



## **Propagation Studies in Passion Fruit (*Passiflora edulis* Sims.) Using Cuttings**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Authors AVJ and AS together designed the study, performed the statistical analysis, wrote the protocol and wrote the manuscript. Both authors read and approved the final manuscript.*

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### **ABSTRACT**

Passion fruit is a high value export oriented crop, which is gaining popularity among farmers. One of the constraints in expansion of this crop is availability of quality planting material. Passion fruit is propagated through seed, cutting and grafting. Among these methods, cuttings encourage the production and multiplication of true to type planting material. Therefore, a study was conducted at the Fruits Crops Research Station, Kerala Agricultural University, Vellanikkara, Thrissur, during August 2019 - November 2019 to evaluate the effect of different concentrations of NAA and number of nodes on the rooting of cuttings and survival percentage. The experiment was laid out in completely randomized design with twenty treatments and two replications. Experiment consisted of two factors, viz. NAA concentration (200 ppm, 400 ppm, 600 ppm, 800 ppm and control) and number of nodes (one node, two node, three node and four node), following quick dip method. The study revealed that there was significant variation among the treatments. When the effect of number of nodes alone was considered, four noded cutting had the maximum survival percentage, and higher root and shoot parameters. Improved survival percentage, and enhanced root and shoot

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characteristics were noticed with the increasing NAA concentration. From the present study, it was concluded that combined effect of more number of nodes and higher NAA concentration had profound effect on survival percentage, shoot length, root length, number of leaves and leaf area and four noded cuttings dipped in 800 ppm NAA, for 3-5 seconds was found to be the best successful propagule for passion fruit.

**Keywords:** *Passion fruit cuttings; NAA concentration; number of nodes; root characteristics; shoot characteristics.*

## 1. INTRODUCTION

Passion fruit is a perennial woody vine native to tropical America. There are three types of passion fruit under cultivation. They are the yellow passion fruit (*Passiflora edulis forma flavicarpa*) which is suited to tropical conditions or the plains; the purple passion fruit (*Passiflora edulis forma edulis*) which grows best under subtropical conditions or high altitudes and the giant granadilla (*Passiflora quadrangularis*). Due to its adaptability under humid tropical regions, it is gaining commercial importance in Kerala [1]. Passion fruit which is rich in vitamins, A, B and C and having excellent aroma is cultivated for its fruits which are used for fresh consumption and in the processing industry for the production of jam, squash, syrup etc. Leaf and stem of passion fruit have cytotoxic, anti-oxidant and antibacterial properties [2]. The seeds contain 23 per cent oil which is similar to sunflower or soybean oil and rind residue is used as cattle feed. Passion fruit cultivation has not become popular, due to lack of technical know-how regarding cultivation aspects and shortage of suitable varieties and good quality planting materials. However, passion fruit has high production potential in the plains of Kerala, owing to its wide adaptability under humid tropical conditions.

Recently, there is a trend among Kerala farmers to shift from traditional cash crops to fruit cultivation due to low price of cash crops. Passion fruit is such a crop, farmers are ready to cultivate in larger areas. In India, passion fruit is cultivated in an area of 9.11 thousand ha with a production of 45.82 thousand tones. Many diseases affect the production potential of passion fruit, major diseases include phytophthora blight, woodiness virus and brown spot [3]. Availability of the required number of disease free quality planting material is a constraint in expanding the passion fruit cultivation. Little information is available about the possible propagation techniques in passion fruit, limiting the commercial cultivation and

thereby the development of management strategies for further production. Even though passion fruit can be grown from seeds and cuttings, its commercial cultivation requires production of more number of quality planting materials. Seedling plants take a few weeks for transplanting and it also results in variability, due to the cross pollinating nature of the crop, especially yellow types. Stem cuttings can give true to type plants which can transfer all the desirable traits from mother plants to the progenies. Enhanced and early rooting will be advantageous for early establishment of the orchard. Synthetic plant growth regulators were found to induce rooting in cuttings [4]. Several studies have shown that number of nodes and the concentration of growth hormone had significant effect on enhancing rooting of cuttings [5,6]. As per the investigation by Sevik and Guney [7], the cuttings with at least one bud must be used in order to produce *Mellisa officinalis* rooted stem cuttings. They also found that the auxin group of hormones (IAA (Indole-3-acetic acid), IBA (Indole-3-butyric acid), and NAA ( $\alpha$ -Naphthalene acetic acid) had an apparent effect on morphological characteristics of the newly generated plants, especially root generation. In a propagation study for passion fruit conducted at CHES, Chettalli, it was found that NAA was the more effective auxin for promoting root initiation and further development in semi-hardwood cuttings, compared to IBA [8]. It is desirable to standardize the size of cuttings, with number of nodes and auxin concentration required for getting rooted cuttings easily and with maximum success. According to Bemkaireima et al. [9], three noded cuttings performed better with respect to length of shoot and number of roots, while four noded cuttings showed better response in terms of survival percentage. Treating cutting with 200 ppm NAA for very short period or 80 ppm NAA for 12 hour increased the rooting in passion fruit cuttings [10]. Selection of the right planting material will ensure good quality and enhanced yield in the crop which in turn will be highly useful to the farmers for revenue generation and income

