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# INFLUENCE OF SHOOT AGE ON ROOTING IN MULBERRY CUTTINGS AND THE GROWTH OF SAPLINGS UNDER TWO DIFFERENT ENVIRONMENTS

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ABS**TRACT**
Mulberry (Morus spp.) is cultivated to get leaf which is the only food to silkworm (*Bombyx mori* L.), reared to yield silk, the queen of textiles. It is propagated by different methods like seed, grafting, layering, cutting and tissue culture etc. Propagation through cuttings though found to be the quickest and the most convenient method, has not been helpful to get rooting beyond 70 per cent in most of the mulberry genotypes, otherwise promising in yield and other quality parameters. The present study was carried out at College of Temperate Sericulture, Mirgund, SKUAST-K to find out the influence of age of shoots of mulberry on their rooting and other growth parameters. Shoots of 6, 9 and 12 months from three promising mulberry genotypes-Goshoerami, Ichinose and KNG were tested for their rooting and other growth parameters. Observations recorded on rooting and other growth parameters reveal that the 9 month old shoots performed better than the other two ages in almost all the parameters recorded during the first year of their growth.

**KEY WORDS:** Mulberry, rooting, growth, cutting, propagation, age.

## INTRODUCTION

Mulberry which belongs to genus *Morus* of the family *Moraceae*, the only food to silkworm (*Bombyx mori*. L.) is a hardy plant found globally in almost all types of agro climates extending from tropical to temperate regions. The major species of the Genus Morus include *Morus alba, Morus nigra, Morus rubra, Morus australis, Morus atropurpurea, Morus cathayana, Morus notabilis, Morus mesosygia* (Perez-Gregorio., 2011). The plant is propagated through stem cuttings, grafting or budding. However, success of these methods depends on a number of factors such as genetic makeup of the plant, age and physiological conditions of the parental cutting, climatic conditions and others. Freshly developed mulberry shoots cannot be used for propagation through stem cuttings as at least 6-7 month maturity is required to make the cuttings from the parental plant (Kapur *et al*., 2001).Using cuttings is probably the cheapest and effective method for propagating new plants. Age and size of planting stock is important for initial survival and establishment of cuttings (Raza-ul-Haq, 1992). Many studies have been conducted on the use of cuttings in mulberry propagation under Kashmir conditions. The studies involving cuttings planted under open field conditions have not yielded encouraging results giving even less than 10 percent success in Goshoerami which is the most popular and promising genotype in terms of leaf yield and quality (Baksh *et al.*,1998). Mulberry (*Morus spp*.) is cultivated to get leaf which is the only food to silkworm (*Bombyx mori* L.), reared to yield silk, the queen of textiles. It is propagated by different methods like seed, grafting, layering, cutting and tissue culture etc. Propagation through cuttings though found to be the quickest and the most convenient method, has not been helpful to get rooting beyond 70 percent in most of the mulberry genotypes, otherwise promising in yield and other quality parameters. The present study was carried out at College of Temperate Sericulture, Mirgund, SKUAST-K to find out the influence of age of shoots of mulberry on their rooting and other growth parameters. Shoots of 6, 9 and 12 months from three promising mulberry genotypes-Goshoerami, Ichinose and KNG were tested for their rooting and other growth parameters. Observations recorded on rooting and other growth parameters reveal that the 9 month old shoots performed better than the other two ages in almost all the parameters recorded during the first year of their growth. Even the use of growth regulators involving additional expenditure on the cost of harmones, has not addressed the low survival of cuttings in the genotypes namely Goshoerami, Ichinose and KNG otherwise promising in terms of leaf yield and quality. The College of Temperate Sericulture,Mirgund has developed a low cost polyhouse technology which has enabled to get a survival of 60-70 percent in the otherwise shy to root mulberry genotypes in a reduced time period of just 2 years as against 4-5 years through the conventional root grafting. The technique involves the planting of cuttings prepared from one year old shoots in polybags containing rooting medium comprising of sand, clay and well decomposed FYM in the ratio of 6:3:1 under polyhouse. Though the technique has helped to enhance the rooting percentage by 50-60 percent over the practice of open field conditions, by modifying the rooting medium and microclimate yet there is scope for further improvement. Once the reasons for the remaining 40-50

percent failure are established this would allow us to devise means to overcome these reasons which as of now might include shoot and root diseases, proper age of the shoots, nutritional status and anatomical features of the cuttings etc.

