**Impact of IBA, NAA and rooting media on morphological parameters of stem cuttings in fig (*Ficus carica* L.)**

**Abstract**

*Ficus carica* L. an economically significant subtropical fruit species, is traditionally propagated through cuttings, necessitating improved rooting techniques for sustainable production. The present investigation reveals the effects of IBA (Indole-3-butyric acid), NAA (Naphthalene acetic acid), and different rooting media on the morphological parameters in fig (*Ficus carica* L.) stem cuttings. The experiment aimed to enhance rooting success and optimize growth conditions for efficient propagation. A series of treatments involving two factors – Factor I (rooting media) with three levels *viz*., S1 – Top soil: vermicompost: perlite (1:2:1), S2 – Top soil: peat: sawdust (1:2:1), S3 – Control and Factor II (plant growth regulators) with five levels viz., G1 – IBA @ 3000 ppm, G2 – IBA @ 5000 ppm, G3 – NAA @ 3000 ppm, G4 – NAA @ 5000 ppm, G5 – Control was applied to fig stem cuttings. The findings indicate that specific combinations of auxins and rooting media significantly influence root initiation and subsequent growth performance.

***Keywords:*** *Ficus carica. L, stem cuttings, rooting media, auxins, morphological parameters*.

1. **INTRODUCTION**

The genus Ficus, commonly known as figs, belongs to the family Moraceae and represents an important group of trees. Among them, Ficus carica L. is the most well-known and economically significant species. Native to Asia Minor and middle east the fig is a large, deciduous, subtropical tree or shrub that was introduced to the Mediterranean region early in history. Egypt is the leading producer in all over world. The total area under fig cultivation is around 5600 hectares of land with a production of about 13,802 thousand tons *i.e.,* about 12.32 tons per hectare (MoFPI, 2025).

Figs can be propagated both sexually and asexually. While seeds are used primarily for rootstock development or hybridization, asexual methods—such as grafting, layering, and cuttings—are more commonly used for producing true-to-type plants. Among these, propagation through cuttings is the most economical and practical, although achieving successful rooting in hardwood cuttings remains a major challenge. Rooting media and plant growth regulators play a vital role in this process Aghera, DK (2018).

The choice of rooting medium significantly influences root development, with materials such as soil, sand, perlite, vermiculite, and farmyard manure (FYM) showing varied effectiveness. Auxins, particularly synthetic types like indole-3-butyric acid (IBA) and 1-naphthaleneacetic acid (NAA), are frequently used to improve rooting success. These hormones stimulate root initiation, enhance root quantity and quality, and improve overall rooting percentage, especially in species that are difficult to propagate. Therefore, optimizing the concentration and combination of growth hormones is essential for successful root induction in fig cuttings (Supriya and Singh, 2024).

1. **MATERIALS AND METHODS**

The current research examined the influence of IBA, NAA, and rooting media on the morphological characteristics of stem cuttings in fig (*Ficus carica* L.) at the School of Agricultural Science, Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu, during the years 2024 – 2025. The study was laid out in Factorial Complete Randomized Design (FCRD) consists of Factor I (Media) with three levels – (S1 – Top soil: vermicompost: perlite (1:2:1), S2 – Top soil: peat: sawdust (1:2:1), S3 – Control) and Factor – II (Growth regulators) with three levels – (G1 – IBA @ 3000 ppm, G2 – IBA @ 5000 ppm, G3 – NAA @ 3000 ppm, G4 – NAA @ 5000 ppm, G5 – Control) with three replications.

**2.1. Treatment details**

**Table 1: List of Treatment Details**

|  |  |
| --- | --- |
| **Treatment** | **Treatment details** |
| **S1G1****S1G2****S1G3****S1G4****S1G5****S2G1****S2G2****S2G3****S2G4****S2G5****S3G1****S3G2****S3G3****S3G4****S3G5** | Top soil: Vermicompost: Perlite (1:2:1) + IBA @ 3000 ppmTop soil: Vermicompost: Perlite (1:2:1) + IBA @ 5000 ppmTop soil: Vermicompost: Perlite (1:2:1) + NAA @ 3000 ppmTop soil: Vermicompost: Perlite (1:2:1) + NAA @ 5000 ppmTop soil: Vermicompost: Perlite (1:2:1) + ControlTop soil: Peat: Sawdust (1:2:1) + IBA @ 3000 ppmTop soil: Peat: Sawdust (1:2:1) + IBA @ 5000 ppmTop soil: Peat: Sawdust (1:2:1) + NAA @ 3000 ppmTop soil: Peat: Sawdust (1:2:1) + NAA @ 5000 ppmTop soil: Peat: Sawdust (1:2:1) + ControlControl+ IBA @ 3000 ppmControl+ IBA @ 5000 ppmControl+ NAA @ 3000 ppmControl+ NAA @ 5000 ppmControl |

