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**Akshay KR**
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mudigere, Karnataka, India

**Narayana Swamy M**
Department of Crop Improvement & Biotechnology, College of Horticulture, Mudigere, Karnataka, India

**Raviraj Shetty**
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mudigere, Karnataka, India

**Ganapathi M**
Department of Crop Physiology, College of Horticulture, Mudigere, Karnataka, India

**Thippeshappa GN**
Department of Soil Science and Agril. Chemistry, College of Horticulture, Mudigere, Karnataka, India

**Correspondence**
**Akshay KR**
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mudigere, Karnataka, India

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# Efficacy of media and growth regulators on rooting of black pepper (*Piper nigrum*) cuttings

**Akshay KR, Narayana Swamy M, Raviraj Shetty, Ganapathi M and Thippeshappa GN**

**Abstract**
The present research was conducted at ZAHRS, Mudigere, Karnataka to know the optimum concentration of growth regulators and different types of media to induce rooting in black pepper cuttings under greenhouse conditions. The study revealed that, among the different growth regulator formulations the IBA 1000 ppm formulation helped in better induction of rooting by over 70 per cent as against 43. 33 per cent in the control. However, the cuttings treated with proven growth regulator concentration (IBA 1000 ppm) was raised in the media comprising soil + sand + FYM + vermin compost (1:1:1:1 v/v) significantly increased the different shoot parameters of cuttings such as, days to sprout, number of leaves per cutting, length of shoot, percentage of sprouting, fresh and dry weight and root parameters such as, minimum days to rooting, higher percentage of rooting, higher number of primary roots, maximum fresh and dry weight of roots. Hence the study proved that, the cuttings treated with growth regulator IBA 1000 ppm concentration and raised in rooting media of soil + sand + FYM + vermin compost (1:1:1:1 v/v) were proven best for propagating Black pepper cuttings.

**Keywords:** Black pepper, Growth regulator, Media, Root parameter, Shoot parameter

## Introduction
India is the land of spices. The flavour and fragrance of Indian spices had magic spell in human civilization and culture. India contributes about 40-50 per cent of world's production of spices (Parthasarathy and Madan, 2010) [1]. Black pepper (*Piper nigrum* L., Family: Piperaceae) popularly known as "king of spices", is the oldest and most important spice crop grown in India. It is native to Western Ghats and it is grown in 26 countries including India, Indonesia, Srilanka, Thailand, China, Vietnam, Cambodia, Brazil, Mexico and Guatemala.

Black pepper is widely used spice in the world and it is an indispensable item in the preparation of processed meat, sauces, soups, curry powders and pickles. From medicinal point of view it is used as a carminative, stomachic and febrifuge. The major economic products from pepper are black pepper and white pepper. Other value added products like pepper oil and oleoresin find increasing use in food industries of developed countries. Besides some new forms of pepper like preserve green pepper in brine, vinegar, dehydrated green pepper etc. are becoming more popular. Hence the black pepper is also called as 'Black gold' on account of its economic importance. (Devasahayam *et al.*, 2010) [2].

Black pepper can be propagated through seeds and vegetative methods. Owing to its heterozygous nature, seedlings do not breed true to type and known to have long pre-bearing period. Hence, vegetative propagation through cuttings is commercially adopted. Besides this grafting, budding and layering are also practiced. But propagation through cuttings is easier hence it is preferred for large scale multiplication. Cuttings taken from runners shoots (Creeping shoots on the ground) and orthotropic shoots (erect growing shoots) are used commercially for vegetative propagation.

Availability of adequate quantity of quality planting material for large scale multiplication is one of the major constraints in increasing the productivity of pepper in India. The recent developments like, use of growth regulators, media, greenhouse or mist technology, rapid multiplication techniques are found helpful in solving this problem to a greater extent. In this context plant growth regulators (PGRs) have great potential in increasing the agricultural

production and help in removing the barriers imposed by genetic and environmental factors. Plant growth regulators play a vital role in improving the rooting in black pepper cuttings. This would improve the vigour of freshly transplanted plant material in the field and reduces the rate of mortality of plants. Hence, the study conducted to know the efficacy of media and growth regulators on rooting of black pepper (*piper nigrum*) cuttings.