**Table 1. Treatments showing number of nodes in the cuttings and NAA concentrations**

Treatment number	No. of nodes in the cutting and NAA concentration	Treatment number	No. of nodes in the cutting and NAA concentration
T1	One noded, without NAA (control)	T11	Three noded, without NAA (control)
T2	One noded + 200ppm NAA	T12	Three noded + 200ppm NAA
T3	One noded + 400ppm NAA	T13	Three noded + 400ppm NAA
T4	One noded + 600ppm NAA	T14	Three noded + 600ppm NAA
T5	One noded + 800ppm NAA	T15	Three noded + 800ppm NAA
T6	Two noded, without NAA (control)	T16	Four noded , without NAA (control)
T7	Two noded + 200ppm NAA	T17	Four noded + 200ppm NAA
T8	Two noded + 400ppm NAA	T18	Four noded + 400ppm NAA
T9	Two noded + 600ppm NAA	T19	Four noded + 600ppm NAA
T10	Two noded + 800ppm NAA	T20	Four noded + 800ppm NAA

enhancement. The present investigations were undertaken with the objective of standardizing the concentration of NAA and number of nodes on the cuttings for getting maximum success in passion fruit.

## 2. MATERIALS AND METHODS

Field experiment with twenty treatments, two replications and twenty five cuttings per replication was laid out at Fruit Crops Research Station, Kerala Agricultural University, Vellanikkara during August 2019 to November 2019. The experimental site was situated at 10° 31' North latitude and 76° 3' East longitude, at an altitude of 22.25 m above mean sea level, having typical warm humid tropical climate of Kerala. Cuttings were taken from disease free, vigorous growing adult vines of 134P. 134P is a purple coloured (*Passiflora edulis* var. *edulis*) pipeline variety from Pineapple Research Station, Vazhakulam under Kerala Agricultural University. Four different types of semi-hardwood cuttings viz., one noded, two noded, three node and four noded were used for the experiment. There were four different concentrations of NAA viz., 200 ppm, 400 ppm, 600 ppm and 800 ppm along with

control. The twenty combination treatments are listed in Table 1. Cuttings were planted in grow bags of size 15 cm x 10 cm filled with potting mixture, ie, sand: soil: compost in the ratio 1:1:1. The bulk density of the soil used for experiment was 1.37 Mg/m<sup>3</sup>. The polybags were arranged as per the layout and placed in the propagation structure. Observations were recorded on number of leaves, total leaf area, shoot length, and root length as well as survival percentage at 3 months after planting. Data were analysed statistically in Completely Randomized Design and significance was tested using analysis of variance technique [11].

## 3. RESULTS AND DISCUSSION

Effect of different noded cuttings on survival percentage, shoot and root parameters at 90 DAP (Days after planting) are given in Table 2. Significant influence was noticed with respect to survival percentage, shoot and root characteristics at 90 DAP by using different noded cuttings. For all the parameters studied, four noded cuttings (N4) exhibited the highest values, which may be due to the increased carbohydrate reserve present in them. Survival

percentage (70.60) was also the highest in the four noded cuttings (N4). This was followed by three noded cuttings (N3), which was on par with two noded cutting (N2) and the lowest survival percentage was obtained in single noded cuttings (N1). This might be due to the low reserve of carbohydrates in the single noded cuttings since it had the minimum size among the treatments. Number of leaves (7.70) and leaf area (166.15 cm<sup>2</sup>) were highest in four noded cuttings (N4). In a similar study conducted by Bemkairima et al. [9] number of leaves (6.53), total leaf area (55.9 cm<sup>2</sup>) and survival percentage (45) were highest in four noded cuttings and the values of the present study are comparable with those results. Root length also showed the same trend and four noded cuttings (N4) had the highest root length (14.25 cm), which was on par with three noded cuttings (N3). This was followed by two noded cutting (N2) which was on par with the single noded cuttings (N1). Zimmerman and Hitchcock [12] reported that higher number of nodes in the cuttings of vine crops resulted in higher root production, which is in agreement with the present results. Basu and Ghosh [13] reported that superiority in root length could be due to higher C: N ratio in the tissues of cuttings and higher food reserves in the cuttings. Shoot length observed also varied significantly with the number of nodes present in the cuttings and shoot length (28.75 cm) was the highest in four noded cutting (N4), followed by three noded (N3), two noded (N2) and one noded cuttings (N1). Longer shoot length, higher number of leaves and higher survival percentage in four noded cuttings might be due to the longer roots which resulted in better root development, helping in more absorption of nutrients and water.

