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# Standardising Planting Materials for enhancing Growth and Yield Parameters of Black Pepper (*Piper nigrum*) under Coconut based Ecosystem

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**ABSTRACT: Growth and yield of black pepper is greatly influenced by the type of planting material, but in India there exists a lack of quality planting material. Hence the present study was aimed to standardise the effect of different planting materials for enhancing the growth and yield of black pepper under coconut based ecosystem. Keeping the above thing in view, an experiment was conducted at Coconut Research Station, Aliyarnagar to standardize the suitable planting material on growth and development of black pepper in coconut garden based ecosystem during 2015 - 2018 as an intercrop. Experiment was laid out in randomized block design with seven treatments and each treatment was replicated thrice. Three different types of planting material of black pepper used were rooted cuttings of orthotropic shoots, runner shoots and plagiotropic shoots of the variety Panniyur 1. During 2015-16, $T_2$ and $T_3$ registered maximum plant height (254.0 cm) and number of leaves (87.8) respectively. Among the treatments, during 2016-17 maximum plant height was in $T_1$ (3.18 m), number of leaves per plant was high in $T_4$ (80.52), number of laterals/ 50 cm$^2$ was maximum in $T_2$ (3.47), $T_5$ recorded high number of spikes/ 50 cm$^2$ (9.5), spike length was maximum in $T_3$ (15.00 cm), number of berries per spike was high in $T_4$ (100.83). During 2017-18, $T_2$ showed maximum number of laterals per 50 cm$^2$ (4.70), leaf length (18.92 cm), leaf breadth (14.10 cm), number of spikes per 50 cm$^2$ (8.60), spike length (16.40 cm), number of berries per spike (106.60), green berry weight (2.45 kg/vine) and yield (0.833 kg/plant). In this study rooted cuttings from runner shoot (3 plants/ tree), rooted cuttings from runner shoot (4 plants/ tree) and rooted cuttings from orthotropic shoot (2 plants/ tree) showed better performance under coconut garden. In the present study, we have identified the type of planting material that is best suited for growth and yield parameters under coconut based ecosystem and the future research can be done to estimate the quality parameters for the same.**

**Keywords:** Black pepper**;** planting material; orthotropic shoot; runner shoots; intercrop; coconut based ecosystem; plagiotropic shoots; Panniyur 1 pepper.

## INTRODUCTION

Coconut (*Cocos nucifera* L.) is a globally important, most useful, and high-value commercial plantation crop. It is also known as the 'Tree of Life,' 'Tree of Heaven' and 'Kalpavriksha'. The top five coconut-producing countries in the world are Indonesia, Philippines, India, Sri Lanka, and Brazil (Nath, 2002). In India, more than 90 per cent of coconut cultivation is done in Kerala, Tamil Nadu, Karnataka and Andhra Pradesh states alone (Maheswarappa *et al.,* 2010). However, production and productivity from coconut farm is not sustainable with monocropping of coconut (Nagawekar *et al*., 2002). More vertical and horizontal interspaces are available in coconut gardens, providing opportunities to use available space, proper utilisation of inputs various kinds of natural resources such as soil, water, light and labour to increase farm production and income. (Maheswarappa *et al.,* 2010 and Ghosh and Bandopadhyay, 2011). Coconut is commonly cultivated at a spacing of 7.5 m × 7.5 m as a monocrop, but it utilizes only 22.3 % of land area and remaining land space is available for cultivation of inter crops and mixed crops (Bavappa *et al.,* 1986 and Maheswarappa *et al.,* 2001).

Black pepper (*Piper nigrum*) is one of the most important spice crops and several studies showed that, black pepper can be grown successfully with coconut (Nagawekar *et al.,* 2002; Sadanandan, 2000). Intercropping black pepper with coconut and arecanut plantations in various agro-climatic zones of the country have established its practicability as a profitable crop in various cropping models (Reddy and Thomas 2001). As a result, this study was carried out in order to standardise the appropriate planting material for black pepper for the coconut garden ecosystem.