**Material and methods**

The present investigations were carried out in naturally ventilated polyhouse with completely randomized design at Zonal Agriculture and Horticultural research station, Mudigere. The healthy cuttings of Panniyur-1 variety were procured from ZAHRS, Mudigere. The cuttings having two nodes with thickness of 0.8-1.0 cm diameter and 10 cm length were selected. For rooting media a potting mixture consists of jungle soil, sand and FYM in the ratio of 2:1:1 was filled into 20 × 12 cm sized perforated polythene bag of 200 micron thickness. Before planting the cuttings, media was drenched with Copper-oxy chloride (0.3 %) as a prophylactic measures against fungal diseases.

Several growth regulator formulations were used at different concentrations. Each treatment was replicated thrice, with 100 cuttings per replication. The Growth regulator formulations are $T_1$ Control (dipped in tap water)**,**$T_2$- IBA 500 ppm**,** $T_3$ - IBA 1000 ppm**,** $T_4$- IBA 1500 ppm**,** $T_5$- NAA 250 ppm**,** $T_6$- NAA 500 ppm**,** $T_7$- NAA 1000 ppm**,**$T_8$- IAA 1000 ppm**,** $T_9$- IBA + NAA 250 ppm**,** $T_{10}$- IBA + NAA 500 ppm**,** $T_{11}$- IBA + NAA 1000 ppm**.** Where, IBA = Indole Buteric Acid, IAA= Indole Acetic Acid and NAA=Naphthalene Acetic Acid. Before preparing the stock solutions, IAA, IBA and NAA were dissolved in 0.1 N NaOH solutions. Required concentration of the growth regulator solution was taken and the cuttings were dipped upto 1.5 – 2.0 cm deep in the solution for one minute. Then they were air dried subsequently for few seconds and immediately two cuttings per polythene bag were planted and placed in naturally ventilated poly house.

Among rooting media, there were thirteen treatments used singly or in combination. Each of the treatment consisted of 100 cuttings replicated thrice. The experiment was conducted in naturally ventilated poly house. The growth regulator formulations viz., IBA, 1000 ppm was used as a standard pre-treatment to all cuttings. The media formulations are $T_1$- Soil:Sand:FYM (2:1:1), $T_2$ -Soil:Sand:FYM:SD (1:1:1:1), $T_3$ - Soil:Sand:FYM:SD (2:1:1:1), $T_4$ - Soil:Sand:FYM:SD (3:1:1:1), $T_5$ - Soil:Sand:FYM:CD (1:1:1:1), $T_6$ - Soil:Sand: FYM:CD (2:1:1:1), $T_7$ - Soil:Sand:FYM:CD (3:1:1:1), $T_8$ - Soil:Sand:FYM:CPC (1:1:1:1), $T_9$ - Soil:Sand:FYM:CPC (2:1:1:1), $T_{10}$ - Soil:Sand: FYM:CPC (3:1:1:1), $T_{11}$ - Soil:Sand: FYM:VC (1:1:1:1), $T_{12}$ - Soil:Sand:FYM:VC (2:1:1:1), $T_{13}$ - Soil:Sand: FYM:VC (3:1:1:1). Where, FYM= Farm yard manure, SD= Saw dust, CD= Coir dust, CPC= Coffee pulp compost and VC= Vermi compost.

Observations like root parameters (Days taken for root initiation, Percentage of cuttings rooted, Number of roots per rooted cutting, Length of the longest root, Fresh weight of roots per rooted cutting, Dry weight of roots per rooted cutting) and Shoot parameters(Number of days taken for sprouting, Per cent sprouting, Length of new shoot per cutting, Number of leaves on sprout per cutting at 30, 60 & 75 days after planting, Fresh weight of shoot per rooted cutting, Dry weight of shoot per rooted cutting) were recorded.

**Result and discussion**

**Effect of Growth regulator on root and shoot parameters of Black pepper cuttings**

**Shoot parameters:** The data (Table 1 and 2) clearly indicates the significant influence of growth regulators on all shoot parameters as compared to control. IBA was superior to NAA. The combination of IBA and NAA at different concentrations was not so effective in respect of shoot parameters studied. However IBA at 1000 ppm concentration recorded early sprouting, maximum per cent sprouting, length of shoot, number of leaves, fresh and dry weight of shoots as [2] in guggal may be due to better utilization of stored nutrients and other factors hastened the sprouting.