Effect of NAA concentration on shoot and root parameters and survival percentage at 90 DAP are shown in Table 3. NAA concentration had significant effect on different characters studied. Survival percentage (64.50%) was the highest when NAA 800 ppm (A5) was used, which was followed by NAA 600 ppm (A4). Maximum number of leaves (7.00) was observed in the treatment NAA 800 ppm (A5) and minimum number of leaves (5.88) in the control. Shoot length varied significantly and was higher in all the NAA concentrations used when compared with the control (14.34 cm). The highest shoot length (27.94 cm) was observed NAA 800 ppm (A5) which was on par with NAA 600 ppm (A4). Total leaf area was significantly influenced by

NAA concentrations and was found superior to the control. Total leaf area (164.38 cm<sup>2</sup>) was the highest in NAA 800 ppm (A5), followed by NAA 600 ppm (A4). Higher survival percentage and shoot parameters might be due to the stimulated cambial activity resulting from the application of auxin like hormones which increased the mobilization of reserve food materials to the site of root initiation as reported by Gurumurthy et al. [14]. NAA concentrations significantly influenced the root length. Root length (14.56 cm) was the maximum for NAA 800 ppm (A5). According to Tripathi et al. [10] root characters were significantly influenced by higher level of NAA concentration and were found superior over control. Pandey et al. [15] reported that root initiation and root characters were influenced by the optimum concentrations of exogenous auxins which caused the mobilization and utilization of carbohydrates and nitrogen, along with the presence of cofactors at the cut portion. In a study conducted in pomegranate cuttings by Rajamanickam and Balamohan [16], it was found that the concentration of IBA increased number of leaves, shoot length, root length and survival percentage.

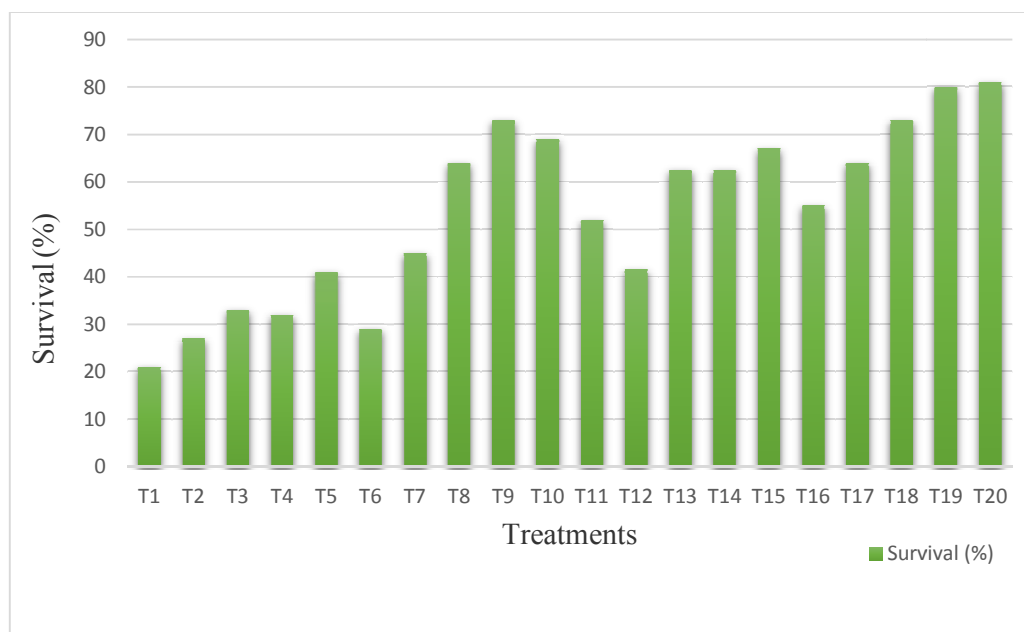
The combined effect of different noded cuttings and different NAA concentrations on survival percentage, shoot and root characteristics varied significantly at 90 DAP. The results of the study on the effect of different noded cuttings of passion fruit and different NAA concentrations on root and shoot parameters and survival percentage are presented in Table 4. Survival percentage among different treatments varied significantly ranging from 21 to 81% and is presented in Fig. 1. According to Bemkairima et al. [9], interaction effect of four noded cuttings treated with IBA showed superiority with respect to survival percentage, which is in line with the present results. Significant variation in number of leaves was observed among the treatments and it varied from 4 (Treatment 1) to 8.50 (Treatment 20). Shoot length of passion fruit cuttings varied significantly and was the highest in T20 (34.50 cm) while the lowest shoot length was observed in Treatment 1 (8.25 cm). The high success rate in Treatment 20 may be due to optimum concentration of NAA and carbohydrate reserve present in the cuttings. Singh and Singh [17] reported that the combination of four noded cuttings and 800 ppm NAA was superior over other treatments may be because of the rooting cofactor in its stem or due to the inherent rooting capacity of the species.

