

# EFFECT OF GROWING CONDITIONS AND TIME OF PLANTING ON THE ROOTING IN STEM CUTTING OF MULBERRY (*MORUS ALBA* L.) UNDER SUB TROPICAL VALLEY CONDITION OF HIMALAYA REGION

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## KEYWORDS

Mulberry  
IBA  
Planting time  
Growing condition  
Rooting

Received on :  
05.09.2016

Accepted on :  
11.01.2017

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## ABSTRACT

This investigation was conducted at the Horticultural Research Centre, HNB Garhwal University(A central university), Srinagar Garhwal, Uttarakhand, India. The treatments included time of planting (December 25<sup>th</sup>, January 10<sup>th</sup> and January 25<sup>th</sup>), three growing conditions (Partial shade, Open condition and Mist chamber) and 500 ppm concentration of IBA. Hardwood stem cuttings of Mulberry were collected from 5 to 6 year old plants and 15 ± 2 cm long cuttings having 4 to 6 nodes. The experiment was laid out in Factorial randomized block design (FRBD) and three replicated. The maximum Shoot percentage (75.56%), rooting percentage (67.22%) were recorded under T<sub>3</sub> (January 25<sup>th</sup>) planting time and the maximum length of sprout (8.67 cm), number of primary root (12.67), length of root (13.11 cm) were recorded under T<sub>2</sub> (January 10<sup>th</sup>). In case of growing condition, maximum percentage of sprouted cuttings (76.70%), length of sprout (8.08 cm) shoot percentage (76.67%), root percentage (73.89%), number of primary root (10.11) were recorded under G<sub>1</sub> (Mist chamber) growing condition. It may be concluded that mist chamber growing condition and T<sub>2</sub> (January 10<sup>th</sup>) planting time shows the best performance of mulberry cutting.

## INTRODUCTION

Mulberry belongs to family Moraceae, it is perennial, fast growing fruit tree and thrives well under the tropical, subtropical, and temperate region. Mulberry is being grown throughout but it's more extensive area in Karnataka particularly Mysore especially for sericulture. The important use of mulberry leaf is rearing of the silk worms for production of silk. It is also used for timber purpose such as making of chair, table, sports item and agricultural implements. Bark is also used for making good quality paper.

Mulberry is usually propagated by seed. But vegetative method of propagation are always preferred to get seedlings of to type. Generally cutting, shield, ring or flute budding and inarching are also practised in mulberry. The suitable time of cuttings preparation and planting is related to the environmental conditions and physiological condition of the plant. Hartmann *et al.*, 2002 Observed that the rooting of the cutting is one of the important techniques for vegetative propagation and it was observed that cuttings play important role in the rooting of important fruit species. But, there are some exogenous and endogenous factors affecting rooting of cuttings such as growth regulators. Ahmad *et al.* (2011) reported that the mulberry (*Morus alba* L.) performance of cutting in outdoor and indoor at polythene low tunnel. number of root, root length and root fresh and dry weight were found maximum in 5cm cutting. Root growth was found maximum in outdoor as compared to

under polythene sheet. The *Citrus auriantifolia* cuttings treated with 500 ppm concentration of IBA, performed the best in all aspects, as root formation, length of root, diameter of root (Tomar and Bhatt, 2010). The auxins activated shoot growth which might have resulted in elongation of leaves and stems through cell division accounting in longest and thickest sprout. Kalyoncu *et al.* (2009) recorded that the maximum rooting percentage (100%) was observed under 2000 and 3000ppm IBA. It has been hypothesized that the time of planting and growing conditions is effected on rooting and survivable of Mulberry. The present study is proposed for vegetative multiplication of Mulberry through stem cuttings to find out the appropriate time of planting and also to find out the best growing condition for rooting.

## MATERIALS AND METHODS

Experiment was conducted under Horticulture Research Center, Chauras Campus of H.N.B Gharhwal University, (A Central University)Uttarakhand. Geographically the valley is spread between latitude 300, 12' 0" to 300 13' 4" North and longitude 780 0' 45" to 780 0' 50" East at an elevation 540 m above MSL. The valley shows a semi-arid and sub-tropical climate, except during rainy season rest of months are usually dry with exception occasional showers during winter or early spring. The average minimum and maximum temperature, relative humidity and rainfall vary from 6.44 to 34.35°C,

65.25% and 2.60 to 235.45 mm respectively.