**2.2. Statistical tool:** STAR, OPSTSAT

**2.3. Collection of stem cuttings**

Past season matured shoots were collected from Pomological station, Coonoor. Cuttings from one-year-old shoots with four to five nodes were semi-hardwood. Early in the morning, cuttings were gathered using a secateur. Cuttings should have no leaves on them and be cut to a length of 18 to 22 cm by trimming off the ends that are just above a bud. In order to expose the most surface area possible for optimal roots, the cuttings were slanted.

**2.4. Preparation of plant growth hormone**

$$ppm=\frac{mass of solute (g)}{volume of water (ml)} 106$$

$$volume of PGR= \frac{ reqiured contentrtaion \left(ppm\right)X volume of water (ml)}{stock contentrtion (ppm)}$$

By using the any one of the formulae plant growth hormones were prepared. Sodium hydroxide (1N) added to dissolve the plant growth hormones.

**2.5. Preparation of raised beds and planting of cuttings**

Three beds were raised at the composition of S1 – Top soil: vermicompost: perlite (1:2:1), S2 – Top soil: peat: sawdust (1:2:1), S3 – Control. Five cuttings were planted per replications. By quick dip method, cuttings were dipped in plant growth regulators for 25 seconds and planted in slanting position. Raised beds were irrigated daily and weeds were removed properly.

**2.6. Shoot parameters**

**2.6.1 Days taken for sprouting**

Every day, treated cuttings were checked to find the amount of time taken for sprout initiation.

**2.6.2 Leaf length**

Length of leaves was manually measured by using of scale from the rooted cuttings after 90 days and expressed in cm.

**2.7. Root parameters**

**2.7.1 Number of roots**

Number of adventitious roots that are emerged from the rooted cuttings was observed after 90 days.

**2.7.2 Number of root forks**

It refers to the number of secondary roots that forms from the primary roots in stem cuttings.

**2.7.3 Average length of roots**

Using a measuring scale, the average length of adventitious roots for each treatment was manually measured on the 90th day of planting and expressed in centimetres.

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**2.7.4 Root surface area**

It was calculated manually by measuring the length and diameter and substituted in the formulae mentioned below and expressed in cm2.

$$Root surface area=2πrh$$

**2.7.5 Root volume**

It was calculated manually by measuring the length and diameter and substituted in the formulae mentioned below and expressed in cm3.

$$Root volume= πr^{2 }h$$

**2.7.6 Dry weight of roots**

The roots that were collected from each rooted cuttings were dried at 600 C for 12 hours in hot air oven and expressed in grams.

**2.7.7 Fresh weight of roots**

Every rooted cutting from each treatment was collected and promptly weighed on an electronic balance, and presented in grams.

**2.7.8 Survival percentage (%)**

The total number of rooted cuttings that survived under each treatment in each replication was used to calculate the survival percentage of rooted cuttings.

$$Survival \left(\%\right)= \frac{Total number of survived cuttings}{Total number of cuttings planted} X 100$$

**3. RESULTS AND DISCUSSION**

**3.1 Impact of rooting media and plant growth regulator on shoot parameters**

**3.1.1 Days taken for sprouting**

The findings of the research regarding the impact of IBA and NAA, as well as the growing media on the duration taken for the sprouting of fig (*Ficus carica* L.), are illustrated in Fig. 1.

The cuttings that were placed in S2 (Topsoil: Peat: Sawdust in a 1:2:1 ratio) sprouted the quickest at 17.11 days, followed closely by S1 (Topsoil: Vermicompost: Perlite) at 18.40 days, while S3 (Control) took the longest at 18.72 days. Peat has traditionally been utilized alone or combined with inorganic (Mendez *et al.,* 2015) and organic materials (Messiga *et al.,* 2021) due to its exceptional characteristics, which include low pH, effective cation exchange, and increased porosity.

