowing. The average physical characteristics are stem width 2mm; stem length 59 mm, leaf width 33mm, leaf length 42 mm and no. of leaves 4.6. The results of growth of seedlings in 100% cocopeat is shown in table 3

After 10 days of first observation, average physical characteristics are stem width 3.33 mm; stem length 108mm, leaf width 42.33 mm, leaf length 56.66mm and no. of leaves 5.66. Results of second observation are shown in table 4.

100% Peat moss

The seeds were sown in this substrate on 2nd August 2015. Four plastic trays, one having 221 cells (17 rows, 13 columns) are used for seed sowing. The average physical characteristics are stem width 1.66 mm; stem length 43.33 mm, leaf width 24 mm, leaf length 34.66 mm and no. of leaves 4. The results of growth of seedlings in 100% peat moss is shown in table 3

After 10 days of first observation, average physical characteristics are stem width 3 mm; stem length 91.33mm, leaf width 33 mm, leaf length 53.33mm and no. of leaves 5. Results of second observation are shown in table 4.

50% Cocopeat + 50% Peat moss

The seeds were sown in this substrate on 2nd August 2015. Four plastic trays, one having 221 cells (17 rows, 13 columns) are used for seed sowing. Average physical characteristics are stem width 2 mm; stem length 55 mm, leaf width 33.66 mm, leaf length 38.33 mm and no. of leaves 4. The results of growth of seedlings in 50% cocopeat and 50% peat moss is shown in table 3.

After 10 days of first observation, average physical characteristics are stem width 3.16 mm; stem length 100.33 mm, leaf width 42.33 mm, leaf length 49.66 mm and no. of leaves 5. Results of second observation are shown in table 4.

60% Cocopeat + 40% Vermiculite

The seeds were sown in this substrate on 2nd August 2015. Four plastic trays, one having 221 cells (17 rows, 13 columns) are used for seed sowing. Average physical characteristics are stem width 0.4 mm; stem length 29.66 mm, leaf width 23.66 mm, leaf length 26.66 mm and no. of leaves 3.66.The results of growth of seedlings in 60% cocopeat and 40% vermiculite is shown in table 3.

After 10 days of first observation, average physical characteristics are stem width 2 mm; stem length 64 mm, leaf width 35.66 mm, leaf length 48 mm and no. of leaves 5. Results of second observation are shown in table 4.

From considering both observations table 3 and 4 and graphs fig 1 and fig 2, growth of seedlings in the tray with only cocopeat is better comparison to other substrates and growth of seedlings in mixture of cocopeat and vermiculite is poor. Observing the growth of seedlings in different substrate we can say that cocopeat is best growing substrate among all substrates we used. After that mixture of 50% cocopeat and 50% peat moss provides better results. Fig 3 shows the difference in growth of seedlings of different substrates.

Table 3: Data of first observation on 17/08/2015

Substrate	Stem Width (mm)	Stem Length (mm)	Leaf Width (mm)	Leaf Length (mm)	Number of Leaves
100% COCOPEAT	2	59	33	42	4.6
100% PEATMOSS	1.66	43.33	24	34.66	4
50% COCOPEAT + 50% PEATMOSS	2	55	33.66	38.33	4
60% COCOPEAT + 40% VERMICULITE	0.4	29.66	23.66	26.66	3.66

