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# Effect of different growing media on vegetative propagation in betelvine (*Piper betle* L.)

**Pratima Usendi, Bhagwat Saran Asati and Toran Lal Sahu**

## Abstract
The present experiment was conducted during the year 2020-21 under shade net condition at Horticultural Farm, Pt. KLS College of Horticulture & Research Station Rajnandgaon (C.G.). The experiment included nine treatments in Completely Randomized Design (CRD) having three replication in which ten cuttings under each repetition of treatments. The various combinations of growing media significantly improved the vegetative growth of betelvine under study. Among the parameters under study, treatment Soil: Sand: FYM: Vermicompost:: 1:1:1:1 showed higher for most of the characters *viz*. minimum days taken for sprouting (22.93 days), number of sprouts, average length of sprouts, number of shoots, percentage of shoot, number of leaves, number of roots, percentage of roots, length of root, root diameter, root volume, surface area of root, root fresh weight, root dry weight, plant fresh & dry weight, & survival, while treatment Soil: Sand: Vermicompost:: 1:1:1 was also superior for length of shoots, fresh weight of shoot & dry weight of shoot. The result of the experiment suggested that vermicompost as a growing media is found most suitable for promoting growth parameters of betelvine cuttings.

**Keywords:** Growing media, betelvine, cutting, vegetative, propagation

## Introduction
The betel vine *(Piper betle* L.; Family: Piperaceae) is the leaf of a vine. In India, it is known as 'Pan'. Betel vine is a perennial, dioecious, evergreen climber that is grown in tropics and subtropics for its leaves that are used as a chewing stimulant. Betel leaf is served on different social, cultural, and religious occasions in India. This crop is mostly grown in Chhattisgarh's Rajnandgaon district, namely in the Chhuikhadan and Dongargarh blocks. Billori is the name of the betelvine variety grown in this location. Meetha Paan and Kalkatia Paan are two more prominent Paan varieties in this region. The cultivation of betelvine is mostly a job for small and marginal farmers with tiny plots of land. Few experiments have been carried out to examine the rooting effects of growing media among various plant species (Akshay *et al*. 2018) [2]. Availability of adequate quantity of quality planting material for large scale multiplication is one of the major constraints in increasing the productivity of betelvine in India. The recent developments like, use of growing media, shade net or greenhouse technology, rapid multiplication techniques are found helpful in solving this problem to a greater extent. The growing media play a vital role in improving the vegetative growth in betelvine cuttings. This would improve the vegetative growth of cuttings material in the field and reduces the rate of mortality of plants. Hence, the study conducted to know the effect of different media on vegetative propagation in betelvine (*Piper betle* L.).

## Material and Methods
The experiment was done during the year 2020-21 at protected condition i.e., shade net at Horticultural Farm, Pt. K. L. S. College of Horticulture & Research Station Rajnandgaon (C.G.). The experiment was laid out in the Completely Randomized Design and replicated three times. Each replication consisted of 9 treatments i.e., $T_1$ (Peat moss: Soil: Sand:: 2:1:1), $T_2$ (Saw dust: Soil: Sand:: 2:1:1), $T_3$ (Rice dust: Soil: Sand 2:1:1), $T_4$ (Soil: Vermicompost: Cocopeat: Saw dust::1:1:1:1), $T_5$ (Soil: Sand: Vermicompost::1:1:1), $T_6$ (Soil: Sand: FYM: Vermicompost::1:1:1:1 ), $T_7$ (Soil: Sand: FYM: Vermicompost:: 2:1:1:1), $T_8$ (Soil: Sand: FYM:: 2:1:1) and $T_9$ (Control/Soil). Observations of various characters were recorded. Data was subjected to statistically analysis (Completely Randomized Design) by applying statistical procedure were under taken on the basis of observations taken during the experiment for nine treatments as method described by Panse and Sukhatme (1995) [15]. Black polythene bags of size 5 × 8 inch with thickness of 200 gauges were used in this experiment. The polythene bags were filled with different growing media consisted of sand, soil & well decomposed FYM, vermicompost, saw dust, peat moss, rice husk, coco peat in the different ratio and in the bottom of the polythene bags 3-4 holes were made to ensure the drainage.