**Root parameters:** An early root induction was observed in all the cuttings treated with growth regulators especially with IBA as compared to NAA, IAA and in combination of IBA and NAA. IAA was also quite helpful in inducing early rooting compared to control which took maximum number of days for root induction in black pepper cuttings. Hormones like substances were formed in developing bud, which transfer through phloem to the base of the cuttings, where these stimulate rooting. The basis for this may be enhanced hydrolysis of nutrient reserves (mainly starch) by auxin treatments.

**Effect of Rooting media on root and shoot parameters of Black pepper cuttings**

**Shoot parameters**

Among the various rooting media studied in the present investigation, there were significant differences in shoot characters (Table 1 & 2). The earliest sprouting (15.93 days) and the maximum per cent sprouting (85.33 %) was observed in the media (Table 1 & fig. 1) comprised of soil + sand + FYM + Vermicompost (1:1:1:1 v/v). This might be due to the presence of growth promoting substances in vermicompost which helped in better utilization of stored carbohydrates, nitrogen and other factors. These results are in confirmity with [3, 11] who reported that vermicompost could be a definitive source of plant growth regulators produced by interactions between microorganisms and earthworms, which could contribute significantly to enhancement of plant growth. The treatment, soil + sand + FYM + Vermicompost (1:1:1:1 v/v) had a profound influence on length of new shoot and number of leaves (Table 1) per cutting (20.26 cm and 6.70 respectively). The above mentioned shoot parameters combined, led to higher fresh and dry weight of shoot (17.47 g and 6.65 g, respectively). This may be attributed due to the excellent structure, porosity and nutrients in available form such as nitrate nitrogen and soluble phosphorus might have been the main reasons for excellent growth in media comprising of vermicompost [4, 10, 13]. Further, [5] reported that, the amounts of nitrate nitrogen in the planting media increased with the increasing vermicompost concentrations. Also [6], reported that vermicompost might have greatly increased surface areas, providing more micro sites for microbial decomposing organisms and strong adsorption and retention of nutrients which might have resulted in better growth of cuttings [7]. Also observed that the length and weight of the shoots of *Catharanthus rosus* and *Oriza sativa* showed significant increase when they were applied with the casts of *Perionyx.* These results are in conformity with [8, 17] in black pepper.

**Root parameters**

The present study indicated that, significant influence of rooting media on increasing the rooting percentage of black pepper cuttings propagated under naturally ventilated polyhouse. The effect was marked in rooting media *viz.*, soil + sand + FYM + vermicompost (1:1:1:1 v/v) with 80%, soil + sand + FYM + vermicompost (2:1:1:1 v/v) with 76.67 % and soil + sand + FYM + coir dust (1:1:1:1 v/v) with 76.67 per cent (Table 2). Similar views were reported by [9, 16] in vanilla. This can be attributed due to the better physicochemical properties of vermicompost consisting media like optimum water retention capacity (57.35 %) and near neutral pH (7.60). As it is also a source of plant growth regulators, it had resulted in highest rooting percentage. These results are in confirmity with views of [10] who reported that vermicompost is finely divided peat-like materials with high porosity, aeration, drainage, waterholding capacity. Also, [11] reported that vermicompost could be a definitive source of plant growth regulators. The earliest rooting (33.07 days) was observed in the cuttings pretreated with IBA 1000 ppm and raised in the media, soil + sand + FYM + vermicompost (1:1:1:1 v/v) which differed significantly from rest of the treatments. An early sprouting and higher shoot parameters in initial stages might have brought earliness and better rooting (Table 2). Further, stored food materials with the aid of growth regulators and better physicochemical properties of the media had hastened the rooting [12].

The different rooting media also influenced the number of primary roots (Fig. 2 & Table 2). The maximum primary roots (11.07) were observed in the treatment soil + sand + FYM + vermicompost (1:1:1:1 v/v). This may be attributed to the excellent structure, porosity and nutrients in available form such as nitrate nitrogen and soluble phosphorus for excellent rooting in vermicompost comprising media [13, 14]. also reported more number of primary roots in vermicompost (18.2) when compared to sand (9.8), while studying the effect of different media on cardamom seedlings. Regarding the length of the longest primary root (Fig. 2), the media comprising soil + sand + FYM + coir dust (1:1:1:1 v/v) registered significantly the longest primary root length (26.79 cm) followed by soil + sand + FYM + coir dust (2:1:1:1 v/v) with 24.27cm, showed better performance as compared to other media. Coir dust has a low particle density indicating it's high specific surface, which contributes to the high adsorption of water and ions. Coir dust has a high water holding capacity [15]. Increased root length might be attributed to the better texture and porosity of coir dust which probably facilitated easy penetration of roots [16] and also being a well drained media it promoted better root characters.