## MATERIALS AND METHODS

Investigation on the age of mulberry shoots on propagation of some promising mulberry genotypes under Kashmir conditions was conducted at College of Temperate Sericulture, Mirgund under polyhouse and open conditions during the year 2017. Six, nine, and twelve month old mulberry shoots were collected from $P_4$ Basic Seed Farm, Manasbal Central Silk Board G.O.I and the farm of College of Temperate Sericulture Mirgund. Cuttings of (9-15 cm) length with at least 4-6 viable buds were prepared by giving a slanting cut without damaging the bark. The cuttings after preparation were given a one minute dip in Dithane and then wrapped in moist gunny bags to avoid desiccation and drying. Cuttings were planted in the last week of March and maintained in the polyhouse as well as under open conditions. The varieties of mulberry used for the study were Goshoerami, Ichinose and K.N.G. Experiment was laid in R.C.B.D (two factorials) with 9 treatment combinations and 03 replications. In each treatment of every replication, 24 cuttings were planted. For polyhouse, rooting media comprising of sand, clay and well decomposed farmyard manure in the ratio of 6:3:1 filled in well punctured polybags of size of 4.5´×11´. The polybags were then placed under the polyhouse.

Under open field conditions, the land was thoroughly prepared and levelled. The small nursery beds, to accommodate 24 cuttings at 6 inch× 6 inch spacing were prepared. Polyhouse was maintained at temperature of 25-30ºC and relative humidity of 80-90 per cent. These cuttings were planted on 30th of March 2017. In the polyhouse, moisture was provided as spray. The humidity and temperature inside the polyhouse were 25-30ºC and 80-90 percent respectively. The cuttings planted under open field conditions on the other hand were irrigated as per need. Weeding and other cultural operations were carried out regularly. Observations on sprouting was recorded regularly on 07 days interval till rooting whereas the root growth parameters were recorded at the end of the growing season by taking three saplings each. The data collected was compiled and analysed using suitable statistical package (Opstat) software.

## RESULTS AND DISCUSSION

Sprouting of the planted cuttings started from the 1st week itself under both conditions. All the treatments started sprouting during the first week of planting but the extent of sprouting was more under polyhouse than under open field conditions. The treatments registered their maximum sprouting on 35thday of planting under polyhouse where it ranged from 92.30 percent in $G_2A_1$ (Ichinose six month age) and $G_3A_2$ (K.N.G 9 months) to 100 percent in $G_1A_2$ (Goshoerami 9 months) and $G_1A_3$ (Goshoerami 12 months). On the other hand sprouting under open field conditions touched its maximum on 56th day of planting ranging from 90 percent in $G_3A_1$ (K.N.G six months) to 95.83 percent in $G_2A_2$ (Ichinose 9 months). Perusal of data (Table 1) pertaining to sprouting percentage indicated that survival of the sprouted cuttings started declining after 35th day of planting under polyhouse and 56th day of planting under open field conditions where after some sprouted cuttings started drying and finally died. The survival remained constant after 56th day under polyhouse and 112th day under open field conditions which was considered as the rooting of the cuttings as per Baksh *et al* (2000) who have suggested that once the survival of sprouted cuttings remains constant; this could be treated as their rooting ability. Mortality of the sprouted cuttings started earlier under polyhouse than under open field conditions because under polyhouse temperature was higher and the cuttings which were not able to root started drying earlier than under open field conditions where the temperature was comparatively low and enabled even the non-rooted cuttings to survive longer. Thus the rooting occurs around 56th days under polyhouse and 112 days under open field conditions. The survival in general was more than 60 percent under polyhouse conditions whereas it was around 10 percent under open field conditions. The rooting ability of the three genotypes was in general more than 60 percent making them good rooters under polyhouse though being poor rooters under open field conditions. The rooting ability of a genotype under temperate climatic conditions is said to be good if it is more than 50 percent (Anonymous, 1992).

The number of roots per sapling, longest root length, root weight, root volume,root-shoot ratio was invariably higher in saplings raised from 9 months old shoots ($A_2$) under polyhouse but under open field conditions the parameters were higher in the saplings raised from 12 month old cuttings. Similar results were found by Kibbler *et al.*, (2002) who also reported variation in the rooting of cuttings of *Tabebuia heterophylla* differing in age. Young cuttings may root fast in certain species but they do not have enough food reserves and do not coop up with the growing needs. Mature and hardwood cuttings on the other hand have enough stored food to sustain for a longer period of time. Young cutting may have failed due to their more proneness to desiccation being tender and poor in reserve nutrients. Many internal factors that changed with age have been found to influence root initiation and shoot development in stem cutting which include auxins, rooting cofactors, carbohydrates and nitrogen levels. (Hartmann and Kester.,1975). Raza -ul –Haq., (1992) also reported that age and size of planting stock is important for initial survival and establishment of cuttings. Hae and Funnah (2011) while working on the effect of propagation of kei apple *(Dovyaliscaffra*) have found significant difference between hardwood and softwood cuttings.