The cutting was taken from the healthy mother plants and uniform shoots was selected as propagating materials. The cuttings were made in 15 cm in length with pencil thickness & having 3-5 nodes. The 10 cutting were treated in each replication and total 30 cutting were planted in each treatment. Therefore, total 270 cuttings were used for rooting of cuttings. The cuttings were made as a slanting cut at top portion and a smooth horizontal cut at basal portion of cutting.

## Result and Discussion

### Sprout parameters

The data revealed that the days taken for sprouting was found significant and the minimum days taken for sprouting (21.63 days) was noted under treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1), which was statistically similar with treatment $T_7$ (Soil: Sand: FYM: Vermicompost:: 2:1:1:1) (22.63 days), $T_5$ (Soil: Sand: Vermicompost:: 1:1:1). (22.93 days) & treatment $T_8$ (22.96 days). This could be due to the presence of a growth regulator components in vermicompost, which improves the use of carbohydrates, nitrogen, and other micronutrients stored in the compost. These results are confirmatory with Gravrilov (1963). On counting number of sprouts per cutting, significant effect by different treatment at 25, 50, 75 and 100 days after planting was found. The maximum number of sprouts per cutting (1.06), (1.10), (2.46), and (4.46) was observed under treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1), which was at par (2.33 & 4.20) with treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1). at 75 and 100 days after planting respectively. Ranjusha and Gangaprashad (2014) [16] reported that the maximum number of sprouts was found in soil: sand: vermicompost medium. Edwards and Burrows (1988) [5] observed this might be due to vermicompost act as a rich source of nutrients with good water absorber.

Significant influence on length of sprouts by different growing media at 25, 50, 75 and 100 days after planting was observed. The highest length of sprouts per cutting (0.42 cm), (1.03 cm), (1.91 cm), and (2.09 cm) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1), which was at par (0.39, 0.97 cm) with treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1) at 25 and 50 days after planting respectively, while lowest length of sprouts per cutting at 25, 50, 75, and 100 days after planting (0.14 cm), (0.31 cm), (0.72 cm), and (1.07 cm) was noted in treatment $T_9$ (Control/Soil). Probably it could be because of better use of stored food materials, carbohydrates & other elements and favorable environmental condition with the assistance of plant growth hormone to the sprout length per cutting. The present findings are in concurrent with Singh (1979) in *Jasminum sambac*, Husen and Mishra (2001) [12] in *Vitex negundo*, Singh *et al.* (2003) in *Piper longum.*

### Shoot parameters

An observation related to number of shoots per cutting was found significant influence by different growing media at 100 days after planting. The maximum number of shoots per cutting (4.01) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1), while minimum number of shoots per cutting (1.66) was noted in treatment $T_9$ (Control/Soil). This might be due to the presence of growth promoting component in vermicompost which better utilization of stored carbohydrates nitrogen and other factors. These results are in conformity with Akshay *et al.* (2018) [2], Gravrilov (1963) and Vadiraj *et al.* (1992) [23]. Percentage of shoots per cutting was found significantly influenced by different growing media at 100 days after planting. The maximum percentage of shoots per cutting (80.26%) was recorded in treatment $T_6$ (Soil: and: FYM: Vermicompost:: 1:1:1:1), while minimum percentage of shoots per cutting (33.33%) was noted in treatment $T_9$ (Control/Soil). According to Reddy (1998) [17], this could be because vermicompost has a large surface area, which provides many micro sites for microbial decomposition organisms as well as significant nutrient adsorption and retation which might have resulted in better growth of cuttings. This result is in conformity with Thankamani *et al.* (2007) [21] in black pepper.

Observation related to length of shoots per cutting was noted significant influence by different growing media at 100 days after planting. The highest length of shoots per cutting (20.67 cm) was recorded in treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1). The increase in shoot length may be due to presence of some growth promoting component in vermicompost. The vermicompost also contained a humus and micronutrient which might be responsible for better initial vegetative growth. Furthermore, such medium induced cambial division and increased apical meristematic activity. Similar findings have been reported by Sharma (1993) in mulberry, Singh *et al.* (2003) and Hota *et al.* (2018) [11]. Diameter of shoots per cutting was found significant influence by different growing media at 100 days after planting. The maximum diameter of shoots per cutting (4.09 mm) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1). This could be attributed to a higher nutritional mix, nutrient and water holding capacity, and high porosity of the media, all of which contributed to the formation of a strong root system, which in turn supported a stronger shoot system. Such medium induced cambial division and increased apical meristematic activity. Similar results have been reported by Sharma (1993) in mulberry and Singh *et al.* (2003).

