academicJournals

Vol. 12(46), pp. 3284-3290, 16 November, 2017
DOI: 10.5897/AJAR2015.10103
Article Number: 78AA35B66722
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Propagation of Farash (*Tamarix aphylla)* as affected by cutting lengths under low polytunnel and open air

Aitzaz Malik* and Shahid Hafeez

Department of Forestry, Range Management and Wildlife, University of Agriculture Faisalabad, Faisalabad, Punjab, Pakistan.

Received 3 July, 2015; Accepted 25 May, 2017

A research study was conducted on *Tamarix aphylla* in August, 2008, in the experimental area of Department of Forestry, University of Agriculture Faisalabad, Punjab to find out the impact of vegetative propagation of Farash (*T. aphylla*) through different size of cuttings in open air and under low polytunnel. In this study, 2", 4" and 6" long cuttings were planted in shade in polythene bags, with nine holes, 3" wide and 7" long, made in each bag for irrigation purpose. The data was recorded twice a month on sprouting percentage, height of plant, root length and number of root branches for two months after initial planting in the month of August. Sprouting percentage and height of plants were maximum in T_3 (6" long cuttings) and minimum in T_1 (2" long cuttings) in both open air and low polytunnel, but overall the success rate was much higher under the low polytunnel. The measurement of roots length and number of roots branches was maximum in T_1 than T_3, in open air and low polythene tunnel.

Key words: *Tamarix aphylla*, cuttings, growth, open air, polytunnel.

INTRODUCTION

Within the Tamariacacea family, there are 4 genera and 289 species (The Plant List, 2010). This family thrives in temperate conditions and can be found distributed as such in Europe, Asia and Africa within their maritime deserts and sandy tracts. This family is not abundant on Indian subcontinent where its representation is 20% of all species spread between Srilanka, India, Pakistan, Bangladesh, Bhutan and Myanmar (Kundu, 2009). Having thought to have its origins in the Central Sahara, it then spread throughout North Africa, Egypt and the Middle East spreading to India, Afghanistan and Pakistan. The spread also covered the areas of Eriteria, Kenya and Ethiopia (CABI, 2015). Tamariacacea is a small family of about 4 genera and 289 species (The Plant List, 2010) temperate in distribution, usually found in sandy tracts and maritime deserts of Asia, Africa and Europe. On the Indian subcontinent (comprising Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka and India), the family Tamaricaceae is poorly represented (20% of all species) (Kundu, 2009). Qaisar

*Corresponding author. E-mail: aitzaz103@yahoo.com.

(1982) stated that in Pakistan it is represented by 4 genera and 35 species. The native range of *T. aphylla* extends over the Middle East, North, East and Central Africa, and parts of West and South Asia. The species is thought to have originated in the Central Sahara, from where it spread to Pakistan, India, Afghanistan, the Middle East, Egypt and North Africa, as well as to Eritrea, Somalia, Kenya and Ethiopia (CABI, 2015; Orwa et al., 2009).

T. aphylla is evergreen, moderate sized and fast growing tree of upto 18 m height with an erect tapering trunk and smooth branches. Department of Agriculture and Fisheries (2013) concluded that it is heat, salt, draught and frost tolerant. Mature trees of *T. aphylla* have dark grey to black and rough stem of up to 1 m in diameter but immature trees have light grey trunks. Department of Land Resources Management (2014) concluded that even because of pendulous needles and branches, it is not a true pine or conifer. Silvery grey appearance on tree foliage of whitish coating is because of salt secreting glands from the needles. Small, white and pink flowers occur in dense racemes. Biophysical limits of *T. aphylla* are 0 to 1200 m above sea level, mean annual rainfall is 250 to 500 mm and mean annual temperature is 10 to 50°C. *Tamarix aphylla* grows naturally in canals, riverbanks, coastal plains, salt marshes, salty deserts and sand dunes. It can grow positively in saline soil and expand in occasional inundation areas than never flooded ones. It flourishes on loamy soils and can grow easily on stiff clays and sand. Nowadays, *T. aphylla's* wood can be used in different ways. Soft branches and leaves also provide a good quality of forage especially in dry time scale of the year. Its wood is flammable and can be used for firewood and charcoal (calorific value, 4835 kcal/kg) but catches fire slowly because of salt contents especially in small branches (Orwa et al., 2009). Its wood is used as fuel in United States and has been proposed for fence posts (Guler et al., 2007). *T. aphylla* have close-grain wood which is helpful in making carts, tool handles, ornaments, furniture, wheels, carpentry and fruit boxes (Orwa et al., 2009). On the other hand, it has been found to be a suitable raw material for making particle boards and can be used as biomass for sugar production (Sadegh et al., 2012; Hashemi, 2011).