The cuttings treated with G1 (IBA @3000 ppm) began sprouting in a shorter time of 16.37 days, followed by G2 (IBA @5000 ppm) at 17.93 days, while the untreated cuttings (G5) took longer to sprout at 20.09 days. This outcome is attributed to the higher concentration of the IBA hormone, which enhances root development, accelerates root initiation, and facilitates the sprouting process (Khapre *et al.,* 2012). The findings of this study align with the results reported by Pandey *et al.,* (2023) for jamun and Maninderdeep et al. (2021) for grapes.

There was no significant relation between rooting media and plant growth regulator on leaf length.

**3.1.2 Leaf length**

 The findings of the study regarding the impact of IBA and NAA, as well as the growing media, on the leaf length of fig (*Ficus carica* L.) are shown in Table 2.

The cuttings placed in S2 (Topsoil: Peat: Sawdust (1:2:1)) resulted in the longest leaves measuring 14.19 cm, followed by S1 (Topsoil: Vermicompost: Perlite (1:2:1)) with leaves of 12.35 cm, while S3 (Control) yielded the shortest leaves at 11.77 cm. This can be attributed to the superior aeration and lower bulk density of sawdust, which promotes the growth of healthy shoots (Messiga *et al.,* 2021).

The cuttings treated with 3000 ppm of IBA (G1) achieved the longest leaf length of 14.79 cm, followed closely by the 5000 ppm NAA (G4) treatment with a leaf length of 13.26 cm, while the untreated cuttings (G5) yielded the shortest leaf length of 10.72 cm. The extension of shoots and leaves may be attributed to growth regulators that enhance the uptake of nitrogen, carbohydrates, and various nutrients due to higher concentrations of IBA. Comparable findings were observed by Kaur (2017) in peach and Maninderdeep *et al.,* (2021).

There was no significant effect on leaf length due to the rooting media and plant growth regulators.

**3.2 Impact of rooting media and plant growth regulator on shoot parameters**

**3.2.1 Number of roots**

The findings of the investigation regarding the influence of IBA and NAA as well as different growing media on the quantity of roots in fig (*Ficus carica* L.) are detailed in Table 2.

The cuttings grown in S2 (Topsoil: Peat: Sawdust (1:2:1)) developed the largest number of roots at 15.79, followed by S1 (Topsoil: Vermicompost: Perlite (1:2:1)) with 13.95, while S3 (Control) produced the least at 13.91. According to Okanlawon *et al.,* (2016), peat soil creates ideal conditions for rooted cuttings due to its greater organic matter content, porosity, and ability to retain moisture, leading to enhanced root growth and development.

The cuttings treated with IBA @5000 ppm (G2) achieved the highest root count of 19.29, followed by G4 (NAA @3000 ppm) with 14.51, whereas untreated cuttings exhibited the fewest roots. The increased root number at IBA @5000 ppm can be attributed to the build-up of internal elements that facilitate cell division and promote the expression of root primordia, resulting in a robust rooting system. Similar results were documented by Bhosale *et al.,* (2014) in pomegranate and Yogesh *et al.,* (2023) in guava cultivar Lucknow-49.

The interaction effect between the plant growth regulators and the rooting medium on the number of roots was found to be non-significant.

**3.2.2 Average length of roots**

The findings from the investigation regarding the influence of IBA, NAA, and different growing media on the average root lengths of fig (*Ficus carica* L.) are displayed in Table 2.

The cuttings cultivated in S2 media (Topsoil: Peat: Sawdust (1:2:1)) yielded the longest root length at 19.77 cm, followed by S1 (Topsoil: Vermicompost: Perlite (1:2:1)) at 18.48 cm, while the shortest roots were recorded in S3 (Control) media at 17.19 cm. According to Waseem *et al.,* (2013), an effective propagation medium must retain both water and nutrients, as this significantly affects the average root length. Shamsuddin *et al.,* (2021) noted that when cuttings were placed in peat soil as the propagation medium, it resulted in the longest roots.

 The longest roots were achieved with cuttings treated with IBA @5000 ppm (G2), measuring 23.79 cm, followed by IBA @3000 ppm (G1) at 18.71 cm; the untreated cuttings (G5) produced the shortest roots at 14.64 cm. The breakdown of polysaccharides in these cuttings into physiologically active sugars likely contributed to the increased root length initiated by IBA @5000 ppm. This treatment also supplies energy to the root primordia through respiratory processes and promotes the swift elongation of meristematic cells, leading to longer roots (Sing *et al.,* 2014). Similar findings were shared by Rao *et al.,* (2022) in pomegranate and Yogesh *et al.,* (2023) in guava.