Observation related to fresh weight of shoots & dry weight of shoots was found significantly influenced by different growing media at 100 days after planting. The maximum fresh weight & dry weight of shoots per cutting (6.64, 2.24 g) was recorded in treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1). This might be due to the porosity and nutrients in available form such as nitrate nitrogen and soluble phosphorus might have been main reasons for excellent growth in media according to Atiyeh *et al.* (2000) [4] and Vadiraj *et al.* (1992) [23] in black pepper.

### Root parameters

Observation related to number of roots per cutting was found significant influence by different growing media at 100 days after planting. The maximum number of roots per cutting (10.60 roots) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1) While minimum number of roots per cutting (2.73 roots) was noted in treatment $T_9$ (Control/Soil). This is due to the increased physicochemical properties of vermicompost-based medium, such as their optimal water holding capacity (57.35 percent) and pH near neutral (7.60) reported by Akshay *et al.* (2018) [2]. Percentage of roots per cutting was found significant influence by different growing media at 100 days after planting. The highest percentage of roots per cutting (70.66%) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost 1:1:1:1), while lowest percentage of roots per cutting (18.22%) was noted in treatment $T_9$ (Control/Soil). This could be attributed to a plentiful supply of

plant growth regulators, as the rooting percentage was the highest. These results are in conformity with views of Haissing and Davis (1984) [10].

Observation related to length of roots per cutting was found significantly influenced by different growing media at 100 days after planting. The maximum length of roots per cutting (22.49 cm) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1) which was at par with treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1) with (21.24 cm), while minimum length of roots per cutting (11.16 cm) was noted in treatment $T_9$ (control/soil). Improved rooting properties in the sand, soil-based medium may be owing to increased drainage, aeration, nutrition, and media's water holding capacity as findings agree with the Ercisli *et al*. (2002) [6] in kiwifruit and Ochoa *et al*. (2003) [14] in oleander cuttings. Diameter of roots per cutting was found significantly influenced by different growing media at 100 days after planting. The maximum diameter of roots per cutting (1.49 mm) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1) which was non-significant with treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1) with (1.48 mm), treatment T7 (Soil: Sand: FYM: Vermicompost:: 2:1:1:1) with (1.46 mm) and treatment T3 (Rice husk: Soil: Sand:: 2:1:1) with (1.38 mm) While minimum diameter of roots per cutting (0.54 mm) was noted in treatment $T_9$ (Control/Soil). Because rooting of stem cuttings in sand and soil can be influenced by adding vermicompost. Vermicompost is the optimum medium for rooting and growth of carnation stem cuttings as reported by Mahale *et al*. (2002) [13].

Surface area of roots per cutting was found significantly influenced by different growing media at 100 days after planting. The maximum surface area of roots per cutting (103.98 $cm^2$) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1), while minimum surface area of roots per cutting (19.25 $cm^2$) was noted in treatment $T_9$ (control/soil). The best results were found to be the number of roots, root length, and root volume. Observation related to volume of roots per cutting was found significantly influenced by different growing media at 100 days after planting. The maximum volume of roots per cutting (36.69 $cm^3$) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1), while minimum volume of roots per cutting (2.62 $cm^3$) was noted in treatment $T_9$ (Control/Soil). This could indicate that longer cuttings indicate deeper roots. Adugna *et al*. (2015) observed that the longer roots can penetrate deeper, allowing them to absorb more water and nutrients. The present study's findings are similar with previous research of Grima *et al*. (2011) [9]. Two nodal cuttings grown on degraded animal manure were measured for root volumes were also reported by Umesh *et al*. 2011 [22].

**Plant parameters**

Observation related number of leaves per plant was found significantly influenced by different growing media at 100 days after planting. The maximum number of leaves per plant (10.76 leaves) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1) which was statistically similar with treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1) with (10.68 leaves).While minimum number of leaves per plant (3.41 leaves) was noted in treatment $T_9$ (Control/Soil). This could be attributed to the superior structure, porosity, and nutrients in available form such as nitrate nitrogen and soluble phosphorus in vermicompost media reported by Edwards *et al*. (1988) [5], Haissing and Davis (1984) [10]. Observation related to fresh weight & dry weight of plants was found significant influence by different growing media at 100 days after planting. The maximum plant fresh weight (8.13 g) was recorded in treatment $T_6$, which was at par with treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1) with (7.50 g) and Dry weight of plant (2.06 g), whereas minimum plant fresh weight (3.15 g) was noted in treatment $T_9$ (Control/Soil) because of better physical properties & enhance nutrient level. The improvement of soil porosity, drainage, soil permeability with decrease in soil and water availability with decease in soil density due to presence of vermicompost & FYM in growth media have provided support for fast growth cutting observed by Zaller (2007) [24].