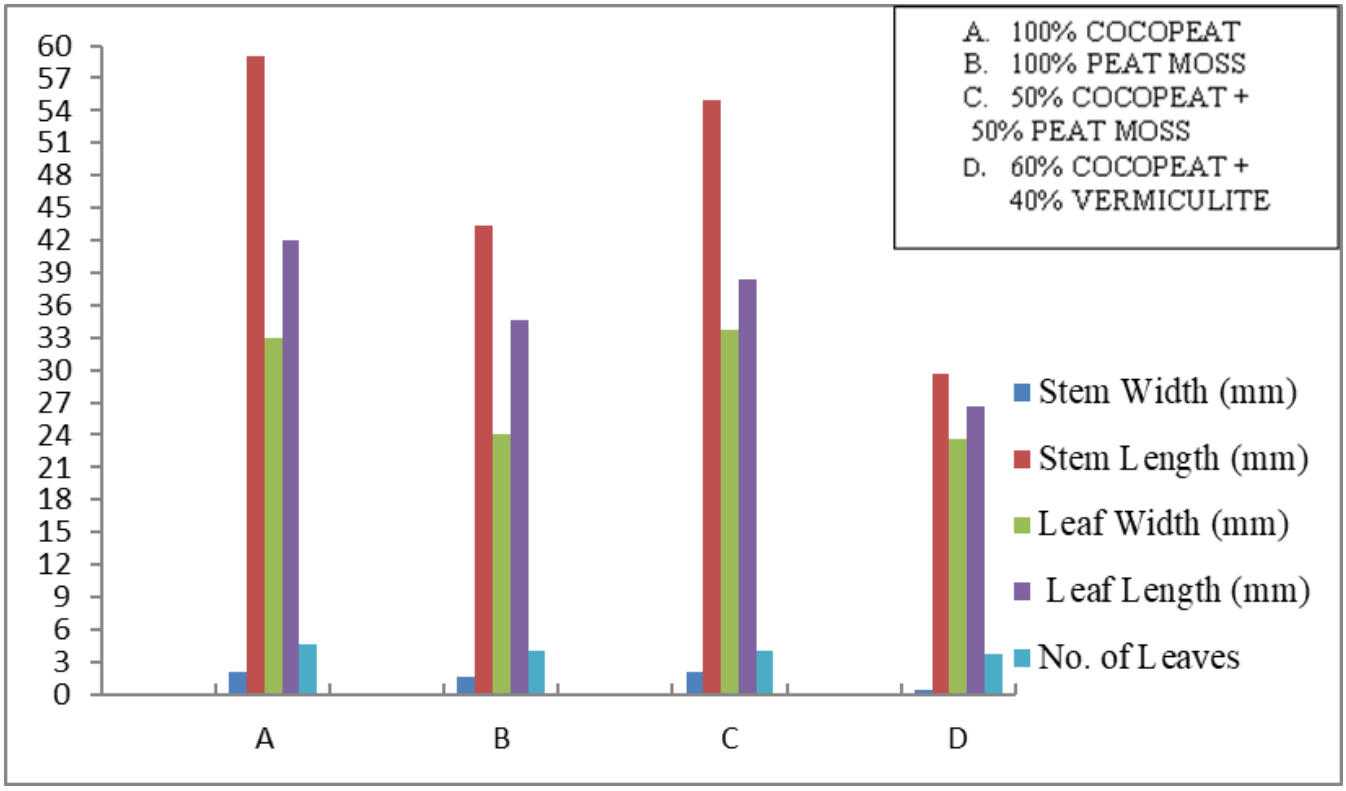


Fig 1: Graphical representation of 1st observation after 10 days of germination

Table 4: Data of second observation on 27/08/2015

Substrate	Stem Width (mm)	Stem Length (mm)	Leaf Width (mm)	Leaf Length (mm)	Number of Leaves
100% COCOPEAT	3.33	108	42.33	56.66	5.66
100% PEATMOSS	3	91.33	33	53.33	5
50% COCOPEAT+ 50% PEATMOSS	3.16	100.33	42.33	49.66	5
60% COCOPEAT+ 40%VERMICULITE	2	64	35.66	48	5