The fresh and dry weight of roots was significantly higher (5.08 and 1.96 g, respectively) in cuttings raised on soil + sand + FYM + vermin compost (1:1:1:1 v/v). The fresh and dry weight of roots reflects the root parameters recorded. The treatments with better root parameters have higher fresh and dry weights, while treatments with lower root parameters had shown lower fresh and dry weights.

**Conclusion**

It was evident in the present study that, the percentage of rooting of cuttings would be better if they are pre-treated with growth regulators and kept in better rooting media for favourable rooting. This indicates that cuttings need some physiological stimulation and better environment for favourable rooting. In the present study 80 per cent rooting was obtained by favourable growth regulator treatment when raised in an ideal rooting medium under greenhouse conditions. These technologies would go a long way in improving the "turnover efficiency" of availability of rooted cuttings per unit time to meet the increasing demands of growers. It may be summarized that the black pepper planting material can be raised with high success (80 %) by pre-treatment of cuttings with IBA at 1000 ppm and growing in the medium of soil + sand + FYM + vermin compost (1:1:1:1 v/v) in poly house conditions.

**Table 1:** Effect of growth regulators on shoot parameters at different time intervals (30, 60, 75 days after planting) of black pepper cuttings.

| Treatment | Days to sprout | 30 DAP | | | 60 DAP | | | 75 DAP | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of leaves | Length of new shoots(cm) | Percent of sprouting (%) | No. of leaves | Length of new shoots(cm) | Percent of sprouting (%) | No. of leaves | Length of new shoots(cm) | Percent of sprouting (%) |
| T1 - Control | 24.47 | 0.40 | 2.10 | 12.33 | 1.40 | 4.44 | 30.33 | 2.20 | 6.17 | 49.00 |
| T2 – IBA 500 ppm | 19.27 | 1.13 | 3.38 | 30.33 | 2.07 | 7.57 | 57.67 | 3.60 | 9.10 | 73.00 |
| T3 - IBA 1000 ppm | 17.40 | 1.53 | 3.83 | 40.00 | 2.47 | 8.11 | 67.00 | 4.20 | 10.40 | 82.67 |
| T4 - IBA 1500 ppm | 19.93 | 0.80 | 3.13 | 28.67 | 1.87 | 6.39 | 55.67 | 3.13 | 8.42 | 71.33 |
| T5 – NAA 250 ppm | 19.60 | 1.07 | 3.40 | 31.33 | 2.00 | 7.15 | 64.67 | 3.47 | 8.96 | 73.67 |
| T6 - NAA 500 ppm | 19.80 | 0.87 | 3.16 | 24.33 | 1.93 | 6.47 | 49.00 | 3.20 | 8.53 | 69.00 |
| T7 – NAA 1000 ppm | 20.60 | 0.67 | 2.66 | 19.33 | 1.60 | 5.87 | 40.00 | 2.80 | 7.97 | 62.67 |
| T8 –IAA 1000 ppm | 19.80 | 0.93 | 3.20 | 28.33 | 1.93 | 6.93 | 52.00 | 3.27 | 8.70 | 71.00 |
| T9 – NAA + IBA 250 ppm | 20.13 | 0.73 | 3.10 | 27.00 | 1.73 | 6.38 | 50.00 | 3.07 | 8.16 | 70.67 |
| T10 – NAA+ IBA 500 ppm | 20.60 | 0.67 | 3.06 | 22.33 | 1.67 | 5.95 | 47.33 | 2.87 | 8.14 | 65.33 |
| T11 – NAA+ IBA 1000 ppm | 21.87 | 0.53 | 2.28 | 14.33 | 1.53 | 5.83 | 35.33 | 2.40 | 7.39 | 53.00 |
| F –test | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| S Em± | 0.61 | 0.06 | 0.09 | 1.54 | 0.08 | 0.26 | 2.37 | 0.13 | 0.22 | 2.06 |
| C D 5% | 1.78 | 0.18 | 0.25 | 4.51 | 0.24 | 0.77 | 6.96 | 0.38 | 0.63 | 6.04 |

** Highly Significant

**Table 2:** Effect of growth regulators on Root parameters at different time intervals (30,60,75 days after planting) of black pepper cuttings.