Observation related to survival percentage was found significantly affected by different growing media at 100 days after planting. The maximum survival percentage (86.66 %) was recorded in treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1), which was at par with treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1) with (86.53 %), treatment T7 (Soil: Sand: FYM: Vermicompost:: 2:1:1:1) with (86.06 %), treatment T1 (Peat moss: Soil: Sand:: 2:1:1) with (79.86 %), treatment T3 (Rice husk: Soil: Sand:: 2:1:1) with (79.86 %), treatment T8 ( Soil: Sand: FYM:: 2:1:1) with (78.66 %), whereas minimum survival percentage (40.66 %) was noted in treatment $T_9$ (Control/Soil). Rooting media are crucial for the quality of rooted cutting geraniums, according to Altman and Freudenberg (1983) [3]. They discovered that rooting media are best to other media and result in improved quality and survival of the rooted cuttings. According to Gerrakakis and Ozkaya (2005), olive cutting survival rates are substantially higher than plant survival rates.

**Table 1:** Effect of different media on sprout parameters in betelvine

| Treatments | Days taken for sprouting | Number of sprouts (DAP) | | | | Length of sprout (DAP) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 25 | 50 | 75 | 100 | 25 | 50 | 75 | 100 |
| ($T_1$) Peat moss: Soil: Sand::2:1:1 | 27.93 | 0.56 | 0.93 | 2.06 | 3.13 | 0.36 | 0.49 | 0.91 | 1.59 |
| ($T_2$) Saw dust: Soil: Sand::2:1:1 | 30.70 | 0.40 | 0.53 | 1.63 | 2.33 | 0.18 | 0.43 | 0.80 | 1.49 |
| ($T_3$) Rice husk: Soil: Sand::2:1:1 | 23.50 | 0.73 | 0.56 | 1.73 | 2.53 | 0.34 | 0.49 | 1.35 | 1.53 |
| ($T_4$) Soil: Vermicompost: Cocopeat: Sawdust::1:1:1:1 | 27.26 | 0.73 | 0.43 | 1.80 | 2.33 | 0.27 | 0.45 | 1.12 | 1.47 |
| ($T_5$) Soil: Sand: Vermicompost::1:1:1 | 22.93 | 0.83 | 1.06 | 2.33 | 4.2 | 0.39 | 0.97 | 1.54 | 1.72 |
| ($T_6$) Soil: Sand: FYM: Vermicompost::1:1:1:1 | 21.63 | 1.06 | 1.10 | 2.46 | 4.46 | 0.42 | 1.03 | 1.91 | 2.09 |
| ($T_7$) Soil: Sand: FYM: Vermicompost::2:1:1:1 | 22.63 | 0.60 | 0.80 | 2.00 | 3.26 | 0.31 | 0.73 | 1.28 | 1.63 |
| ($T_8$) Soil: Sand: FYM::2:1:1 | 22.96 | 0.53 | 0.63 | 2.06 | 3.00 | 0.32 | 0.59 | 1.10 | 1.58 |
| ($T_9$) Control (Soil) | 32.02 | 0.36 | 0.36 | 1.56 | 1.73 | 0.14 | 0.31 | 0.72 | 1.07 |
| SEm± | 0.47 | 0.035 | 0.035 | 0.10 | 0.13 | 0.017 | 0.023 | 0.065 | 0.071 |
| C.D. at 5% | 1.41 | 0.10 | 0.05 | 0.30 | 0.40 | 0.051 | 0.068 | 0.193 | 0.212 |
| CV | 3.17 | 9.39 | 8.51 | 8.87 | 7.88 | 9.66 | 6.45 | 9.35 | 7.78 |