There was no notable significant difference in root length between the plant growth regulators and the rooting media.

**3.2.3 Number of root forks**

The findings of the investigation regarding the impact of IBA and NAA, as well as the growing media, on the number of root forks in fig (*Ficus carica* L.) are shown in Table 2.

The cuttings planted in S2 media (Topsoil: Peat: Sawdust (1:2:1)) yielded the highest average of 6.59 root forks, followed by S*1* (Topsoil: Vermicompost: Perlite (1:2:1)) with an average of 6.01, while the least number of root forks was noted in S*3* (Control) media with 5.59. According to Gopale and Zunjarrao (2011), a well-ventilated medium enhances metabolic activities essential for root initiation, leading to an increase in the number of root forks. Similar results were observed in Buchholzia coriacea cuttings that were grown on sawdust and topsoil, as compared to river sand (Akinyele, 2010).

 A higher number of root forks was noted when the cuttings were treated with 5000 ppm of IBA (G*2*), reaching an average of 7.30, followed by NAA @5000 ppm (G4) with 6.22, while the untreated cuttings (G5) had the lowest average of 4.96. The application of both natural and synthetic auxins at higher concentrations not only increases the number of roots and root forks per cutting but also tends to stimulate the growth of preexisting root systems, thereby supporting sprouting and overall growth (Haissing, 1974). Comparable results were documented by Saha *et al.,* (2020) with eucalyptus.

The interaction effect between the rooting media and plant growth regulator on the number of root forks was found to be non-significant.

**3.2.4 Root surface area and Root volume**

The findings of the research regarding the influence of IBA and NAA, as well as different growing media, on the root surface area and root volume of fig (*Ficus carica* L.), are compiled in Table 3.

The cuttings placed in S2 media (Topsoil: Peat: Sawdust in a 1:2:1 ratio) demonstrated the greatest root surface area (51.48 cm²) and root volume (7.49 cm³), followed by S1 (Topsoil: Vermicompost: Perlite in a 1:2:1 ratio) with 47.86 cm² and 6.70 cm³. In contrast, the lowest root surface area (43.81 cm²) and root volume (6.03 cm³) were observed in S3 (Control) media. Adequate porosity is vital for root development, and the propagation medium's surface area enhances nutrient and water absorption (Samar and Saxena, 2016).

 The cuttings treated with IBA @5000 ppm (G2) showed the highest root surface area (65.20 cm²) and root volume (10.22 cm³), followed by NAA @5000 ppm (G4) with 48.42 cm² and IBA @3000 ppm (G1) with a volume of 7.13 cm³. The untreated cuttings (G5) yielded the lowest root surface area (33.73 cm²) and root volume (3.06 cm³). Similar results were noted by Loconsole *et al.,* (2022) in cuttings of glossy abelia.

There was no significant difference observed in root volume and root surface area among the various rooting media and plant growth regulators.

**3.2.5 Fresh weight and dry weight of roots**

The findings of the research on the influence of IBA and NAA along with growing media on the fresh and dry weights of roots of fig (*Ficus carica* L.) are detailed in Table 3.

The highest fresh weight (7.31 g) and dry weight of roots (1.27 g) were noted when cuttings were placed in S2 media (Topsoil: Peat: Sawdust (1:2:1)), followed by S1 media (Topsoil: Vermicompost: Perlite (1:2:1)), which recorded a fresh weight of 6.93 g and a dry weight of 0.87 g. The lowest values for fresh weight (6.03 g) and dry weight (0.75 g) were observed in S3 media (Control). According to Okanlawon *et al.,* (2016), peat soil provides optimal conditions for rooting cuttings due to its higher organic matter content, enhanced water retention capacity, and porosity, all of which facilitate root growth and development. Similar findings were reported by Shamsuddin *et al.,* (2021) regarding fig (*Ficus carica* L.).

Cuttings treated with IBA @5000 ppm (G2) demonstrated the highest fresh weight (10.22 g) and dry weight (2 g), followed by IBA @3000 ppm (G1) with a fresh weight of 7.9 g and a dry weight of 0.92 g, while untreated cuttings (G5) produced the lowest fresh weight (3.06 g) and dry weight (0.30 g). The application of IBA is believed to enhance the movement of natural auxin (IAA) from the leaves and shoot tips, which may explain the increase in both fresh and dry root weights. The current results are consistent with those of Caruso *et al.,* (2021) in fig cuttings, Kim *et al.,* (2021) in Veronica stem cuttings, Ali *et al.,* (2022) in dragon fruit, and Rao *et al.,* (2022) in pomegranate.