| Treatment | Shoots | | Roots | | Days taken to rooting initiation | Percent of rooting | No. of primary roots | Root length(cm) |
|---|---|---|---|---|---|---|---|---|
| | Fresh weight (g) | Dry weight (g) | Fresh weight(g) | Dry weight (g) | | | | |
| T1 - Control | 8.16 | 1.57 | 1.30 | 0.49 | 44.27 | 43.33 | 1.78 | 10.93 |
| T2 – IBA 500 ppm | 10.01 | 3.22 | 2.34 | 0.91 | 38.67 | 66.67 | 6.11 | 17.09 |
| T3 - IBA 1000 ppm | 11.00 | 3.52 | 2.71 | 1.02 | 35.47 | 70.00 | 7.28 | 18.18 |
| T4 - IBA 1500 ppm | 9.82 | 2.14 | 2.03 | 0.77 | 40.00 | 56.67 | 5.11 | 15.15 |
| T5 – NAA 250 ppm | 9.90 | 2.70 | 2.32 | 0.89 | 38.80 | 63.33 | 5.67 | 16.93 |
| T6 - NAA 500 ppm | 9.83 | 2.37 | 2.27 | 0.85 | 39.60 | 60.00 | 5.11 | 16.41 |
| T7 – NAA 1000 ppm | 9.10 | 2.04 | 1.67 | 0.68 | 40.27 | 43.33 | 3.33 | 14.55 |
| T8 –IAA 1000 ppm | 9.89 | 2.54 | 2.29 | 0.87 | 38.93 | 60.00 | 5.44 | 16.76 |
| T9 – NAA + IBA 250 ppm | 9.19 | 2.10 | 1.99 | 0.76 | 40.67 | 53.33 | 4.89 | 15.32 |
| T10 – NAA+ IBA 500 ppm | 9.19 | 2.08 | 1.80 | 0.76 | 41.07 | 50.00 | 4.00 | 14.85 |
| T11 – NAA+ IBA 1000 ppm | 8.68 | 1.86 | 1.41 | 0.54 | 42.67 | 43.33 | 1.89 | 12.27 |
| F –test | ** | ** | ** | ** | ** | ** | ** | ** |
| S Em± | 0.37 | 0.20 | 0.14 | 0.04 | 1.06 | 2.66 | 0.25 | 0.34 |
| C D 5% | 1.07 | 0.58 | 0.40 | 0.11 | 3.12 | 7.80 | 0.73 | 1.01 |