**Table 2:** Effect of different media on shoot parameters in betelvine

| Treatments | Number of shoots | Percentage of shoots | Length of shoots | Diameter of shoots | Fresh weight of shoots | Dry weight of shoots |
|---|---|---|---|---|---|---|
| ($T_1$) Peat moss: Soil: Sand::2:1:1 | 2.62 | 52.53 | 12.96 | 2.02 | 3.40 | 0.76 |
| ($T_2$) Saw dust: Soil: Sand::2:1:1 | 1.76 | 35.33 | 8.64 | 1.68 | 2.57 | 0.54 |
| ($T_3$) Rice husk: Soil: Sand::2:1:1 | 2.27 | 45.46 | 11.37 | 2.06 | 2.64 | 1.27 |
| ($T_4$) Soil: Vermicompost: Cocopeat: Sawdust::1:1:1:1 | 1.93 | 38.66 | 8.69 | 1.92 | 2.55 | 1.28 |
| ($T_5$) Soil: Sand: Vermicompost::1:1:1 | 3.15 | 63.06 | 20.67 | 3.20 | 6.64 | 2.24 |
| ($T_6$) Soil: Sand: FYM: Vermicompost::1:1:1:1 | 4.01 | 80.26 | 17.06 | 4.09 | 5.46 | 1.76 |
| ($T_7$) Soil: Sand: FYM: Vermicompost::2:1:1:1 | 2.79 | 55.80 | 13.96 | 2.31 | 3.63 | 0.59 |
| ($T_8$) Soil: Sand: FYM::2:1:1 | 2.20 | 44.00 | 11.88 | 2.00 | 2.58 | 1.43 |
| ($T_9$) Control (Soil) | 1.66 | 33.33 | 6.89 | 1.57 | 2.23 | 0.47 |
| SEm± | 0.06 | 1.24 | 0.69 | 0.10 | 0.19 | 0.03 |
| C.D. at 5% | 0.18 | 3.73 | 2.06 | 0.31 | 0.59 | 0.11 |
| CV | 4.34 | 4.34 | 9.60 | 7.88 | 9.71 | 5.72 |

**Table 3:** Effect of different media on root parameters in betelvine

| Treatments | Number of roots | Percentage of roots | Length of roots | Diameter of roots | Surface area of roots | Volume of roots |
|---|---|---|---|---|---|---|
| ($T_1$) Peat moss: Soil: Sand::2:1:1 | 3.00 | 20.00 | 15.82 | 1.38 | 75.72 | 26.45 |
| ($T_2$) Saw dust: Soil: Sand::2:1:1 | 3.46 | 23.11 | 13.67 | 0.69 | 45.32 | 9.01 |
| ($T_3$) Rice husk: Soil: Sand::2:1:1 | 7.46 | 49.77 | 14.55 | 0.83 | 77.12 | 27.44 |
| ($T_4$) Soil: Vermicompost: Cocopeat: Sawdust::1:1:1:1 | 4.33 | 28.89 | 15.72 | 0.80 | 32.33 | 5.08 |
| ($T_5$) Soil: Sand: Vermicompost::1:1:1 | 9.06 | 60.44 | 21.24 | 1.48 | 60.25 | 12.67 |
| ($T_6$) Soil: Sand: FYM: Vermicompost::1:1:1:1 | 10.60 | 70.66 | 22.49 | 1.49 | 103.98 | 36.69 |
| ($T_7$) Soil: Sand: FYM: Vermicompost::2:1:1:1 | 5.06 | 33.77 | 17.62 | 1.46 | 61.76 | 20.08 |
| ($T_8$) Soil: Sand: FYM::2:1:1 | 6.80 | 45.33 | 15.79 | 1.37 | 72.08 | 23.99 |
| ($T_9$) Control (Soil) | 2.73 | 2.99 | 11.16 | 0.54 | 19.25 | 2.62 |
| SEm± | 0.15 | 1.002 | 0.78 | 0.04 | 3.46 | 1.17 |
| C.D. at 5% | 0.45 | 2.99 | 2.35 | 0.14 | 10.37 | 3.51 |
| CV | 4.46 | 4.46 | 8.28 | 7.34 | 9.85 | 11.14 |