## MATERIALS AND METHODS

An experiment was carried out at the Coconut Research Station at Aliyarnagar, Coimbatore district, Tamil Nadu to standardise the suitable planting material of black pepper in the coconut based cropping system and also as an intercrop during 2015 - 2018. The experiment was set up in a Randomised Block Design (RBD) with seven treatments and was replicated thrice. Rooted cuttings of orthotropic shoots, runner shoots, and plagiotropic shoots of one the famous pepper varieties, *viz*., Panniyur 1 were used as planting material. Morphological and yield characters recorded were plant height (cm), number of leaves per plant, number of laterals/ 50 $cm^2$, number of spikes/ 50 $cm^2$, spike length, number of berries per spike, green berry weight (kg/vine) and yield (kg/plant). AGRES statistical software was used to perform the statistical analysis of the recorded data.

Treatment details were;

$T_1$ – Rooted cuttings from runner shoot (2 vines per standard),

$T_2$ – Rooted cuttings from runner shoot (3 vines per standard),

$T_3$ – Rooted cuttings from runner shoot (4 vines per standard),

$T_4$ – Rooted cuttings from orthotropic shoot (2 vines per standard),

$T_5$ – Rooted cuttings from orthotropic shoot (3 vines per standard),

$T_6$ – Rooted cuttings from orthotropic shoot (4 vines per standard) and

$T_7$ – Rooted cuttings from plagiotropic shoot.

## RESULTS AND DISCUSSION

The data pertaining to the growth characteristics of black pepper during 2015-16 is depicted in Table 1. The analysis of variance (ANOVA) showed significant differences in the growth characteristics in all the seven treatments. Among the three different planting materials used, runner shoots and orthotropic shoots showed better performance than the plagiotropic shoots. Among the seven treatments, $T_2$ registered maximum plant height (254.0 cm) followed by $T_3$ (251.1 cm) and minimum was found in $T_7$.

**Table 1: Effect of different rooted cuttings on growth characters of black pepper under coconut garden (2015-16).**

| Treatments | Plant height (cm) | No. of leaves/ plant | No. of laterals/50 $cm^2$ |
|---|---|---|---|
| $T_1$– Rooted cuttings from runnershoot (2 vines per standard) | 181.1 | 58.5 | 5.4 |
| $T_2$ – Rooted cuttings from runnershoot (3 vines per standard) | 254.0 | 72.9 | 4.9 |
| $T_3$ – Rooted cuttings from runnershoot (4 vines per standard) | 251.1 | 87.8 | 5.3 |
| $T_4$ – Rooted cuttings from orthotropic shoot (2 vines per standard) | 181.8 | 63.4 | 5.4 |
| $T_5$ – Rooted cuttings from orthotropic shoot (3 vines per standard) | 148.8 | 51.6 | 5.5 |
| $T_6$ – Rooted cuttings from orthotropic shoot (4 vines per standard) | 202.9 | 77.5 | 5.1 |
| $T_7$ – Rooted cuttings from plagiotropic shoot | 105.7 | 30.8 | 4.3 |
| **Mean** | **190.48** | **63.21** | **5.13** |
| **SEd** | **9.90** | **3.32** | **0.26** |
| **CD(0.05)** | **21.58** | **7.25** | **0.57** |