**TABLE 1:** Sprouting behaviour and survival of mulberry cuttings of different ages under polyhouse conditions

| Treatment combinations | 7D | 14 D | 21D | 28D | 35D | 42D | 49D | 56D | 63D | 70D |
|---|---|---|---|---|---|---|---|---|---|---|
| $G_1A_1$ (Goshoerami 6 month) | 65.38 | 73.07 | 80.76 | 88.46 | 96.15 | 80.76 | 73.07 | 61.67 | 61.67 | 61.67 |
| $G_1A_2$ ( Goshoerami 9 month) | 69.38 | 76.92 | 88.46 | 96.15 | 100 | 84.61 | 76.92 | 73.07 | 73.07 | 73.07 |
| $G_1A_3$ ( Goshoerami 12 month) | 73.07 | 80.76 | 88.46 | 96.15 | 100 | 84.61 | 76.92 | 69.23 | 69.23 | 69.23 |
| $G_2A_1$ (Ichinose 6 month) | 61.53 | 73.07 | 80.76 | 88.46 | 92.30 | 80.76 | 73.07 | 57.69 | 57.69 | 57.69 |
| $G_2A_2$ ( Ichinose 9 month) | 69.23 | 80.76 | 88.46 | 92.30 | 96.15 | 80.76 | 73.07 | 65.38 | 65.38 | 65.38 |
| $G_2A_3$ (Ichinose 12 month) | 65.38 | 73.07 | 88.46 | 96.15 | 96.15 | 80.76 | 73.07 | 61.67 | 61.67 | 61.67 |
| $G_3A_1$ (K.N.G 6 month) | 57.69 | 69.23 | 76.92 | 88.46 | 92.30 | 84.61 | 73.07 | 61.67 | 61.67 | 61.67 |
| $G_3A_2$ (K.N.G 9 month) | 69.23 | 76.92 | 84.61 | 92.30 | 96.15 | 84.61 | 73.07 | 65.38 | 65.38 | 65.38 |
| $G_3A_3$ (K.N.G 12 month) | 61.67 | 73.07 | 84.61 | 92.30 | 96.15 | 84.61 | 73.07 | 61.67 | 61.67 | 61.67 |
| Mean | 65.84 | 75.20 | 84.61 | 92.30 | 96.15 | 82.89 | 73.92 | 64.15 | 64.15 | 64.15 |

G1:GoshoeramiA1:6 Month old cutting G2: Ichinose A2:9 Month old cuttingG3: K.N.G A3: 12 Month old cuttings

**TABLE 2:** Sprouting behaviour and survival of mulberry cuttings of different ages under open conditions

| Parameters/ Treatments | 7D | 14D | 21D | 28D | 35D | 42D | 49D | 56D | 63D | 70D |
|---|---|---|---|---|---|---|---|---|---|---|
| $G_1A_1$ (Goshoerami 6 month) | 58.33 | 66.54 | 70.83 | 79.16 | 80.00 | 84.00 | 88.00 | 92.00 | 85.00 | 70.00 |
| $G_1A_2$ ( Goshoerami 9 month) | 62.50 | 75.00 | 75.00 | 84.00 | 85.00 | 87.50 | 91.66 | 96.00 | 90.00 | 88.00 |
| $G_1A_3$ Goshoerami 12 month) | 66.54 | 70.83 | 79.00 | 80.00 | 83.00 | 86.00 | 90.00 | 94.00 | 88.00 | 80.00 |
| $G_2A_1$ (Ichinose 6 month) | 54.14 | 60.10 | 66.54 | 75.00 | 79.00 | 84.00 | 88.00 | 91.00 | 80.00 | 75.00 |
| $G_2A_2$ ( Ichinose 9 month) | 58.33 | 66.54 | 75.11 | 76.00 | 80.00 | 87.50 | 92.20 | 95.83 | 84.00 | 79.00 |
| $G_2A_3$ (Ichinose 12 month) | 62.50 | 70.83 | 70.00 | 80.00 | 83.22 | 85.00 | 87.50 | 94.00 | 83.22 | 70.83 |
| $G_3A_1$ (K.N.G 6 month) | 50.01 | 58.33 | 62.50 | 66.54 | 75.11 | 80.00 | 85.00 | 90.00 | 83.22 | 70.83 |
| $G_3A_2$ (K.N.G 9 month) | 58.33 | 62.50 | 75.11 | 76.00 | 83.22 | 87.50 | 91.66 | 95.83 | 85.00 | 73.11 |
| $G_3A_3$ (K.N.G 12 month) | 54.14 | 65.50 | 66.54 | 79.00 | 85.00 | 86.00 | 90.00 | 94.00 | 80.00 | 72.00 |
| Mean | 58.33 | 66.24 | 71.18 | 77.3 | 81.50 | 85.27 | 89.33 | 93.62 | 84.27 | 75.41 |

