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Review Article

TAXONOMIC DESCRIPTION AND VEGETATIVE PROPAGATION OF TWO MULBERRY SPECIES (*Morus alba* L. & *M. nigra* L.)

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ABSTRACT
Mulberry is a deciduous woody perennial belonging to genus *Morus* and family Moraceae. It is commercially propagated from hardwood cuttings. Phytohormones are increasingly employed to improve rooting and vegetative propagation of plants and it helps in quick multiplication of such plants. The highest rooting percentage was influenced from black mulberry in doses application of concentration 2000 and 3000ppm indole-3-butyric acid (100%). The lowest one was control group from black mulberry which was not rooted. The cuttings treated with high concentration of IBA, performed the best in rooting and survival percentage. The mist house growing circumstances was inaugurate effective in escalating the success rate of the cuttings.

KEY WORDS: *Morus alba*, *M. nigra*, Cuttings, Bio Regulators, Rooting.

INTRODUCTION

The Mulberry species (*Morus alba* L., *M. nigra* L.) are widely propagated by cuttings, layering, and budding. *Morus alba* L. is a native of China, Japan and Korea; while *Morus nigra* L. is native of Iran, Levant and Caucasus but now both species cultivated broadly in Punjab, Uttar Pradesh, Kashmir and North-western Himalayas. The fruit of mulberry is a multiple accessory fruit derived from catkin inflorescence. The actual fruits little achenes or nutlets are surrounding by fleshy. The fruits are used for nutritional supplements. Mulberry leaves especially *Morus alba* L. is the food source of *Bombax mori* (Silkworm) (Ombrello, 2012). Mulberry is commercially cultivated from cutting of hard wood due to some superiorities like fast proliferation of parent materials and maintain the covet uniqueness of the plants. The methods to be employed for propagation would largely depend on the cultivar and agro-climatic condition prevailing at particular location. Those which are difficult to root need proper tenderization of propagation, growing condition, time of planting and plant bioregulators.

Key to identification

1a. Leaves hairy all over the lower surface, Styles densely white hairy …… *nigra*
1b. Leaves hairy only on the midrib and principal veins of lower surface ……*alba*

Taxonomic Description

1.*Morus alba* L., Sp. Pl. 986. 1753; Hook. f. Fl. Brit. India 5: 492. 1890; Duthie, Fl. U. Gang. Pl. 2: 230. 1960.
English: White Mulberry; Hindi: Sahtoot.

A monoecious, deciduous tree, 8-15 m tall tree with a dense leafy crown. Trunk 1-2m in circumference, with dark grey-brown bark. Leaves- filiform, 1-3cm long petiole; lamina narrow to broad, ovate, 5-15 x 4-12cm, 3-costate from truncate to shallowly cordate base, upper surface glabrous, midrib and principal wins pubescent, margins serrate, apex obtuse, acute or shortly acuminate; stipules hairy, lanceolate, brownish membranous. Male catkins 1-2cm long with slender, pedunclehairy, lax flowers. Male flowers: sepals free, broadly ovate, 2.5 mm long, cucullate, obtuse, glabrous or hairy; stamens 4, staminal filaments subequal to sepals. Female catkins without equally long or slightly longer peduncle. Female flowers: sepals suborbicular, as long as or slightly larger than of male flowers, glabrous or ciliate on margins; ovary one celled with glabrous free styles. Sorosis ovoid, 15-25 mm long, 5-8 mm across, white to pinkish-purple or black, sweet, edible.
Fl. & Fr.: April-September.

2. *Morus nigra* L., Sp. Pl. 986. 1753;Hook.f. Fl. Brit. India 5: 492. 1890; Duthie, Fl. U. Gang. Pl. 2: 230. 1960.
English: Black Mulberry; Hindi: Sahtoot.
A monoecious or dioecious, medium or small sized tree, up to 10 m tall a compact spreading wide crown. Trunk 1-2 m in circumference, rough bark, twigs soft, red-brown, densely hairy. Leaves with a striate, 2-3.5cm long, hairy petiole; lamina broad ovate, nearly as broad long, 6-12.5 cm long and broad, pubescent almost all over the lower surface, 4-5-costate from deeply cordate base, margins crenate-dentate, sometimes 2-5-lobed, apex acuminate; stipules lanceolate, pale-brown, hairy. Male catkins 25-35 mm long, including densely hairy, up to 1cm long peduncle. Male flowers: sepals free, broadly ovate, 2.5-3

mm long, deeply concave, lanate-hairy outside; stamens with broadly oval anther. Female catkins oval, 6-8mm long including hairy peduncles. Female flowers: sepals broadly elliptic, 3-3.5 mm long, 2.5-3 mm broad, hairy outside; ovary with densely white hairy, divergent styles. Sorosis ovoid oblong, 15-25 mm long excluding peduncles, dark purple to black, edible.
Fl. & Fr.: March-July.