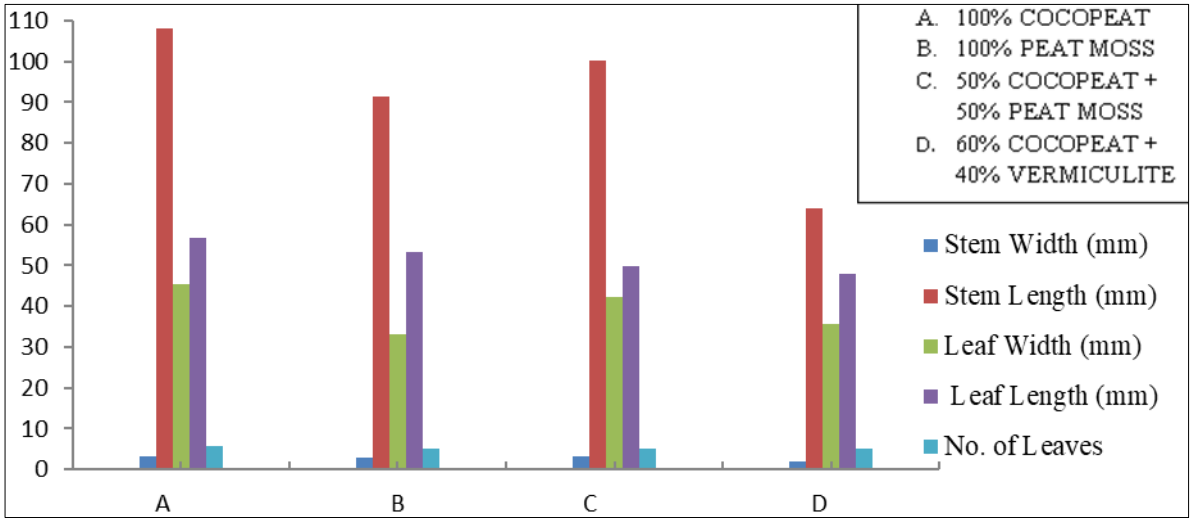
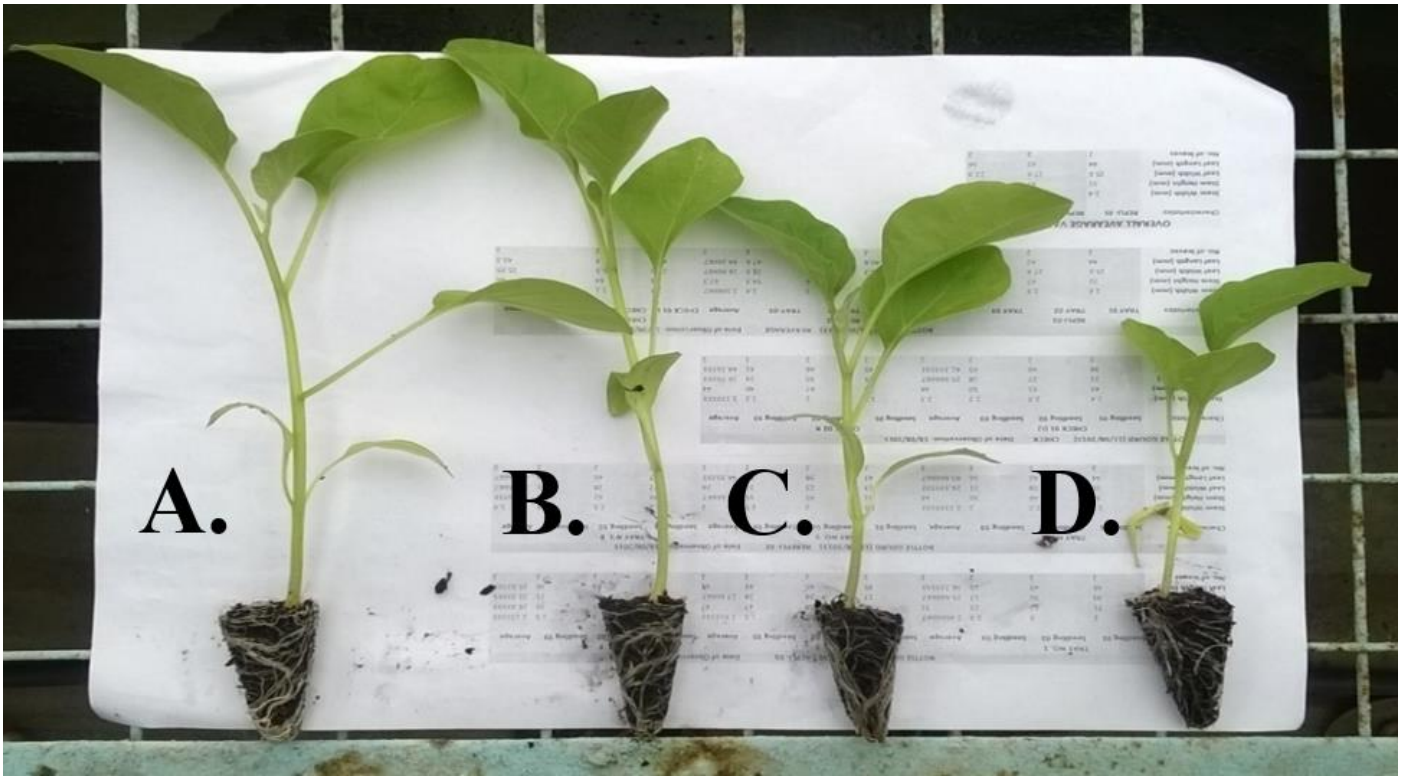


Fig 2: Graphical representation of 2nd observation after 20 days of germination



a. 100% Cocopeat
b. 50% Cocopeat + 50% Peatmoss
c. 100% Peatmoss
d. 60% Cocopeat+ 40% Vermiculite

Fig 3: Comparison of growth of seedlings in different media

Conclusions

Use of suitable growing media or substrates is essential for production of quality horticultural crops. It directly affects the development and later maintenance of the extensive functional rooting system. A good growing medium would provide sufficient anchorage or support to the plant, serves as reservoir for nutrients and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate. Top soil is used as a part of growing medium by many nurserymen. It is a non-renewable resource. Increasing utilization of available land for physical and infrastructural development rapidly declines the supply of quality topsoil and thus promoting the utilization of soilless materials in the production of horticultural crops.

A good growing medium would provide sufficient support to the plant. Sturdy growth of seedlings is obtained in tray with cocopeat and tray with mixture of 50% cocopeat & 50% peat moss. Growth of seedlings in the tray with only cocopeat is better comparison to other substrates and growth of seedlings in mixture of cocopeat and vermiculite is poor. Observing the growth of seedlings in different substrate we can say that cocopeat is best growing substrate among all substrates we used. After that mixture of 50% cocopeat and 50% peat moss provides better results.

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