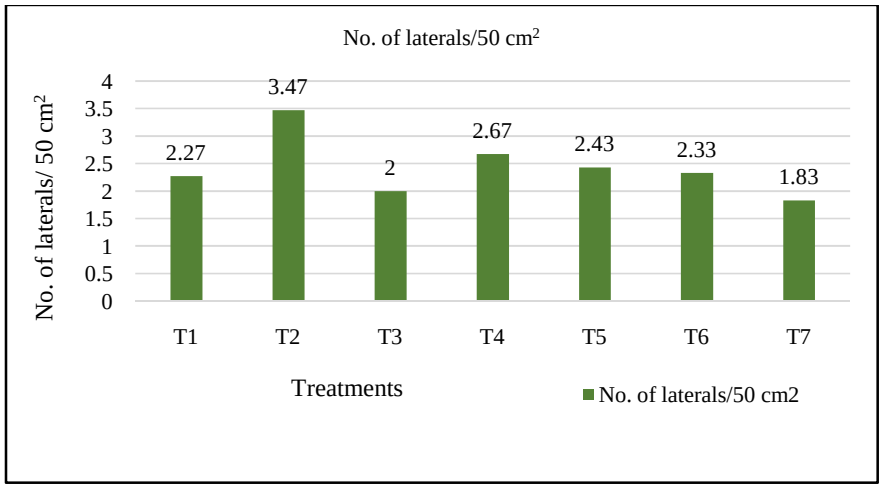


**Fig. 1.** Effect of different planting materials on number of laterals/ 50 $cm^2$ of black pepper under coconut garden.

Maximum number of leaves (87.8) and number of laterals/50 $cm^2$ (5.5) were recorded in $T_3$ and $T_6$ followed by $T_6$ (77.5) and $T_4$ (5.4) respectively and minimum was registered in $T_7$ which might be due to the runner and orthotropic shoots will produce more number of lateral shoots which helps to produce more number of leaves per plant (Khandekar *et al*., 2014). The data relating to the growth and yield characteristics of black pepper during 2016-17 is depicted in Table 2. All the seven treatments recorded significant variations for morphological and yield traits. Coconut is the crop of small and marginal farmers (Rethinam, 1990). Among the three different planting materials used, runner shoots and orthotropic shoots showed better performance than plagiotropic shoots. Among the treatments, $T_1$ recorded maximum plant height (3.18 m) followed by $T_2$ (2.78 m) reduction in plant height of plagiotropic shoot plants because of bush habit of plant. Number of leaves per plant was found to be high in $T_4$ (80.52) and $T_5$ (80.12) followed by $T_2$ and $T_1$. Number of laterals/ 50 $cm^2$ was maximum in $T_2$ (3.47) followed by $T_4$ (2.67). The increase in the number of leaves and laterals in $T_4$ and $T_5$ was due to the capacity to produce more number of lateral shoots by runner shoots and orthotropic shoots which in turn help to produce more number of leaves per plant (Khandekar *et al*., 2014). Better performance of black pepper was observed under coconut cultivation (Ghosh, 2009). Number of spikes/ 50 $cm^2$ ranged from 1 to 9.5 wherein $T_5$ recorded high number of spikes/ 50 $cm^2$ (9.5) followed by $T_7$ (8.0). Spike length was maximum in $T_3$ (15.00 cm) followed by $T_4$ (14.50 cm) and $T_1$ (12.41 cm). Number of berries per spike was high in $T_4$ (100.83) followed by $T_3$ (76.0) (Fig. 2). More lateral shoots of the plant increased the number of leaves per plant can support to increase yield due to higher photosynthesis in runner shoots and orthotropic shoots. The data relating to the growth and yield characteristics of black pepper during 2017-18 is depicted in Table 3.

**Table 2: Effect of different planting materials on the growth and yield of black pepper under coconut garden (2016-2017).**