| Treatments | 77D | 84D | 91D | 98D | 105D | 112D | 119D | 126D |
|---|---|---|---|---|---|---|---|---|
| $G_1A_1$ (Goshoerami 6 month) | 62.50 | 54.14 | 37.5 | 28.11 | 17.50 | 9.33 | 9.33 | 9.33 |
| $G_1A_2$ ( Goshoerami 9 month) | 70.83 | 58.33 | 41.66 | 30.00 | 20.83 | 12.50 | 12.50 | 12.50 |
| $G_1A_3$ ( Goshoerami 12 month) | 72.00 | 53.11 | 33.33 | 23.10 | 16.50 | 13.10 | 13.10 | 13.10 |
| $G_2A_1$ (Ichinose 6 month) | 60.10 | 50.00 | 32.00 | 20.83 | 12.50 | 8.33 | 8.33 | 8.33 |
| $G_2A_2$ ( Ichinose 9 month) | 65.00 | 52.00 | 33.33 | 25.10 | 15.10 | 9.33 | 9.33 | 9.33 |
| $G_2A_3$ (Ichinose 12 month) | 64.00 | 46.00 | 30.00 | 16.66 | 15.10 | 12.50 | 12.50 | 12.50 |
| $G_3A_1$ (K.N.G 6 month) | 60.10 | 45.83 | 25.10 | 15.10 | 7.33 | 5.33 | 5.33 | 5.33 |
| $G_3A_2$ (K.N.G 9 month) | 62.50 | 51.01 | 29.16 | 21.00 | 12.50 | 5.50 | 5.50 | 5.50 |
| $G_3A_3$ (K.N.G 12 month) | 60.10 | 50.00 | 23.10 | 14.50 | 12.50 | 8.33 | 8.33 | 8.33 |
| Mean | 64.12 | 51.15 | 31.68 | 21.6 | 14.42 | 9.36 | 9.36 | 9.36 |

G1: Goshoerami A1:6 Month old cutting
G2: Ichinose A2:9 Month old cutting
G3: K.N.G A3: 12 Month old cutting

**TABLE 3:** Rooting behaviour of cuttings as influenced by age of shoot under polyhouse conditions

| Treatment combinations | Survival (%) | Number of root/ Sapling | Length of longest root (cm) | Root weight (g) | Root volume ($cm^3$) | Root-shoot ratio |
|---|---|---|---|---|---|---|
| $G_1A_1$ (Goshoerami 6 month) | 61.67 | 12.00 | 21.33 | 2.27 | 2.17 | 0.52 |
| $G_1A_2$ ( Goshoerami 9 month) | 73.07 | 15.00 | 24.67 | 4.63 | 5.17 | 0.68 |
| $G_1A_3$ Goshoerami 12 month) | 69.23 | 12.33 | 21.17 | 3.87 | 3.93 | 0.71 |
| Sub Mean | 67.99 | 13.11 | 22.39 | 3.59 | 3.76 | 0.64 |
| $G_2A_1$ (Ichinose 6 month) | 57.69 | 10.67 | 15.00 | 2.27 | 2.83 | 0.52 |
| $G_2A_2$ (Ichinose 9 month) | 65.38 | 14.00 | 22.33 | 4.37 | 4.63 | 0.75 |
| $G_2A_3$ (Ichinose 12 month) | 61.67 | 12.00 | 21.00 | 3.27 | 3.20 | 0.59 |
| Sub Mean | 61.58 | 12.22 | 19.44 | 3.30 | 3.56 | 0.62 |
| $G_3A_2$ (K.N.G 6 month) | 61.67 | 10.00 | 12.67 | 2.50 | 2.53 | 0.58 |
| $G_3A_2$ (K.N.G 9 month) | 65.38 | 13.00 | 23.00 | 4.13 | 4.47 | 0.73 |
| $G_3A_3$ (K.N.G 12 month) | 61.67 | 12.33 | 21.00 | 3.37 | 3.23 | 0.69 |
| Sub Mean | 62.91 | 11.78 | 18.89 | 3.33 | 3.41 | 0.67 |
| Factor Mean (Age) | | | | | | |
| $A_{1(6\ month)}$ | 60.34 | 10.89 | 16.33 | 2.34 | 2.51 | 0.54 |
| $A_{2(9\ month)}$ | 67.94 | 14.00 | 23.33 | 4.38 | 4.76 | 0.72 |
| $A_{3(12\ month)}$ | 64.19 | 12.22 | 21.06 | 3.50 | 3.46 | 0.66 |