The interaction of S2G2 (Topsoil: Peat: Sawdust (1:2:1) combined with IBA @5000 ppm) resulted in a lower dry weight of 0.28 g when compared to S3G5 (Control).

**3.2.6 Survival per centage**

The findings of the research on the impact of IBA and NAA, as well as various growing media, on the survival rates of fig (*Ficus carica* L.) are illustrated in Fig. 2.

Among the various rooting media, the S2 media (Topsoil: peat: sawdust (1:2:1)) yielded the highest survival rate (62.67%), while the cuttings placed in S1 media (Topsoil: vermicompost: perlite (1:2:1)) achieved the next highest survival rate of 56%. Conversely, the lowest survival percentage (41.33%) was recorded for cuttings in S3 media (Control). This treatment resulted in longer and more numerous roots, facilitating better moisture and nutrient absorption from the media, which in turn enhanced the survival rate.

The G2 treatment (5000 ppm IBA) notably increased the survival rate of rooted cuttings to 82.22%, followed by G1 (3000 ppm IBA) with a survival rate of 60%. The lowest survival rate of 28.89% was observed in G5 (Control). Singh *et al.,* (2003) stated that IBA promotes rooting and root length in *Piper longum*, indicating that auxin activity might have aided in the hydrolysis and movement of carbohydrates and nitrogenous compounds at the base of cuttings, thus speeding up cell elongation and division in the appropriate environment. This study aligns with previous findings that IBA @5000 ppm resulted in the highest survival rate, as seen in research by Reddy *et al.,* (2008 a) and Thakur *et al.,* (2014) involving olive cuttings.

It was found that there was no significant interaction among the NAA and IBA concentrations and the various rooting media concerning the survival percentages.

**Table 2: Impact of plat growth regulators and rooting medium on leaf length (cm), no. of roots per cuttings, no. of root forks, average length of roots (cm)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Leaf length (cm)** | **No. of roots per cutting** | **No. of root forks** | **Average length of roots (cm)** |
| **S1** | 12.34 | 14.77 | 6.01 | 18.48 |
| **S2** | 14.64 | 15.79 | 6.59 | 19.77 |
| **S3** | 11.85 | 13.08 | 5.59 | 17.19 |
| **CD @ 5%** | 0.914 | 1.242 | 0.369 | 0.981 |
| **SE (D)** | 0.445 | 0.605 | 0.18 | 0.478 |
| **G1** | 13.03 | 14.31 | 5.79 | 18.71 |
| **G2** | 15.64 | 19.29 | 7.30 | 23.79 |
| **G3** | 11.94 | 13.98 | 6.04 | 17.13 |
| **G4** | 13.37 | 14.51 | 6.22 | 18.13 |
| **G5** | 10.72 | 10.66 | 4.96 | 14.64 |
| **CD @ 5%** | 1.18 | 1.603 | 0.46 | 1.266 |
| **SE (D)** | 0.575 | 0.781 | 0.232 | 0.617 |
| **S1G1** | 12.43 | 15.03 | 5.77 | 18.93 |
| **S1G2** | 15.70 | 18.77 | 7.23 | 23.57 |
| **S1G3** | 11.00 | 14.17 | 5.90 | 17.20 |
| **S1G4** | 12.17 | 14.93 | 6.27 | 18.47 |
| **S1G5** | 10.40 | 10.97 | 4.87 | 14.23 |
| **S2G1** | 14.03 | 15.27 | 6.33 | 20.07 |
| **S2G2** | 16.60 | 21.53 | 7.87 | 25.47 |
| **S2G3** | 14.17 | 15.50 | 6.67 | 18.43 |
| **S2G4** | 15.80 | 15.38 | 6.60 | 19.23 |
| **S2G5** | 12.60 | 11.33 | 5.50 | 15.67 |
| **S3G1** | 12.63 | 12.63 | 5.27 | 17.13 |
| **S3G2** | 14.63 | 17.57 | 6.80 | 22.33 |
| **S3G3** | 10.67 | 12.27 | 5.57 | 15.77 |
| **S3G4** | 12.13 | 13.27 | 5.80 | 16.70 |
| **S3G5** | 9.17 | 9.67 | 4.50 | 14.03 |
| **CD @ 5%** | NS | NS | NS | NS |
| **SE (D)** | NS | NS | NS | NS |

