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Comparative Study of Different Rapid Multiplication Methods in Black Pepper (*Piper nigrum* L.) cv. Panniyur - 1

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was conducted during the year 2023-2024. The experiment was conducted in randomized block design with seven treatments namely T_1: Raised bed method, T_2: Soil mound method, T_3: Wooden log method, T_4: Serpentine method, T_5: Split halves of PVC

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method, T_6: Modified serpentine method, T_7: Trench method and each treatment were replicated four times. Among the various treatments studied, the treatment T_4 (Serpentine method) recorded maximum number of cuttings per harvest, total number of cuttings harvested per year, sprouting percentage at 30 days after planting (DAP), survival percentage at 45 DAP.

Keywords: Black pepper; rooted cuttings; rapid propagation; multiplication; techniques.

1. INTRODUCTION

"Black pepper (*Piper nigrum* L.) belongs to the family Piperaceae and is a perennial export-oriented spice crop in India. It is gaining popularity worldwide as an indispensable food adjunct due to its unique pungency and associated flavour. It is regarded as "King of Spices" and "Black Gold" it having enormous socio-economic importance" [1]. "Pepper crop is native to South Asia and historical records reveal that pepper is originated in South India. Black pepper has spicy taste is mainly due to the presence of a compound piperine is a pungent alkaloid that enhances the bioavailability of various structurally and therapeutically diverse drugs" [2]. "Black pepper includes 5-9% of piperine, a pungent alkaloid, as its main bioactive chemical compound" [3]. "Piperine comprises of four isomers namely piperine, chavicine, isopiperine, and isochavicine" [4].

Black pepper can reproduce both vegetatively and through seeds. Seed propagation requires a significant amount of time and effort due to its high sterility and low viability in the post-fertilization stages. They have a modest number of offspring [5]. Furthermore, plants derived from different vines must exhibit variability in growth patterns and productivity [6]. As a result, commercial production is boosted by the adoption of vegetative propagation techniques. Although black pepper can be propagated through layering, cutting, rooted cutting, grafting and budding for industrial cultivation [7]. The black pepper plant has two types of branches. An orthotropic branch is monopodial that grows straight up and has adventitious roots clinging to the support at each node. The plagiotropic branch, also known as the lateral branch or lateral, has a fruit spike and inflorescence at the node [8]. In addition, unintended runner shoots or stolen are also produced by pepper which has long been used as seedlings in Sri Lanka, India, Indonesia, Vietnam and many other nations that grow pepper.

The different rapid multiplication methods of black pepper used in the present study for quicker propagation of black pepper plants, leading to mass multiplication within a shorter time frame. It can reduce the overall cost of production by minimizing the time and resources required for propagation, such as labours and materials. By rapidly multiplying plants, growers can preserve the genetic diversity of black pepper varieties, ensuring a more resilient and adaptable crop in the face of pests, diseases and environmental changes. These methods enable growers to scale up their operations more efficiently, meeting the demands of a growing market for black pepper.

2. MATERIALS AND METHODS

The field experiment was carried out at the Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dapoli, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri during the year 2023-2024. "The experiment was executed in Randomized Block Design (RBD) with seven treatments and four replications. Five black pepper-rooted cuttings were selected randomly from the replication of each treatment to record observations. The average of five cuttings was computed for further statistical analysis. In each treatment, 20 cuttings were planted in every replication. The maximum number of cuttings per harvest, the total number of cuttings obtained per year, the sprouting percentage at 30 DAP, and the survival percentage at 45 DAP were recorded at appropriate stages during the investigation period". The data was statistically analyzed as the method suggested by Panse and Sukhatme (1995) [9].

3. RESULTS AND DISCUSSION

3.1 Number of Cuttings Per Harvest

The data about the number of cuttings in different rapid multiplication methods in black pepper are presented in Table 1 and graphically depicted in Fig. 1. From the data, it is observed that there was a significant difference among the treatments to the number of cuttings per harvest.

The number of cuttings obtained at the first and second harvest differed significantly among the

various treatments. The maximum number of cuttings at the first harvest (55.60) and second harvest (63.37) were observed in treatment T_4 (Serpentine method) which was significantly superior over the rest of the treatments at the first and second harvest. The minimum number of cuttings were recorded in treatment T_7 (Trench method) at first (30.61) and second harvest (35.94).