**C.D ($p \leq 0.05$)**

| | | | | | | |
|---|---|---|---|---|---|---|
| Variety(G) | 3.07 | 0.57 | 1.29 | 0.22 | N.S | N.S |
| Age (A) | 3.07 | 0.57 | 1.29 | 0.22 | 0.34 | 0.1 |
| G×A | N.S | 0.98 | 2.23 | 0.38 | 0.58 | N.S |

**TABLE: 5** Rooting behaviour of cuttings as influenced by the age of shoot under open field conditions

| Parameters/ Treatments | Survival (%) | Number of root/ Sapling | Lengthof longest root(cm) | Root weight (g) | Root volume ($cm^3$) | Root-Shoot ratio |
|---|---|---|---|---|---|---|
| $G_1A_1$ (Goshoerami 6 month) | 9.33 | 7.67 | 6.33 | 1.21 | 1.17 | 0.36 |
| $G_1A_2$ ( Goshoerami 9 month) | 12.50 | 8.00 | 8.00 | 1.59 | 1.53 | 0.53 |
| $G_1A_3$ (Goshoerami 12 month) | 13.10 | 9.33 | 9.67 | 1.93 | 1.83 | 0.48 |
| Sub Mean | 11.64 | 8.33 | 8.00 | 1.57 | 1.51 | 0.46 |
| $G_2A_1$ (Ichinose 6 month) | 8.36 | 7.00 | 5.00 | 1.11 | 1.20 | 0.34 |
| $G_2A_2$ (Ichinose 9 month) | 9.33 | 8.00 | 6.00 | 1.22 | 1.27 | 0.37 |
| $G_2A_3$ (Ichinose 12 month) | 12.50 | 9.33 | 8.33 | 1.55 | 1.33 | 0.34 |
| Sub Mean | 10.06 | 8.11 | 6.44 | 1.29 | 1.27 | 0.35 |
| $G_3A_1$ (K.N.G 6 month) | 5.00 | 4.33 | 5.33 | 1.07 | 1.13 | 0.35 |
| $G_3A_2$ (K.N.G 9 month) | 5.50 | 5.67 | 6.23 | 1.18 | 1.23 | 0.35 |
| $G_3A_3$ (K.N.G 12 month) | 8.36 | 7.67 | 8.67 | 1.40 | 1.33 | 0.34 |
| Sub Mean | 6.29 | 5.89 | 6.74 | 1.22 | 1.23 | 0.35 |
| Factor Mean (Age) | | | | | | |
| $A_{1(6\ month)}$ | 7.56 | 6.33 | 5.56 | 1.13 | 1.17 | 0.35 |
| $A_{2(9\ month)}$ | 9.11 | 7.22 | 6.74 | 1.33 | 1.34 | 0.42 |
| $A_{3(12\ month)}$ | 11.32 | 8.78 | 8.89 | 1.63 | 1.50 | 0.39 |

C.D ($p \leq 0.05$)

| | | | | | | |
|---|---|---|---|---|---|---|
| Variety(G) | 3.33 | 1.16 | 0.94 | 0.19 | 0.22 | 0.06 |
| Age(A) | N.S | 1.16 | N.S | N.S | N.S | N.S |
| G×A | N.S | N.S | N.S | N.S | N.S | N.S |

## CONCLUSION

The survival of the cuttings or the rooting ability remained constant after 56 days in polyhouse and after 112 days under open field conditions which could be taken as the time period required for rooting under polyhouse and open field conditions respectively. And Goshoerami has proved to be the best variety in respect almost all of rooting parameters. Encouraging results were recorded under polyhouse conditions in terms of root. It can be easily concluded that polyhouse has improved the survival and growth of mulberry saplings irrespective of the genotype and the age by providing the ambient conditions like temperature and humidity.

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