| Treatments | Plant height (m) | No. of leaves/ plant | No. of laterals/50 $cm^2$ | No. of spikes/50 $cm^2$ | Spike length (cm) | No. of berries/spike |
|---|---|---|---|---|---|---|
| $T_1$– Rooted cuttings from runnershoot (2 vines per standard) | 3.18 | 79.58 | 2.27 | 4.0 | 12.41 | 44.8 |
| $T_2$ – Rooted cuttings from runnershoot (3 vines per standard) | 2.78 | 79.98 | 3.47 | 1.0 | 11.85 | 55.5 |
| $T_3$ – Rooted cuttings from runnershoot (4 vines per standard) | 2.17 | 76.92 | 2.00 | 1.0 | 15.00 | 76.0 |
| $T_4$ – Rooted cuttings from orthotropic shoot (2 vines per standard) | 2.65 | 80.52 | 2.67 | 6.0 | 14.50 | 100.83 |
| $T_5$ – Rooted cuttings from orthotropic shoot (3 vines per standard) | 2.51 | 80.12 | 2.43 | 9.5 | 11.10 | 55.73 |
| $T_6$ – Rooted cuttings from orthotropic shoot (4 vines per standard) | 2.06 | 76.97 | 2.33 | 1.5 | 8.85 | 54.50 |
| $T_7$ – Rooted cuttings from plagiotropic shoot | 0.57 | 61.17 | 1.83 | 8.0 | 9.15 | 20.33 |
| **Mean** | **2.27** | **76.47** | **2.43** | **4.43** | **11.84** | **58.24** |
| **SEd** | **0.33** | **3.30** | **0.34** | **0.20** | **0.53** | **2.97** |
| **CD(0.05)** | **0.73** | **7.19** | **0.74** | **0.45** | **1.15** | **6.48** |

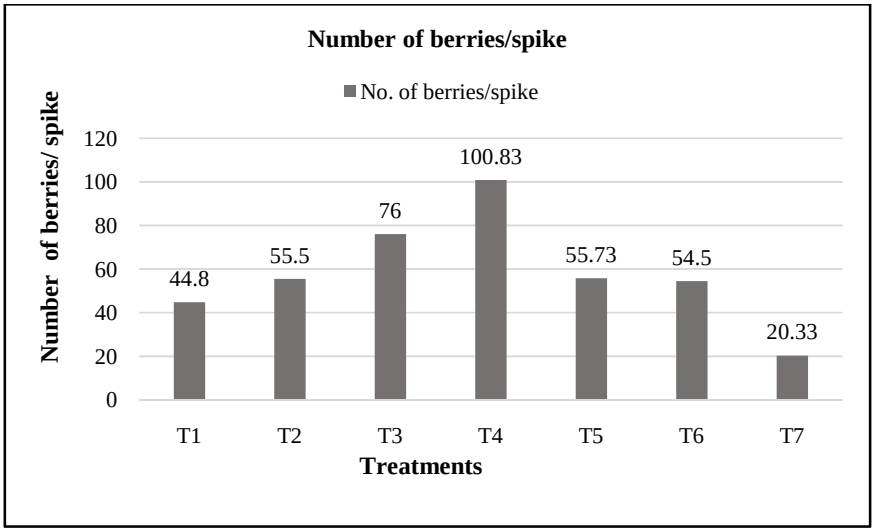


**Fig. 2.** Effect of different planting materials on number of berries/ spike of black pepper under coconut garden.

**Table 3: Effect of different planting materials on the growth and yield of black pepper under coconut garden (2017-2018).**