Propagation

Cuttings preparation time in *Morus* greatly over elaborated the extent and triumph of root formation, the time of cuttings preparation and propagation is related to the state of the plant and environmental circumstances. Both time of cutting collection and rooting conquest varies with the climatic situation and prevailing surroundings temperature. The low rooting amount of cutting during cold may be assign to temperature level at the time of sowing. Harrison-Murraya (1991) reported about the seasonal schedule of the cuttings of plant are taken, can perform a crucial role in root proliferation. Some-times, using of intermittent mist on cuttings is done to decrease the leave's temperature, reduce respiration, and higher relative humidity in surrounding the leaf surface (Langhans, 1955).

Plant growth regulators can be classified into growth promoters and growth retardants. Plant growth regulators are auxins, gibberellin, cytokinin and growth retardants are Abscisic acid and ethylene. Phytohormones are increasingly employed to improve rooting and vegetative propagation of plants and it helps in quick multiplication of such plants and increase roots availability (Swamy *et al*, 2009). Kalyoncu *et al.*, (2009) studied the highest rooting percentage was determined from black mulberry in 2000 and 3000ppm IBA doses application (100%). Ahmad *et al.,* (2010) observed that the mulberry (*Morus alba* L.) performance of cutting in open air and in polythene low tunnel. Root length, number of root branches, root breadth and fresh and dry weight were found maximum in two inches cutting. Koyuncu and Senel (2003) reported that the best rooting percentage was obtained from bunch planting for the rooting of black mulberry hardwood cuttings treated with 5 $g.L^{-1}$ IBA. The mean rooting of black *Morus* cuttings differentiate from 3.4 to 65.0%.

1. Effect of growth regulators

Propagation by cutting is very popular method of multiplication of several Horticulture plants. But it has a limited success in the propagation of mulberry because most of its cultivars are hard–to-root. A considerable work has been done to improve rooting of cuttings in mulberry fruit plants. Plant bioregulators has been used extensively for initiation of rooting in cuttings of different ornamental plants. The artificial root proliferating chemicals that have been found most staunch in promoting adventitious root production in cuttings are indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), and naphthalene acetic acid (NAA). Indole-3-butric acid has been used more widely because it is non-toxic to plants over a wide concentration range (Singh 2002 and Chadha and Choudhry, 1980).

Koyuncu and Senel (2003) reported that the best rooting percentage was obtained from bunch planting for the rooting of black mulberry hardwood cuttings treated with 5 $g.L^{-1}$ IBA. The average rooting of black mulberry cuttings varied from 3.3 to 60.0%. Among all the treatments, number of sprouted cuttings, length of the roots/cutting, percentage of rooted cutting, lengths of longest sprouts of root was higher in IBA 2000 mg. L^{-1} (Singh, 2014).

Jat *et al.* (2017) reported that the maximum percentage of sprouted cuttings, length of sprout, shoot percentage, root percentage, number of primary roots were recorded under G1 (Mist chamber) growing condition. Sprouting percentage and number of leaves were found more in T_4 (8-inch-long cuttings) and height of plants was more in T_3 (6-inch-long cuttings) as we compare these with T_1, which was too small just like a seed, it also showed good results. These parameters performed well in polythene tunnel as compared to open air (Khan *et al.,* 2017). IAA and NAA (100 and 200ppm) resulted in maximum rooting of 93.33%. Maximum root length was observed in IBA (200ppm) as 127.3cm, however maximum number of roots per cutting (22.00) was recorded in NAA (100ppm) (Qaisar *et al.,* 2010).

2. Effect of growing conditions

Intermittent mist is often used on cuttings because it reduces the temperature of the leaves, lowers respiration, and increases relative humidity around the leaf surface (Langhans, 1955). Prolings and Therios (1976) reported that creating humid atmosphere by means of artificial mist around the planted cuttings either in concealed pot culture house or in open conditions has proved to enhance the process of rooting. Khan *et al.* (2007) suggested that the implementation of *Morus alba* cutting in polythene tunnel shows sprouting percentage and number of leaves were found greater in 8-10-inch-long cutting and height of plants was more in 6-7-inch-long cuttings as compared to open air. Kalyoncu *et al.* (2009) performed the effects of different amount of indole-3-butyric acid on springwood top cuttings of 2 black mulberry and 1 white mulberry under mist in the greenhouse. The maximum rooting was showing in black mulberry of 2000 and 3000ppm IBA doses application (100%).The control black mulberry was not rooted. Ahmad *et al.* (2010) reported that the mulberry (*Morus alba* L.) performance of cutting in open air and in polythene low tunnel. Root length, number of root branches, root breadth and fresh and dry weight were found maximum in two inches cutting while minimum in four inches cutting.