Hardwood stem cuttings of Mulberry were collected from 5 to 6 year old plants and 15 ± 2 cm long stem cuttings having 4 to 6 nodes with diameter of 1.0-1.5 cm were taken. The basal cut was made just below the node without any injury to the bud and the upper slanting cut was made about 1.4 cm above the node. The treatments included time of planting (G<sub>1</sub>: December 25<sup>th</sup>, G<sub>2</sub>: January 10<sup>th</sup> and G<sub>3</sub>: January 25<sup>th</sup>), three growing conditions (T<sub>1</sub>: Mist chamber, T<sub>2</sub>: Open condition and T<sub>3</sub>: Partial shade) and C (500 ppm concentration of IBA). The planting medium was comprised of soil and farmyard manure (FYM) in 2: 1 ratio. For the preparation of 500ppm IBA solution, 500 mg IBA was weighted and it was then dissolved in small amount of alcohol and few drops of ammonium hydroxide were also added to stop precipitation. Further, it has diluted to one liter with distilled water and stored in cool and dark place (Singh *et al.*, 2011 and Devi *et al.*, 2016). The lower ends of the cuttings were dipped in dilute solutions, 500ppm of Indole-3-Butyric Acid by quick dip method for 15 seconds before planting in the rooting medium. After the treatment, the cuttings were immediately planted in root polythene and inserted 7.5 cm deep in the rooting media. Cuttings were irrigated properly immediately after planting. The experiment was replicated thrice with 20 cuttings in each treatment and a total of 180 cuttings were planted in mist chamber, 180 cuttings were planted in open condition and 180 cuttings were planted in partial shade. The planted cuttings were allowed to root for 90 days. The cuttings (nine numbers per treatment per replication) were carefully removed from the pots and dipped in water to remove the soil particles adhering to roots to record the observations pertaining to roots *viz.*, percentage of cutting rooted, length of longest root and diameter of root except for the observations on various stem leaf characters and all other were recorded after planting. The data recorded were statistically analyzed by using Factorial Randomized Block (FRBD) Design followed in this study as described by Cochran and Cox (1992).

**RESULTS AND DISCUSSION**

The rooting response of Mulberry (*Morus alba* L.) cutting treated with growing condition and time of planting, in showed in Table 1, 2, 3 and 4. In case of planting time, significantly the highest percentage of sprouted cuttings (75.60%), shoot percentage (75.56%), percentage of rooted cuttings (67.22%) were recorded under T<sub>3</sub> (January 25<sup>th</sup>) planting time and maximum percentage of unsprouted cuttings (34.40%), number of sprouts (4.33), length of longest sprout (8.67 cm), diameter of thickest sprout (0.45 cm), number of leaves (12.67), fresh weight of shoots (42.12gm), dry weight of shoot (10.19gm), number of primary root (12.67), secondary root (43.89), length of longest root (13.11 cm), diameter of thickest roots (0.68 cm), fresh weight of roots (9.40gm), dry weight of roots (2.54gm) were recorded under T<sub>2</sub> (January 10<sup>th</sup>) planting time, while the minimum average number of sprouts per cutting (2.22), length of longest sprout (5.49 cm), diameter of thickest sprout (0.39 cm), number of leaves on new shoots (6.67), fresh weight of shoots (36.56gm), dry weight of shoot (9.60gm), number of secondary root (38.78) were observed under T<sub>1</sub> (December 25<sup>th</sup>) planting time and percentage of sprouting cuttings (65.60%), shoot percentage (65.56%),