| Treatments | Plant height (m) | Leaf length (cm) | Leaf breadth (cm) | No. of laterals/50 $cm^2$ | No. of spikes/50 $cm^2$ | Spike length (cm) | No. of berries/spike | Green berry weight (kg/vine) | Yield (kg/plant) |
|---|---|---|---|---|---|---|---|---|---|
| $T_1$– Rooted cuttings from runnershoot (2 vines per standard) | 4.23 | 17.13 | 13.93 | 3.80 | 7.20 | 13.80 | 81.30 | 2.13 | 0.660 |
| $T_2$ – Rooted cuttings from runnershoot (3 vines per standard) | 3.56 | 18.92 | 14.10 | 4.70 | 8.60 | 16.40 | 106.60 | 2.45 | 0.833 |
| $T_3$ – Rooted cuttings from runnershoot (4 vines per standard) | 3.64 | 18.01 | 13.12 | 3.40 | 5.10 | 9.80 | 78.80 | 2.24 | 0.650 |
| $T_4$ – Rooted cuttings from orthotropic shoot (2 vines per standard) | 2.62 | 16.38 | 12.32 | 3.10 | 5.80 | 15.10 | 62.80 | 1.56 | 0.406 |
| $T_5$ – Rooted cuttings from orthotropic shoot (3 vines per standard) | 3.01 | 15.13 | 11.93 | 2.80 | 7.30 | 14.90 | 82.30 | 1.37 | 0.343 |
| $T_6$ – Rooted cuttings from orthotropic shoot (4 vines per standard) | 3.47 | 15.92 | 11.74 | 2.90 | 6.40 | 7.14 | 86.40 | 1.31 | 0.341 |
| $T_7$ – Rooted cuttings from plagiotropic shoot | 1.26 | 13.28 | 10.13 | 2.50 | 7.90 | 8.95 | 28.40 | 2.52 | 0.706 |
| **Mean** | **3.11** | **16.40** | **12.47** | **3.31** | **6.90** | **12.30** | **75.23** | **1.94** | **0.562** |
| **SEd** | **0.17** | **1.13** | **0.65** | **0.21** | **0.49** | **0.49** | **2.72** | **0.02** | **0.01** |
| **CD(0.05)** | **0.36** | **2.47** | **1.41** | **0.45** | **1.06** | **1.06** | **5.93** | **0.04** | **0.02** |

Among all the treatments, $T_2$ showed maximum number of laterals per 50 $cm^2$ (4.70), leaf length (18.92 cm), leaf breadth (14.10 cm), number of spikes per 50 $cm^2$ (8.60), spike length (16.40 cm), number of berries per spike (106.60), green berry weight (2.45 kg/vine) and yield (0.833 kg/plant). More lateral shoots of plant increased the number of leaves per plant can support to increase yield due to higher photosynthesis in runner and orthotropic shoots. The minimum plant height (1.26 m), number of laterals per 50 $cm^2$ (2.50), leaf length (13.28 cm) and leaf breadth (10.13 cm) were registered in $T_7$. The yield traits viz. number of spikes per 50 $cm^2$ was minimum in $T_3$ (5.10), lowest spike length was in $T_6$ (7.14 cm), number of berries per spike was less in $T_7$ (28.40), green berry weight and yield was found minimum in $T_6$ (1.31 kg/vine) and (0.341 kg/plant) respectively.

Normally in coconut garden when palms are spaced at 7.5×7.5 m as much as 75 % of the available area is not effectively utilized and which utilizes only half of available sunlight in such conditions, mixed cropping with black pepper helps to effective utilization of available space, both horizontally and vertically without affecting the coconut growth and yield, is the modem concept of cropping system (Ghosh *et al*., 2011). Better performance of black pepper in coconut garden might be due to improvement in the soil properties and biological activities in the root region and modification of soil environment for the benefit of the plant growth (Maheswarappa *et al*., 1998). Intercropping with coconut provides chance to get more profit than monocropping of coconut with additional employment opportunities (Nath, 2002).

Coconut based cropping and farming systems involving cultivation of compatible crops in the interspaces of coconut offer considerable scope for increasing production and productivity per unit area, time and inputs by more efficient utilization of resources like sunlight, soil, water and labour (Nelliat, 1973).

## CONCLUSION

In the present study, among the seven treatments, rooted cuttings from runner shoot (2 plants/ tree), rooted cuttings from runner shoot (4 plants/ tree) and rooted cuttings from orthotropic shoot (2 plants/ tree) showed better performance for morphological and spike traits and this was due to effective utilization of interspaces in coconut gardens and available resources hence runner and orthotropic shoots can be better used as the planting material for plant propagation in black pepper in the coconut garden based ecosystem conditions. It also would help coconut gardens to offer excellent opportunities to exploit the inter-space potential for maximizing returns per unit area and increase the overall wellbeing of farmers and farming communities too.

## FUTURE SCOPE

Thus the present study will help to identify the right choice and type of planting material that is best suited for growth and yield parameters under coconut based ecosystem and the future research can be done to estimate the quality parameters for the same.

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