Ahmad *et al.* (2011) reported that the mulberry (*Morus alba* L.) performance of cutting in outdoor and indoor at polythene low tunnel. Root length, number of root branches, root breadth and root fresh and dry weight were found maximum in 5cm cutting while minimum in 10 cm cutting. Singh *et al* (2014) reported that the mulberry (*Morus alba* L.) cuttings were rooted in a rooting media of 1:1 mixture of sandy soil and farm yard manure in plastic root trainers inside a mist house. Among all the treatments, numbers of sprouted cuttings, length of the roots/cutting, percentage of rooted cutting, lengths of longest sprouts of root were higher in IBA 2000 $mg.L^{-1.}$

3. Effect of planting times

Harrison-Murraya (1991) observed that the seasonal timing, or the period of the year in which cuttings are taken, can play an important role in rooting. Kako (2012) in this research, the effects of cuttings breadth and ındol-3-butyric acid (IBA) doses on hard wood stem cuttings black mulberry were studied. Cuttings were taken from late winter and applied to the variousindole-3-butyric acid quantities (0, 1000, 2000, 3000 and 4000mg/l). In order to root, the cuttings of plants were planted in sandy loamy soil. The cuttings breadth and indole-3-butyric acid had significant effects on rooting percentage, length and breadth of transplants. Implementation ofindole-3-butyric acid and kinetin report notable effects on triumphant budding scion (%). Length and breadth of scions, the suitable medication was found from treatment T_4(12-14) mm + 4000ppm indole-3-butyric acid in rooting was (80.72%), and treatment T_3 (10-11)mm + 2000ppm indole-3-butyric acid for both length was (180.50cm) and breadth was (14.28 mm) of transplants, while the best medication in percentage of budding success scion, length and breadth of scions was found in high amount of indole-3-butyric acid and kinetin.

Less rooting in the cuttings which were planted during winter season might be because of carrying more ratio of inhibitor to promoter or because of higher nitrogen to carbohydrate ratio. The cuttings planted in rainy season, performed the best in all aspects, number of sprouted cutting, average number of sprouts, breadth of thickest sprout, number of leaves on new shoots, shoot percentage, length of longest sprout, fresh and dry weight of shoot, root percentage, number of primary roots, secondary root, length of longest root, fresh and weight of root (Singh et al., 2015).

4. Type of cuttings

In mulberry, a great number of studies primarily on wood cutting have been conducted on a large scale whereas studies on the softwood cutting have been limited. Hence, their results were quite different from each other (Konarlı *et al.*, 1977; Ayfer *et al.*, 1986; Ünal *et al.*, 1992; Özkan and Arslan, 1996; Soylu *et al.*, 1997; Yıldız and Koyuncu, 2000; Koyuncuand *et al*., 2003; Koyuncu *et al.*, 2004; Karadeniz andiman, 2004; Erdoan and Aygün, 2006). In these researches, the success result of white mulberry and black mulberry is up to 100% and 90% respectively.

CONCLUSION

All the above investigation shows that IBA treatment is better than the other form of treatments for *Morus alba* cutting development. Hardwood cuttings showed better growth than softwood and semi hardwood cuttings. The survival of *Morus alba* cuttings was observed under green house. *Morus* cuttings grown during rainy season compare to winter alone have a superior positive result.

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REFERENCES

Ahmad, I., Siddiqui, M.T., Khan, R.A. and Butt, T.M. (2010) Root growth of *Morus alba* as affected by size of cuttings and polythene low tunnel. *World Academy Sci., Engi. and Tech.*, 4: 890-892.

Ahmad, I., Siddiqui, M.T., Khan, R.A., Kashif, M. and Butt T.M. (2011) Root growth of *Morus alba* as affected by cutting size and low polythene tunnel. *J. Orntl. Hort. Plants*, 1(1): 35-41

Ayfer, M., Gülen, Y., Kantarcı, M. (1986) Aya dutunun çelikle ço altımı üzerine bir ara tırma. Ank. Ü. Ziraat Fak. Yıllı, 35: 289-297.

Chadha, K.L. and Choudhury, B. (1980) Ornamental Horticulture in India. I.C.A.R., New Delhi.

Dev Kishan Jat, Singh, K.K., Mehta, S.K. and Rana, D.K. (2017) 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. The Bioscan. 11(1): 511-514.

Duthie, J.F. (1903–1929) Flora of the Upper Gangetic plain andof the adjacent Siwalik and Sub-Himalayan tracts. Calcutta.

Erdoan, V., Aygün, A. (2006) Kara dut'un (*Morus nigra* L.) ye il çelikle ço altılaması üzerine bir ara tırma. II. Ulusal Üzümsü Meyveler Sempozyumu, 14-16, Eylül, Tokat.