There are different ways to propagate or multiply a plant. In Tamariacacea, there are 120 species but this study will focus on *T. aphylla*. A plant can be grown from their seeds or cutting off a portion of an established plant (Welch-Keesey and Lerner, 2009) and in the same way *Tamarix* species can naturally be reproducde from seeds and their broked stem fragments. The successful rate of vegetative propagation is quite higher especially when branches broken up by floodwater carry downstream (Crushes, 2008). A cutting is any detached plant part which, under favorable conditions, will produce a new plant identical to the parent plant (Hamilton and Midcap, 2003). A new plant grown form the cuttings of a parent plant which can grow faster and avoids all difficulties then growing from a seed. Vegetative propagation through cuttings or asexual reproduction is still very productive method so evergreen needled trees can also reproduce by parent plant cuttings (Welch-Keesey and Lerner, 2009). In open air, the viability of *T. aphylla's* recalcitrant seed is very low not more than a week, their germinative capacity keep reducing with the passage of time and therefore for better results immediate sowing is the only solution (Orwa et al., 2009). So, the yield of a tree produced from a cutting can be greater than a tree produced from seed. Boles produced by cuttings have better quality and less tapered (Hudson, 2009). Hybridization between superior species, as well as creating orchards of improved trees, has been examined in research. In order to realize genetic goals in tree species, several generations of tree breeding are required and each generation can last for 15 to 50 years depending on the species. Within the past few decades, genetic improvement of tree species has accelerated within the forest industry. Currently, the dilemma is how to speed up this process.

Asexual propagation (vegetative reproduction through cuttings) is one of the methods to solve this question. Until 1971, there were only three propagation programs introduced to this world (Ritchie, 1991), but now this process is successful as a nursery management tool (Hudson, 2009). Arrington (2015) stated that one of the many main advantages of asexual reproduction is the advantage of speed because it does not consider the gamete formation process and another is that the offspring are clones of the parents. The size of length of cuttings can differ according to different plant species (Edson, 1991). McCormack (2006) suggested that different cutting lengths can affect the prosperous rooting in *Morus alba*. So, it is very important to consider the age and size of planting material for initial survival and formation of seedlings (Haq, 1992) and establishment of cuttings and the early life stages of a plant are critical for the establishment of high seedling mortality. The root growth depends on node position, cutting length and leaf area factors and the success of rooting from cuttings depends on the factors like environmental, genotype and physiological state (Ahmed et al., 2011). So, it is vital to upgrade the use of local species by vegetative means (Weber and Stoney, 1986; Arriaga, 1994; Leakey et al., 1994), because propagation by seedlings took a very long time (Ahmed et al., 2011). Desired results from cuttings may affect if environmental conditions are not supplied properly (Hamilton and Micap, 2003). A cover can be used for the existence and initial formation of plants. Humid conditions are quite suitable for the rooting process of *M. alba* and umbrella of greenhouse with plastic cover (Ahmed et al., 2011). Trujillo (2002) also favored plastic cover for the success of cuttings in the nursery. So it is quite settled that polythene cover really

Table 1. Sprouting percentage of *Tamarix aphylla* plant as affected by cuttings size in open air and under low polytunnel.

Time interval after planting (days)	Treatments								Mean
	Open Air				Low Polythene Tunnel				
	T_1 (%)	T_2 (%)	T_3 (%)	Mean	T_1 (%)	T_2 (%)	T_3 (%)	Mean	
15 Days	17.15	28.20	29.10	24.82[e]	21.22	68.07	77.55	55.61[b]	40.21[c]
30 Days	19.22	45.30	48.28	37.60[d]	23.28	80.85	85.10	63.07[a]	50.33[b]
45 Days	21.10	58.10	62.02	47.07[c]	21.10	85.66	86.85	64.54[a]	55.80[a]
60 Days	21.10	58.10	63.23	47.47[c]	21.10	85.66	86.85	64.54[a]	54.83[a]
Mean	19.64[c]	47.42[b]	50.65[b]	39.24	21.67[c]	80.06[a]	84.08[a]	61.94[a]	56.00

T_1: 2" long cuttings; T_2: 4" long cuttings; T_3: 6" long cuttings; %: percentage.

affects the different parameters of a plant.