In general in all the treatments the number of cuttings obtained in first harvest were comparatively less than second harvest. This is because of maximum growth of vine after first harvest and congenial climate during second harvest.

In the present experiment, the maximum number of cuttings per harvest was observed in the serpentine method. It might be due to each node being gently pressed into the polybags with the help of a clip, as the rooted cuttings grow and produce nodes these nodes eventually come in contact with soil and potting media such as vermicompost, allowing for roots at that specific point.

Similar results reported by Kadake [10] observed that the serpentine method produced the maximum number of black pepper cuttings at first (52.35) and second harvest (52.95). Whereas, the raised bed method produced the minimum number of cuttings at first (33.15) and second harvest (35.80). Nivedita Garande (2022) [11] revealed that the maximum number of cuttings were observed in treatment T_6 (modified serpentine method) at first (55.25) and second harvest (55.75) which was followed by serpentine method at first and second harvest (51.50 and 50.25, respectively).

3.2 Total Number of Cuttings

The perusal of data on the total number of cuttings obtained in different rapid multiplication methods of black pepper is presented in Table 1 and depicted in Fig. 1.

From the data, it is observed that there was a significant difference among the different treatments with respect to the total number of cuttings obtained per year. Significantly the maximum number of cuttings (118.97) harvested in a year were recorded in treatment T_4 (Serpentine method) which was significantly superior over the rest of the treatments. However, the minimum number of cuttings (66.55) was recorded in treatment T_7 (Trench method).

In the present study, the maximum total number of cuttings per plant was obtained in the serpentine method. It might be due to the rapid development of roots at each node when pressed and fixed in (soil + vermicompost) media which results in a greater number of cuttings every year.

Table 1. Effect of different rapid multiplication methods in black pepper on the production of several rooted cuttings

Treatments	Number of cuttings per harvest		Total number cuttings obtained per year
	1st harvest 150 DAP	2nd harvest 120 days after 1st harvest	
T_1 - Raised bed (Control)	39.50	46.68	86.18
T_2 - Soil mound	45.65	49.19	94.84
T_3 - Wooden log	34.53	37.40	71.93
T_4 - Serpentine	55.60	63.37	118.97
T_5 - Split halves of PVC	35.74	42.46	78.20
T_6 - Modified serpentine	50.16	52.98	103.14
T_7 - Trench method	30.61	35.94	66.55
Mean	41.68	46.86	88.54
Range	30.61-55.60	35.94-63.37	66.55-118.97
S. Em.±	1.65	2.40	5.20
C. D. at 5%	4.92	7.14	15.46
Result	SIG	SIG	SIG

S. Em.± - Standard error of Mean C. D. – Critical Difference at 5 %

The present results were supported to the research findings reported by Khandekar et al. [12] found that the maximum number of cuttings harvested (73.50) per year in treatment T_1 - soil mound method while the minimum number of cuttings harvested in treatment T_4 - bamboo split method (38.80) per year. Similar findings reported by Thapa et al. [13] stated that the serpentine technique of multiplication produced an average of 60 cuttings from per mother plant per year.

Bhai et al. [14] concluded that the maximum number of black pepper cuttings produced by serpentine method in nine months from a single plant in variety, IISR Malabar Excel was produced (59.60) cuttings followed by IISR Thevam (51.00) and IISR Shakthi (23.00). Kadake [10] observed that the serpentine method produced the highest number of cuttings per year (105.30) in black pepper.

3.3 Sprouting Percentage

The data regarding on sprouting percentage in various rapid multiplication methods in black pepper are presented in Table 2 and graphically represented in Fig 2.

At 30 DAP sprouting percentage at the first and second harvest differed significantly among treatments. Significantly the highest sprouting percentage was recorded in treatment T_4 - Serpentine method at first (93.22 %) and second harvest (97.45 %) which was statistically superior over the rest of treatments. However, the lowest sprouting percentage was observed in treatment T_7 - Trench method at the first (63.64 %) and second harvest (69.70 %).