**Table 2. Effect of different noded cuttings on survival percentage, shoot and root parameters at 90 DAP**

Treatment	Survival (%)	No. of leaves	Shoot length (cm)	Total leaf area (cm <sup>2</sup> )	Root length (cm)
One noded (N1)	30.80	4.80	17.60	71.61	9.75
Two noded (N2)	56.00	6.10	21.63	82.84	9.95
Three noded (N3)	57.10	6.70	24.62	142.29	13.55
Four noded (N4)	70.60	7.70	28.75	166.15	14.25
C. D (0.05)	2.27	1.00	1.89	5.10	1.59

**Table 3. Effect of NAA concentration on shoot and root characteristics and survival percentage at 90 DAP**

Treatment	Survival (%)	No. of leaves	Shoot length (cm)	Total leaf area (cm <sup>2</sup> )	Root length (cm)
Control (A1)	39.25	5.88	14.34	65.42	8.61
NAA 200 ppm (A2)	44.38	5.63	22.74	94.11	11.25
NAA 400 ppm (A3)	58.13	6.63	24.72	115.01	12.25
NAA 600 ppm (A4)	61.88	6.50	26.00	139.69	12.70
NAA 800 ppm (A5)	64.50	7.00	27.94	164.38	14.56
C. D (0.05)	2.53	1.11	2.11	5.70	1.77

**Fig. 1. Effect of number of nodes and NAA concentration on survival percentage**

Statistical analysis showed that leaf area also varied significantly among the treatments. Leaf area, which is major contributing factor towards photosynthesis, varied from 216.00 cm<sup>2</sup> (Treatment 20) to 32.25 cm<sup>2</sup> (Treatment 1). The study also revealed that root length varied significantly with respect to different treatments.

Root length was lowest in Treatment 1 (6.25 cm) and highest in Treatment 20 (16.75 cm). The superiority of Treatment 20 in all the parameters studied might be due to the favourable interaction effect between the number of nodes in the cuttings and NAA concentration.

**Table 4. Effect of different noded cuttings and NAA concentrations on shoot and root parameters and survival percentage at 90 DAP**

Treatment	Survival (%)	No. of leaves	Shoot length (cm)	Total leaf area (cm <sup>2</sup> )	Root length (cm)
T1	21.00	4.00	8.25	32.25	6.25
T2	27.00	4.50	15.50	56.75	9.75
T3	33.00	6.00	20.75	73.30	8.75
T4	32.00	4.50	20.75	97.25	11.00
T5	41.00	5.00	22.75	98.50	13.00
T6	29.00	5.50	12.38	42.00	6.95
T7	45.00	5.50	21.75	81.20	8.75
T8	64.00	6.00	23.25	81.75	11.50
T9	73.00	6.50	24.50	103.75	10.80
T10	69.00	7.00	26.25	105.50	11.75
T11	52.00	7.00	16.00	87.68	11.25
T12	41.50	5.00	25.70	108.25	13.00
T13	62.50	7.00	26.38	136.00	13.75
T14	62.50	7.00	26.75	142.00	13.00
T15	67.00	7.50	28.25	237.50	16.75
T16	55.00	7.00	20.75	99.75	10.00
T17	64.00	7.50	28.00	130.25	13.50
T18	73.00	7.50	28.50	169.00	15.00
T19	80.00	8.00	32.00	215.75	16.00
T20	81.00	8.50	34.50	216.00	16.75
C. D (0.05)	5.07	2.23	4.23	11.40	3.55

#### 4. CONCLUSION

From the present study, it could be concluded that among the different noded cuttings, four noded cutting was superior in all the characteristics studied. As the number of nodes per cutting increased survival percentage, shoot and root parameters also got enhanced. NAA was found to increase the growth of passion fruit cuttings and the highest concentration of NAA used, 800 ppm, resulted in the highest values and was superior for all the parameters studied. The interaction effect between number of nodes per cutting and NAA concentration showed that four noded cutting treated with 800 ppm NAA recorded the highest values for all the traits studied. Thus, four noded cuttings dipped in 800 ppm NAA can be used effectively for the large scale multiplication of passion fruit plants for commercial cultivation thereby ensuring true to type plants. This helps to get uniform crop with high returns.

#### CONSENT

It is not applicable.

#### ETHICAL APPROVAL

It is not applicable.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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