**Table 3. Impact of plat growth regulators and rooting medium on root surface area (cm2), root volume (cm3), fresh weight of roots (g), dry weight of roots (g)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Root surface area (cm2)** | **Root volume (cm3)** | **Fresh weight of roots (g)** | **Dry weight of roots (g)** |
| **S1** | 47.86 | 6.70 | 6.93 | 0.87 |
| **S2** | 51.48 | 7.49 | 7.31 | 1.27 |
| **S3** | 43.81 | 6.03 | 6.03 | 0.75 |
| **CD @ 5%** | 2.879 | 0.59 | 0.617 | 0.248 |
| **SE (D)** | 1.403 | 0.287 | 0.301 | 0.121 |
| **G1** | 46.25 | 7.13 | 7.19 | 0.92 |
| **G2** | 65.20 | 10.22 | 10.22 | 2.00 |
| **G3** | 44.97 | 6.67 | 6.67 | 0.89 |
| **G4** | 48.42 | 6.64 | 6.64 | 0.69 |
| **G5** | 33.73 | 3.06 | 3.06 | 0.30 |
| **CD @ 5%** | 3.716 | 0.761 | 0.796 | 0.321 |
| **SE (D)** | 1.81 | 0.371 | 0.388 | 0.156 |
| **S1G1** | 47.65 | 6.97 | 7.88 | 0.64 |
| **S1G2** | 65.12 | 9.94 | 9.94 | 2.02 |
| **S1G3** | 44.27 | 6.62 | 6.84 | 0.85 |
| **S1G4** | 48.98 | 6.83 | 6.83 | 0.55 |
| **S1G5** | 33.28 | 3.17 | 3.17 | 0.29 |
| **S2G1** | 49.32 | 8.07 | 7.36 | 1.30 |
| **S2G2** | 71.76 | 11.39 | 11.39 | 2.90 |
| **S2G3** | 46.66 | 7.11 | 6.89 | 0.97 |
| **S2G4** | 52.92 | 7.16 | 7.16 | 0.82 |
| **S2G5** | 36.72 | 3.73 | 3.73 | 0.34 |
| **S3G1** | 41.79 | 6.35 | 6.35 | 0.84 |
| **S3G2** | 58.72 | 9.32 | 9.32 | 1.09 |
| **S3G3** | 43.98 | 6.27 | 6.27 | 0.34 |
| **S3G4** | 43.37 | 5.94 | 5.94 | 0.69 |
| **S3G5** | 31.19 | 2.27 | 2.27 | 0.28 |
| **CD @ 5%** | NS | NS | NS | 0.555 |
| **SE (D)** | NS | NS | NS | 0.271 |

*S1G1 - Top soil: Vermicompost : Perlite (1:2:1) + IBA @ 3000 ppm, S1G2 - Top soil: Vermicompost : Perlite (1:2:1) + IBA @ 5000 ppm, S1G3 - Top soil: Vermicompost : Perlite (1:2:1) + NAA @ 3000 ppm, S1G4 - Top soil: Vermicompost : Perlite (1:2:1) + NAA @ 5000 ppm, S1G5 - Top soil: Vermicompost : Perlite (1:2:1) + Control, S2G1 - Top soil: Peat: Sawdust (1:2:1) + IBA @ 3000 ppm, S2G2 - Top soil: Peat: Sawdust (1:2:1) + IBA @ 5000 ppm, S2G3 - Top soil: Peat: Sawdust (1:2:1) + NAA @ 3000 ppm, S2G4 - Top soil: Peat: Sawdust (1:2:1) + NAA @ 5000 ppm, S2G5 - Top soil: Peat: Sawdust (1:2:1) + Control, S3G1 - Control+ IBA @ 3000 ppm, S3G2 - Control+ IBA @ 5000 ppm, S3G3 - Control+ NAA @ 3000 ppm, S3G4 - Control+ NAA @ 5000 ppm, S3G5 - Control*

**Fig. 1** Impact of plat growth regulators and rooting medium on days taken for sprouting

**Fig. 2** Impact of plat growth regulators and rooting medium on survival (%)

**4. CONCLUSION**

Based on this experimental finding it was indicated that S2 media (Top soil: peat: sawdust (1:2:1)) gave best results in terms of shoot and root parameters. Among different concentration of IBA and NAA, IBA @ 3000 ppm reported maximum values for shoot parameters and IBA @5000 ppm results best value for root parameters.

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