In the present investigation, the highest sprouting percentage was observed in the serpentine method. It may be due to the root volume playing an important role in the sprouting of cuttings. Together with the availability of nutrients that led to an increase in root volume and dry matter content, the use of soil and vermicompost media increased the medium's porosity, water-holding capacity, low shrinkage, low bulk density, and delayed biodegradation. Moreover, the weather throughout the trial time was favourable for boosting cell activity for root formation, leading to a larger percentage of sprouting.

The results are following the findings of Kadake [10] revealed that, the highest percentage of sprouting in black pepper cuttings was recorded at first (96.59 %) and second harvest (94.32 %) in treatment T_4 - Serpentine method. Whereas, the lowest percentage of sprouting was recorded in treatment T_1 - Raised bed method at first (77.73 %) and second harvest (78.37 %).

3.4 Survival Percentage

The data about the survival percentage of rooted cuttings of black pepper in different rapid multiplication methods are presented in Table 3 and graphically illustrated in Fig. 3.

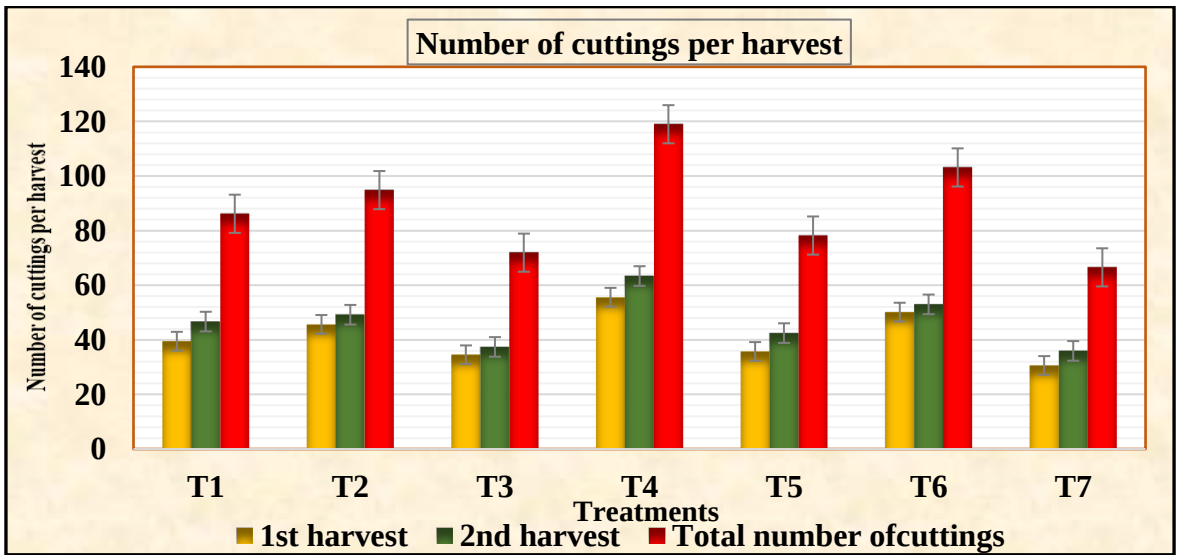

Fig. 1. Effect of different rapid multiplication methods of black pepper on the production of rooted cuttings