** Highly Significant


**Plate 1:** Effect of different concentration of IBA on rooting of black pepper cuttings

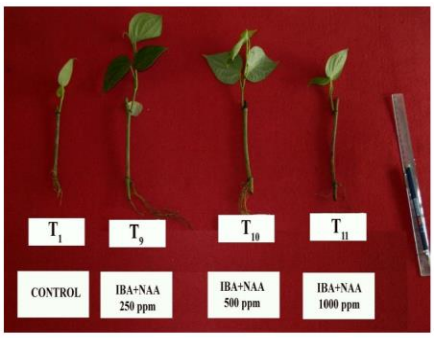


**Plate 2:** Effect of different concentration of IBA+NAA on rooting of black pepper cuttings


**Plate 3:** Effect of different concentration of NAA on rooting of black pepper cuttings

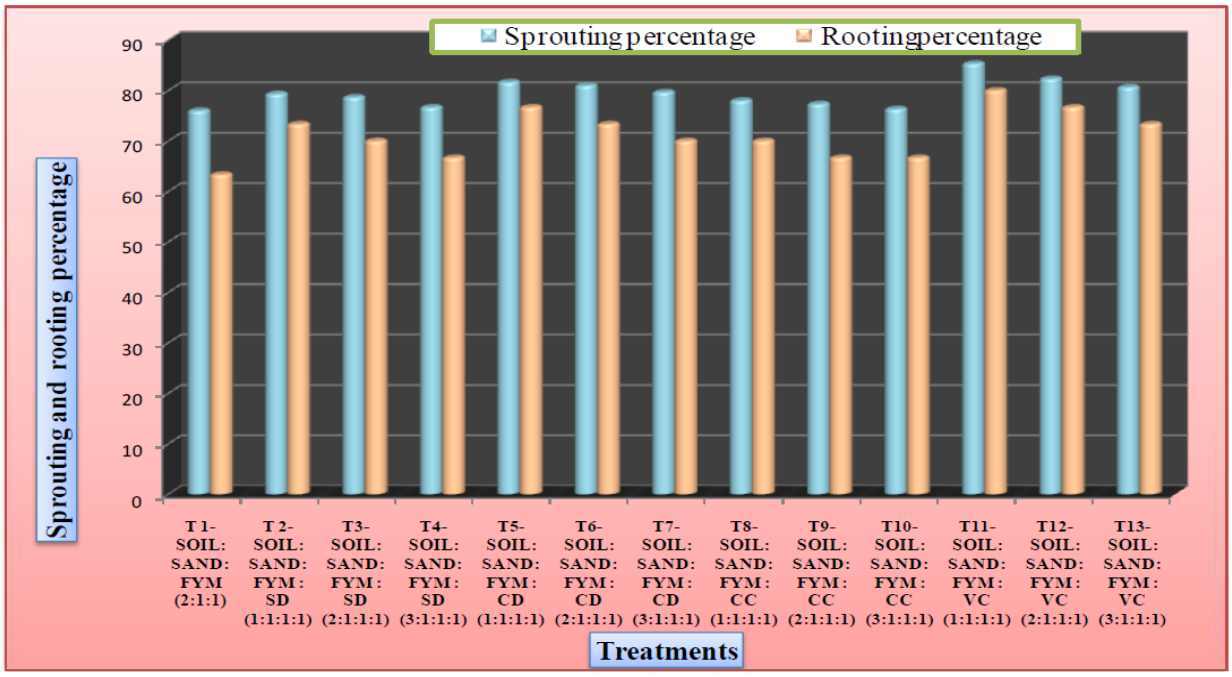


**Fig 1:** Effect of media on sprouting and rooting percentage of black pepper cuttings.

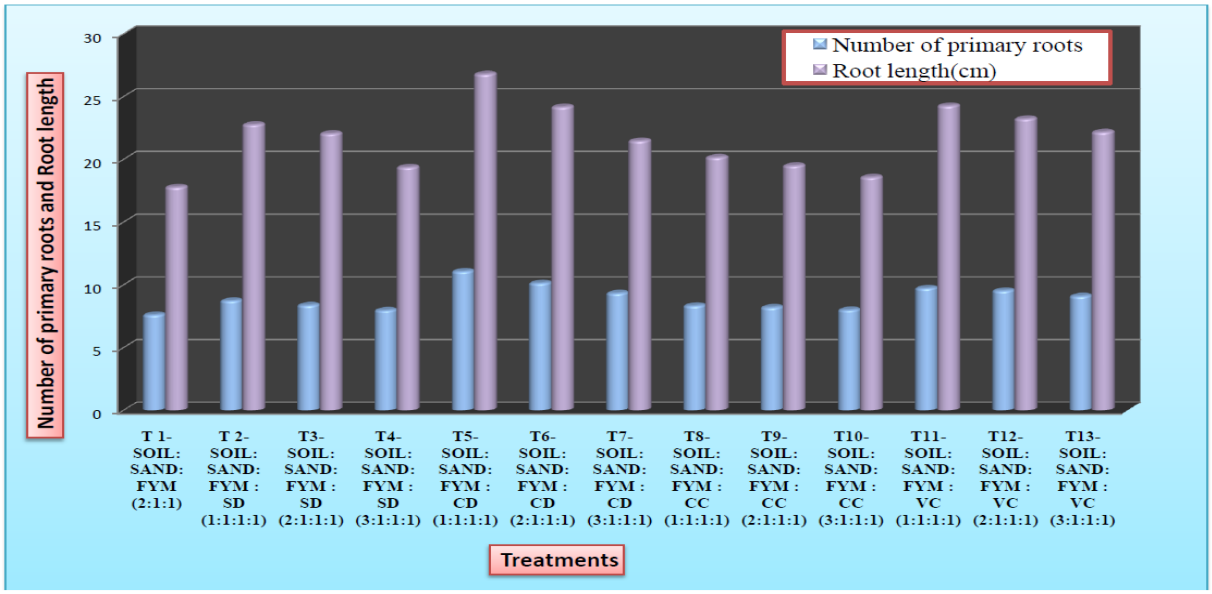


**Fig 2:** Effect of media on number of primary roots and root length of black pepper cuttings.


**Fig 3:** Effect of media on rooting of black pepper cuttings.

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