**Table1: Effect of different growing conditions and various planting time on the shooting performance of Mulberry (*Morus alba* L.)**

| Planting Time                | Percentage of sprouted cutting |                                 |                                | Percentage of unsprouted cuttings |                                 |                                | Average no of sprout per cutting |                                 |                                | Length of longest sprout (cm) |                                 |                                |       |       |
|------------------------------|--------------------------------|---------------------------------|--------------------------------|-----------------------------------|---------------------------------|--------------------------------|----------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------|-------|
|                              | G <sub>1</sub> (Mist chamber)  | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber)     | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber)    | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) |       |       |
| T <sub>1</sub> (December 25) | 60.00                          | 83.30                           | 66.60                          | 69.90                             | 40.00                           | 33.30                          | 29.90                            | 2.66                            | 3.00                           | 1.00                          | 2.22                            | 4.29                           | 7.90  | 5.49  |
| T <sub>2</sub> (January 10)  | 86.60                          | 46.60                           | 63.30                          | 65.50                             | 13.30                           | 36.60                          | 34.40                            | 8.33                            | 2.67                           | 2.00                          | 4.33                            | 14.00                          | 6.16  | 8.67  |
| T <sub>3</sub> (January 25)  | 83.30                          | 63.30                           | 80.00                          | 75.50                             | 16.60                           | 20.00                          | 24.44                            | 4.00                            | 2.33                           | 4.67                          | 3.67                            | 5.94                           | 7.67  | 6.78  |
| Mean                         | 76.60                          | 64.40                           | 69.90                          | 75.50                             | 23.30                           | 29.90                          | 5.00                             | 5.00                            | 2.67                           | 2.56                          | 3.67                            | 8.08                           | 7.25  | 7.25  |
| S.E.m. ±                     | 0.277                          | 0.276                           | 0.479                          | 0.277                             | 0.277                           | 0.479                          | 0.567                            | 0.567                           | 0.982                          | 0.982                         | 0.982                           | 0.779                          | 0.779 | 1.350 |
| CD at 0.5%                   | 0.812                          | 0.812                           | 1.406                          | 0.812                             | 0.812                           | 1.406                          | 1.664                            | 1.664                           | 2.882                          | 2.882                         | 2.882                           | 2.287                          | 2.287 | 3.961 |

**Table2: Effect of different growing conditions and various planting time on the shooting performance of Mulberry (*Morus alba* L.)**

| Planting Time                | Diameter of thickest sprout (cm) |                                 |                                | Number of leaves on new shoot |                                 |                                | Shoot percentage              |                                 |                                | Fresh weight of shoot(gm)     |                                 |                                |        |
|------------------------------|----------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|--------|
|                              | G <sub>1</sub> (Mist chamber)    | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) |        |
| T <sub>1</sub> (December 25) | 0.39                             | 0.36                            | 0.4                            | 0.39                          | 7.67                            | 6.67                           | 60                            | 86.67                           | 66.67                          | 71.11                         | 40.96                           | 34.42                          | 36.56  |
| T <sub>2</sub> (January 10)  | 0.53                             | 0.39                            | 0.43                           | 0.45                          | 24                              | 12.67                          | 86.67                         | 46.67                           | 63.33                          | 65.56                         | 66.56                           | 28.47                          | 42.12  |
| T <sub>3</sub> (January 25)  | 0.4                              | 0.4                             | 0.44                           | 0.41                          | 10                              | 11.89                          | 83.33                         | 63.33                           | 80                             | 75.56                         | 49.28                           | 30.39                          | 39.33  |
| Mean                         | 0.44                             | 0.39                            | 0.42                           | 0.42                          | 13.89                           | 7.89                           | 76.67                         | 65.56                           | 70                             | 75.56                         | 52.26                           | 31.05                          | 34.69  |
| S.E.m. ±                     | 0.013                            | 0.013                           | 0.023                          | 0.023                         | 1.249                           | 2.163                          | 0.027                         | 0.027                           | 0.047                          | 0.047                         | 2.467                           | 2.467                          | 4.273  |
| CD at 0.5%                   | 0.039                            | 0.039                           | 0.068                          | 0.068                         | 3.663                           | 6.345                          | 0.08                          | 0.08                            | 0.139                          | 0.139                         | 7.237                           | 7.237                          | 12.535 |