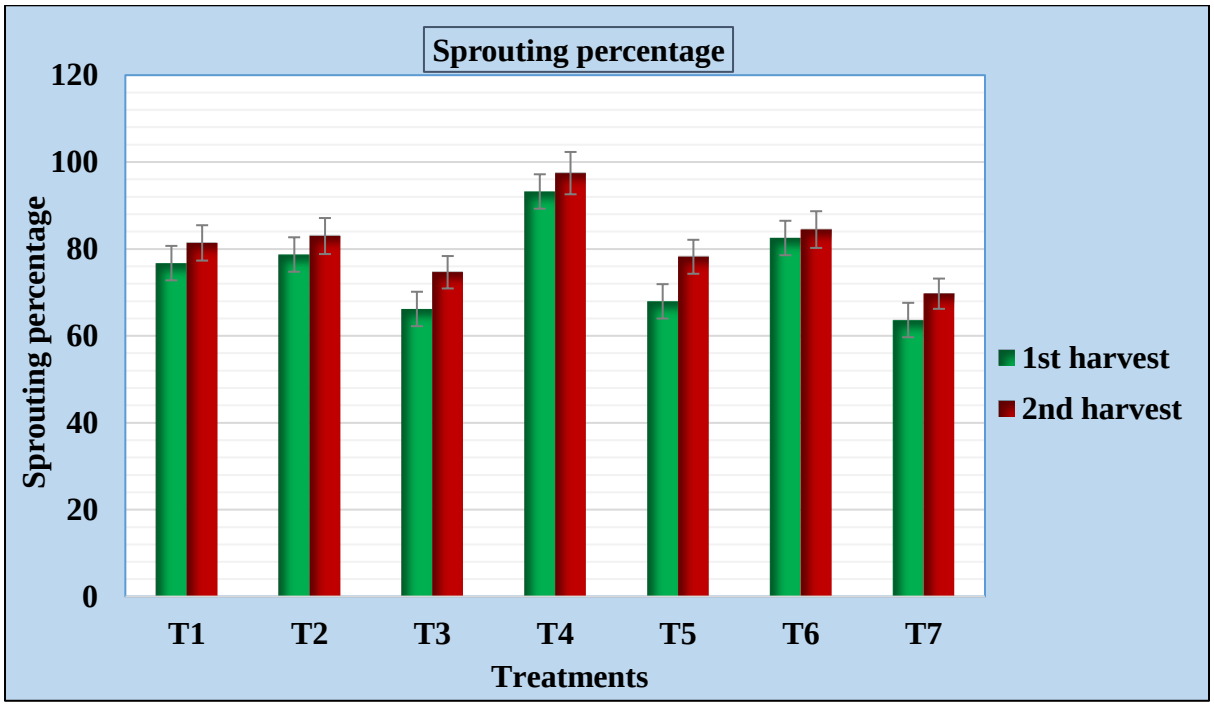

Fig. 2. Effect of different rapid multiplication methods on sprouting percentage per rooted cuttings of black pepper