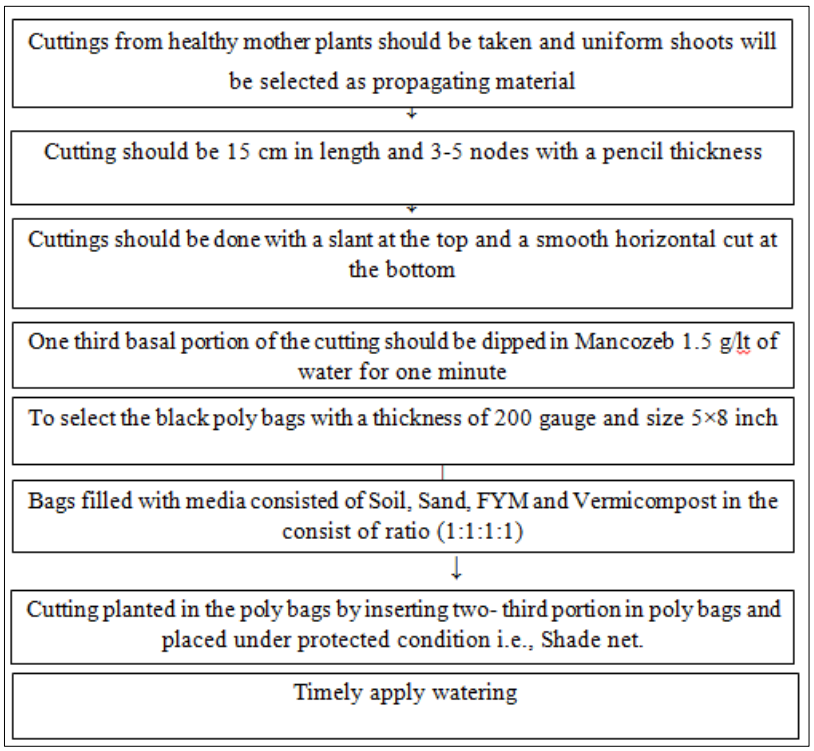
**Table 4:** Effect of different media on plant parameters in betelvine

| Treatments | Number of leaves per plant | Fresh weight | Dry weight of plants | Survival percentage |
|---|---|---|---|---|
| ($T_1$) Peat moss: Soil: Sand::2:1:1 | 6.06 | 5.79 | 1.88 | 79.86 |
| ($T_2$) Saw dust: Soil: Sand::2:1:1 | 4.76 | 4.53 | 0.80 | 63.33 |
| ($T_3$) Rice husk: Soil: Sand::2:1:1 | 5.65 | 5.25 | 1.64 | 79.86 |
| ($T_4$) Soil: Vermicompost: Cocopeat: Sawdust::1:1:1:1 | 5.80 | 4.12 | 0.80 | 66.40 |
| ($T_5$) Soil: Sand: Vermicompost::1:1:1 | 10.68 | 7.50 | 2.00 | 86.53 |
| ($T_6$) Soil: Sand: FYM: Vermicompost::1:1:1:1 | 10.76 | 8.13 | 2.06 | 86.66 |
| ($T_7$) Soil: Sand: FYM: Vermicompost::2:1:1:1 | 9.36 | 6.80 | 1.95 | 86.06 |
| ($T_8$) Soil: Sand: FYM::2:1:1 | 5.50 | 5.22 | 1.67 | 78.66 |
| ($T_9$) Control (Soil) | 3.41 | 3.15 | 0.73 | 40.66 |
| SEm± | 0.38 | 0.25 | 0.02 | 3.72 |
| C.D. at 5% | 1.16 | 0.77 | 0.08 | 11.15 |
| CV | 9.76 | 7.95 | 3.27 | 8.69 |

## Conclusion

This experiment suggested that vermicompost as a growing media is had significant positive effects on vegetative growth parameters. Among the parameters under study, treatment $T_6$ (Soil: Sand: FYM: Vermicompost:: 1:1:1:1) showed higher for most of the characters *viz*. minimum days taken for sprouting (22.93 days), number of sprouts, average length of sprouts, number of shoots, percentage of shoot, number of leaves, number of roots, percentage of roots, length of root, root diameter, root volume, surface area of root, root fresh weight, root dry weight, plant fresh & dry weight, & survival, while treatment $T_5$ (Soil: Sand: Vermicompost:: 1:1:1) was also superior for length of shoots, fresh weight of shoot & dry weight of shoot. The result of the experiment suggested that vermicompost as a growing media is found most suitable for promoting growth parameters of betelvine cuttings.

**Standardized propagation technique for easy & fast multiplication in betelvine**

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