**Table 3: Effect of different growing conditions and various planting time on the rooting performance of Mulberry (*Morus alba* L.).**

| Planting Time                | Dry weight of shoot (gm)      |                                 |                                | Percentage of rooted cuttings |                                 |                                | Number of primary root        |                                 |                                | Number of secondary           |                                 |                                |       |       |
|------------------------------|-------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------|-------|
|                              | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | Mean  |       |
| T <sub>1</sub> (December 25) | 10.39                         | 8.95                            | 9.47                           | 60                            | 70                              | 65.33                          | 65.11                         | 6                               | 7.67                           | 7                             | 6.89                            | 31                             | 43.67 | 41.67 |
| T <sub>2</sub> (January 10)  | 13.79                         | 8.02                            | 8.76                           | 86.67                         | 43.33                           | 60                             | 63.33                         | 18.67                           | 8.33                           | 11                            | 12.67                           | 61                             | 48.33 | 43.33 |
| T <sub>3</sub> (January 25)  | 11.68                         | 8.66                            | 9.94                           | 75                            | 60                              | 66.67                          | 67.22                         | 5.67                            | 6.67                           | 6.67                          | 6.33                            | 40                             | 48.33 | 39.33 |
| Mean                         | 11.95                         | 8.54                            | 9.51                           | 73.89                         | 57.78                           | 64                             | 67.22                         | 10.11                           | 7.56                           | 8.22                          | 6.33                            | 51                             | 43.67 | 41.56 |
| S.E.m.±                      | 0.409                         | 0.409                           | 0.708                          | 0.024                         | 0.024                           | 0.042                          | 0.042                         | 1.325                           | 1.325                          | 2.294                         | 1.781                           | 1.781                          | 5.224 | 3.084 |
| CD at 0.5%                   | 1.2                           | 1.2                             | 2.0789                         | 0.071                         | 0.071                           | 0.123                          | 0.123                         | 3.886                           | 3.886                          | 6.731                         | 5.224                           | 5.224                          | 9.048 | 9.048 |

**Table 4: Effect of different growing conditions and various planting time on the rooting performance of Mulberry (*Morus alba* L.).**

| Planting Time                | Length of longest root (cm)   |                                 |                                | Diameter of thickest root (cm) |                                 |                                | Fresh weight of root (gm)     |                                 |                                | Dry weight of root (gm)       |                                 |                                |       |      |
|------------------------------|-------------------------------|---------------------------------|--------------------------------|--------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|--------------------------------|-------|------|
|                              | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber)  | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | G <sub>1</sub> (Mist chamber) | G <sub>2</sub> (Open condition) | G <sub>3</sub> (Partial Shade) | Mean  |      |
| T <sub>1</sub> (December 25) | 13.67                         | 9                               | 12.67                          | 0.6                            | 0.55                            | 0.69                           | 0.61                          | 5.99                            | 9.56                           | 8.71                          | 8.08                            | 1.89                           | 2.63  | 2.34 |
| T <sub>2</sub> (January 10)  | 19                            | 9                               | 11.34                          | 0.81                           | 0.59                            | 0.63                           | 0.68                          | 13.99                           | 8.05                           | 6.17                          | 9.4                             | 3.41                           | 2.26  | 2.54 |
| T <sub>3</sub> (January 25)  | 14.33                         | 9.67                            | 10.33                          | 0.6                            | 0.6                             | 0.56                           | 0.59                          | 8.68                            | 6.63                           | 7.62                          | 7.64                            | 2.48                           | 1.95  | 2.07 |
| Mean                         | 15.67                         | 9.22                            | 12.11                          | 0.67                           | 0.58                            | 0.63                           | 0.63                          | 9.55                            | 8.08                           | 7.5                           | 7.64                            | 2.59                           | 2.28  | 2.12 |
| S.E.m.±                      | 0.428                         | 0.428                           | 0.742                          | 0.008                          | 0.008                           | 0.014                          | 0.014                         | 0.448                           | 0.448                          | 0.776                         | 0.776                           | 0.092                          | 0.092 | 0.16 |
| CD at 0.5%                   | 1.257                         | 1.257                           | 2.177                          | 0.023                          | 0.023                           | 0.04                           | 0.04                          | 1.313                           | 1.313                          | 2.275                         | 2.275                           | 0.271                          | 0.271 | 0.47 |