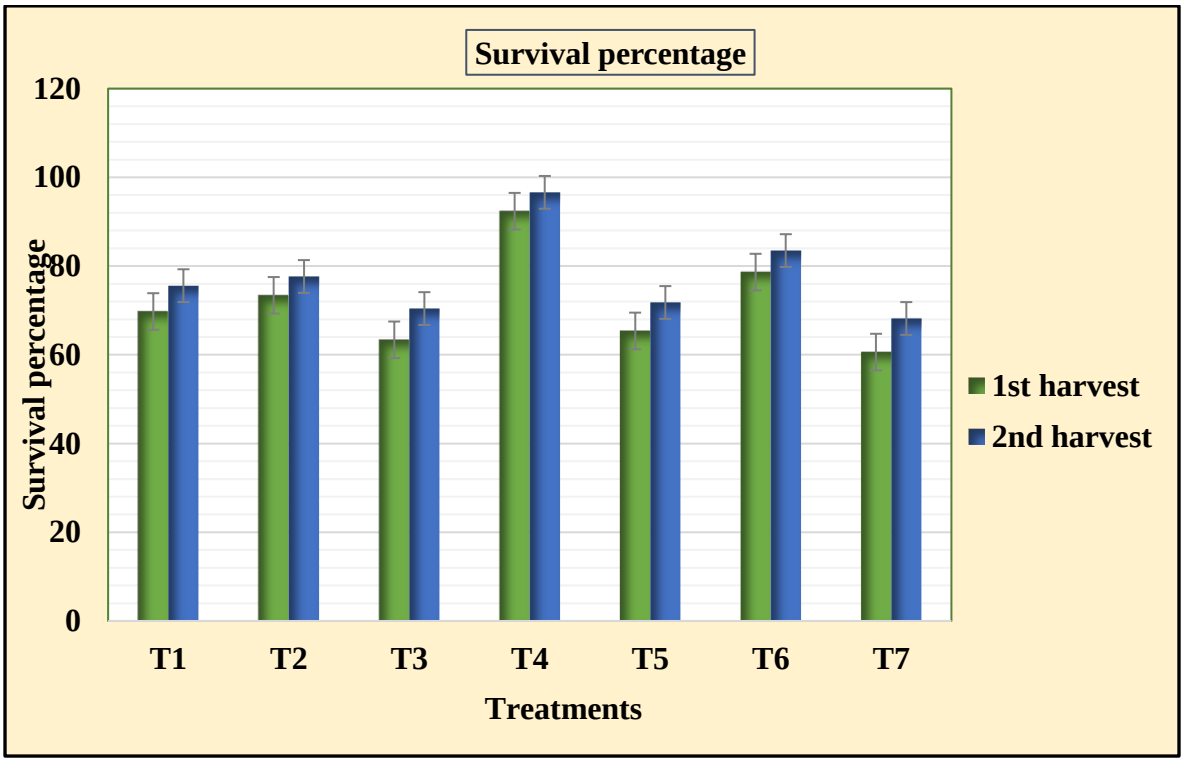

Fig. 3 Effect of different rapid multiplication methods on survival percentage of rooted cuttings in black pepper

Table 2. Effect of different rapid multiplication methods on sprouting percentage of rooted cuttings in black pepper

Treatments	Sprouting Percentage (30 DAP)	
	1st harvest 150 DAP	2nd harvest 120 days after 1st harvest
T_1 - Raised bed (Control)	76.74	81.39
T_2 - Soil mound	78.72	82.97
T_3 - Wooden log	66.19	74.64
T_4 - Serpentine	93.22	97.45
T_5 - Split halves of PVC	67.94	78.20
T_6 - Modified serpentine	82.52	84.46
T_7 - Trench method	63.64	69.70
Mean	75.56	81.25
Range	63.64-93.22	69.70-97.45
S. Em.±	3.49	4.37
C. D. at 5%	10.38	12.98
Result	SIG	SIG

S. Em..± - Standard error of Mean C. D. – Critical Difference at 5 %

Table 3. Effect of different rapid multiplication methods in black pepper on survival percentage

Treatments	Survival Percentage (45 DAP)	
	1st harvest 150 DAP	2nd harvest 120 days after 1st harvest
T_1 - Raised bed (Control)	69.76	75.58
T_2 - Soil mound	73.40	77.65
T_3 - Wooden log	63.38	70.42
T_4 - Serpentine	92.37	96.61
T_5 - Split halves of PVC	65.38	71.79
T_6 - Modified serpentine	78.64	83.49
T_7 - Trench method	60.61	68.18
Mean	71.91	77.67
Range	60.61-92.37	68.18-96.61
S. Em.±	3.40	4.11
C. D. at 5%	10.10	12.22
Result	SIG	SIG

S. Em..± - Standard error of Mean C. D. – Critical Difference at 5 %

The maximum survival percentage of rooted cuttings at the first harvest (92.37%) and second harvest (96.61%) were observed in treatment T_4 (Serpentine method). Whereas, the minimum survival percentage was recorded in treatment T_7 (Trench method) at first (60.61 %) and second harvest (68.18 %).

In the present investigation, the serpentine method (T_4) had the maximum survival percentage at both the first and second harvest. It might be due to that the vermicompost supplied physical conditions and adequate nutrients to rooted cuttings, resulting in improved metabolic and physiological activities along with good development of the root system.

The results are in conformity with findings reported by Thapa et al. [15] reported that the maximum survivability (93.00 % and 88.33 %, respectively) at 30 and 90 days after cuttings in Panniyur -1 by serpentine layering method. Thapa et al. [16] revealed that, the highest survivability of black pepper cuttings (94.00 % and 90.17 %) at 30 and 90 days after cutting of layers, respectively was recorded with the plant

grown under treatment T_{10} (top soil + coir pith + vermicompost @ 1:1:1) followed by (93.00 % and 88.83 %) at 30 and 90 days after cutting of layers in T_9 (top soil + sand + vermicompost @ 1:1:1) by serpentine method; these findings are in agreement with present results.

4. CONCLUSION

Based on the current study, it can be concluded that, the maximum number of cuttings per harvest, the total number of cuttings obtained per year, the sprouting percentage and the survival percentage were observed in treatment T_4 (Serpentine method). So far as growth performance, quality, and production of the total number of samples per year are concerned, the serpentine method hence, which was found best for rapid multiplication in black pepper.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors here by declare that No generative AI technologies such as large language models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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