Harrison-Murray, R.S. (1991) A leaf-model evaporimeter for estimating potential transpiration in propagation environments. *J. Hort. Sci.*, 66: 131-139.

Hooker, J.D. (1872-97) Flora of British India. London, U.K.

Kako, S.M. (2012) The effect of auxin IBA and kinetin in budding success percentage of mulberry (*Morus sp.*). *Int. J. Pure Appl. Sci. Technol.*, 13(1): 46-5

Kalyoncu, I.H., Ersoy, N., Yılmaz, M. and Aydın, M. (2009) Effects of humidity level and IBA dose application on the softwood top cuttings of white mulberry (*Morus alba* L.) and black mulberry (*Morus nigra* L.) types. *African J. Biotech.*, 8(16): 3754- 3760.

Karadeniz, T., Iman, T. (2004) Beyaz dut ve kara dutun meyve özellikleri ve çelikle ço altılması. Ulusal Kivi ve Üzümsü Meyveler Sempozyumu Kitabı, Trabzon. s: pp. 428-432,

Khan, G.S., Ahmad, I. and Nawaz, M.F. (2007) Sprouting percentage and growth behaviour of *Morus alba* as affected by size of cuttings and polythene tunnel. *Pak. J. Agri. Sci.*, 44(2): 328-331.

Qaisar, K.N., Khan, P., Rather, T.A. and Khan, F.S. (2010) Effect of Growth Hormones on Rooting Response of Shoot Cutting of *Morus alba* var. Gosherami. J. Trees. Sci., 29 (1&2). 39-41.

Konarlı, O., Çelebio lu, G., Çıragil, N. (1977) Yaprak dut çe itlerinin odun çeli i ile üretilmesi. Bahçe, 8(2): 35-40.

Koyuncu, F., Vural, E., Çelik, M. (2004) Kara dut (*Morus nigra* L.) çeliklerinin köklendirilmesi üzerine ara tırmalar. Ulusal Kivi ve Üzümsü Meyveler Sempozyumu Kitabı, Trabzon. s: pp. 424-427.

Koyuncu, F, Enel, E. (2003) Rooting of black mulberry (*Morus nigra* L.) hardwood cuttings. J. Fruit Ornam. Plant Res., 11: 53-57.

Langhans, R.W. (1955) Mist for growing plants. *Farm Res.* (Cornell Univ.) 21(3): 3.

Ombrello, T. (2012) The Mulberry tree and its silkworm connection. In Cranford, N.J. (ed.): *Plant of the week.* Union County College.

Özkan, Y., Arslan, A. (1996) Kara dut'un (*Morus nigra* L.) odun ve ye il çelikle ço altılması üzerine ara tırmalar. GOP Ü. Ziraat Fak. Dergisi, 13(1): 15-27.

Prolongs, I.C. and Therios, I. (1976) Rooting response of juvenile and adult leafy olive cuttings to various factors. *J. Hort. Sci*., 5: 31-39.

Rio, C. Del, L. Rallo and Caballero, J.M. (1991) Effect of carbohydrate content on the seasonal rooting of vegetative and reproductive cuttings of olive. *J. Hort. Sci*., 66: 301-309.

Singh, K.K., Jat, D.K. and Mehta, S.K. (2015) Rootability of hardwood cuttings of mulberry (Morus alba l.) Influenced by planting time and growing Conditions under valley condition of Garhwal Himalayas. Plant Archives. 15(2):1031-1036.

Singh, A.K. and Singh, V.B. (2002) Influence of wood maturity and auxin on the regeneration of *Bougainvillea* cuttings. *Prog. Hort*., 34(2): 196-199.

Singh, K.K., Choudhary, T. and Kumar. A. (2014) Effect of Various Concentrations of IBA and NAA on the Rooting of Stem Cuttings of Mulberry (*Morus alba* L.) under Mist House Condition in Garhwal Hill Region. Indian Journal of Hill Farming 27(1): 125-131.

Soylu, A., Akbudak, B., Gümü, C., Mert, C. (1997) De i ik uygulamaların Ichinosa dut odun çeliklerinin köklenmesi üzerine etkileri. I. Köklendiricilerin etkileri. Ulud. Ü. Ziraat Fak. Dergisi, 13: 11-20.

Ünal, A., Özça ıran, R., Hepaksoy, S. (1992) Kara dut ve mor dut çe itlerinde odun çeliklerinin köklenmesi üzerinde bir ara tırma. Türkiye I. Ulusal Bahçe Bitkileri Kongresi, Cilt: 1 (Meyve), s: pp. 267-270.

Yıldız, K., Koyuncu, F. (2000) Kara dutun (*M. nigra* L.) Karadutun (*M. nigra* L.) odun çelikleri ile çoğaltýlmasý üzerine bir araştýrma. Derym. 17(3): 130-135.