percentage of rooted cuttings (63.33%), were observed under T<sub>2</sub> (January 10<sup>th</sup>) planting time and percentage of unsprouting cuttings (24.40%), number of primary root (6.33), length of longest root (11.44 cm), diameter of thickest roots (0.59 cm), fresh weight of roots (7.64gm), dry weight of roots (2.17gm) was observed under T<sub>3</sub> (January 25<sup>th</sup>) planting time. Many workers showed that cuttings collected from late winter rooted more than those from early winter however it is the species specific and also varies from cultivar to cultivar. The lowest rooting was observed in autumn planting by them. January months have been found to induce better root system in Mulberry cuttings. This is due to enhanced activity of hydrolyzing enzymes and adequate mobilization of reserve food material. The enhanced hydrolysis activity in the presence of optimum production of endogenous hormones was responsible for the increased rooting in cuttings. Ansari *et al.* (2013) Observed that the most effect on rooting percentage and numbers of roots was obtained on 5 Jan and 4 Feb time of planting. Carbohydrate reserves in the cuttings are responsible for the highest sprouting and rooting. It may be affected by season and various factors such as light, temperature and nutrient availability to the survival percentage of cuttings. The better number of roots per cutting with optimum time and IBA treatments might be ascribed due to better root growth which augmented absorption and translocation of nutrients from soil which take active part in several plant metabolic processes (Singh, 2003). It is well known fact that sprouting depends on physical status and food reserves of cuttings as the cuttings utilize the reserved food when temperature rises and start sprouting earlier than callus formation (Mabood *et al.*, 1996). The present findings are similar to the findings of Pirlak, (2000) in Cornelian Cherry, Koyunce and Senel. (2001) in mulberry and Singh *et al.* (2011) in Pomegranate cutting.

In case of growing condition the maximum percentage of sprouted cuttings (76.70%), number of sprout (5.00), length of longest sprout (8.08 cm), diameter of thickest sprout (0.44 cm), number of leaves (13.89), shoot percentage (76.67%), fresh weight of shoots (52.26gm), dry weight of shoot (11.95gm), percentage of rooted cuttings (73.89%), number of primary root (10.11), secondary root (51.00), length of longest root (15.67 cm), diameter of thickest roots (0.67 cm), fresh weight of roots (9.55gm), dry weight of roots (2.59gm) were recorded under G<sub>1</sub> (mist chamber) growing condition and percentage of unsprouted cuttings (35.60%) was observed under G<sub>2</sub> (open condition), while the minimum percentage of unsprouted cuttings (23.30%) was recorded under G<sub>1</sub> (mist chamber) growing condition, percentage of sprouted cuttings (64.40%), longest sprout (5.61 cm), diameter of thickest sprout (0.39 cm), shoot percentage (65.56%), fresh weight of shoots (31.05gm), dry weight of shoot (8.54gm), percentage of rooted cuttings (57.78%), number of primary root (7.56), number of secondary root (32.78), length of root (9.22 cm), diameter of thickest roots (0.58cm) were recorded under G<sub>2</sub> (open condition) growing condition and number of sprout per cutting (2.56), number of leaves (7.89), fresh weight of roots (7.50gm), dry weight of roots (2.12gm) was recorded under G<sub>3</sub> (partial Shade) growing condition. In the present study, the highest values of root and shoot parameters of cuttings were observed at the mist chamber growing condition. High carbohydrate

and low nitrogen have been observed to favour root formation (Carlson, 1929). The enhance hydrolytic activity in present of applied auxin coupled with appropriate time of planting might be responsible for the increased rooted percentage of cuttings. Singh *et al.* (2015) reported that the highest rooting and survival percentage of Mulberry cutting was observed under mist house growing condition. Kalyoncu *et al.* (2009) observed that the maximum rooting percentage was recorded under 2000 and 3000ppm IBA concentration under misting system in the greenhouse. Mist house condition is often used on cuttings because it reduces the leaves temperature, increases relative humidity and lowers respiration around the leaf surface. The better rooting percentage of cuttings was increased by auxins treatment, especially treatment by IBA. Similar results were also reported by Singh *et al.* (2015) in Phalsa, Singh *et al.* (2014) in pomegranate and Singh *et al.* (2016) in Sweet orange. It may be concluded that time of planting and growing condition had a large impact on the success, rooting and survival in cuttings of Mulberry. Planting time in January and mist chamber growing condition were found to be the good treatments may be recommended for the propagation of Mulberry cutting.

## ACKNOWLEDGMENT

My warmest thanks are due to late Professor Y K Tomar and non teaching staff Horticultural Reseach Centre, HNB Garhwal University (A Central University) Srinagar Garhwal, Uttarakhand for thier cooperation and help during the experimentation.

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