In 1823, *Tamarix* species were first introduced into the United States but now they are planted as windbreaks, ornamental and for stream bank stabilisation (Crushes, 2008). *T. aphylla* recognised as windbreaks, erosion control, sand dune problems and as an ornament. However, it is planted in the hot deserts of Iran to control sand dunes problems (Sadegh et al., 2012).

MATERIALS AND METHODS

Study site

The experiment was carried out at experimental area of the Department of Forestry, University of Agriculture Faisalabad. Latitude 36 to 26° and Longitude 73 to 06°E.

Cutting preparation and planting

Three different sizes of branch cuttings (2", 4" and 6" long) of Farash (*T. aphylla*) were prepared from six-year-old healthy trees in the first week of August 2008. These cuttings were then planted and irrigated immediately in the polythene bags of 3" × 7" size which were filled with sandy loam soil. Half of these bags were placed in the open air, while the remaining half was placed under the low polytunnel. There were two experiments (open air block and under low polytunnel block) were organised in accordance with Randomized Complete Block Design (RCBD) with three replications each. The data on sprouting percentage and height of plant were recorded after 15, 30, 45 and 60 days but root length and root branches data was recorded right after 60 days. There were three treatments in each replica and three treatments were labeled as T_1 for 2" long cuttings; T_2 for 4" long cuttings and T_3 for 6" long cuttings. There were 50 polythene bags in each treatment (T_1, T_2 and T_3) which makes 150 in each replica of open air and under polytunnel, making a total of 900 bags for the whole experiment. The data were subjected to analysis of variance and comparison among the treatments by the Least Significant Difference Test at 5% probability level (Steel et al., 1997).

RESULTS AND DISCUSSION

Sprouting percentage

It is vital to find out the survival percentage of plants by the propagation of different size of stem cuttings in different environmental conditions. The maximum sprouting after 15 days was observed in T_3 (77.55%) under polytunnel while in open air it was only 29.10% (Table 1). Overall, after 30 days, there was a negligible increase in the sprouting percentage, thus thirty days are adequate for assessing sprouting. The results of the present study showed that the cutting size and polythene cover influence the sprouting of tree cuttings at nursery stage. These findings are also in line with those of Mebrathu and Hanover (1990), Cobbina (1990), Haq (1992), Mitchell (1998), and Trujillo (2002).

The sprouting percentage in all treatments (T_1, T_2 and T_3) was much higher under low polytunnel than in open air and after 60 days the most successful treatment was T_3 (6" long cuttings) under low polytunnel with 86.85% (mean value 84.08%) sprouting and in open air it was only 63.23% (mean value 39.24%) (Figure 1). This significant figure clearly shows that the environmental conditions (polytunnel) do affect the sprouting percentage of *T. aphylla*. Rafay et al. (2015) revealed that the sprouting percentage was maximum with 6" cuttings under low polythene tunnel are maximum than others and in different mediums. So the results indicate that the low polytunnel is better for propagating *T. aphylla* plants from branch cuttings.

Height of plants (cm)

After 15 days, the height of plants exposed to the open air was less being 2.23 cm for T_3 (6" long cuttings), 1.98 cm for T_2 (4" long cuttings), and 1.52 cm for T_1 (2" long cuttings). The plants were much taller in first 15 days when kept under low polytunnel being 3.21 cm for T_3, 3.10 cm for T_2 and 3.22 cm for T_1 (Table 2). Overall, after 30 days, there was no difference in the height of plants in open air but under low polytunnel T_3 have shown a significant height than other treatments. After 60 days, the results for plant height clearly shows (Figure 2) that under low polytunnel plants flourished and developed more vigorously with a mean difference of 3.54 cm than in open air (Table 2). Rafay et al. (2015) concluded that

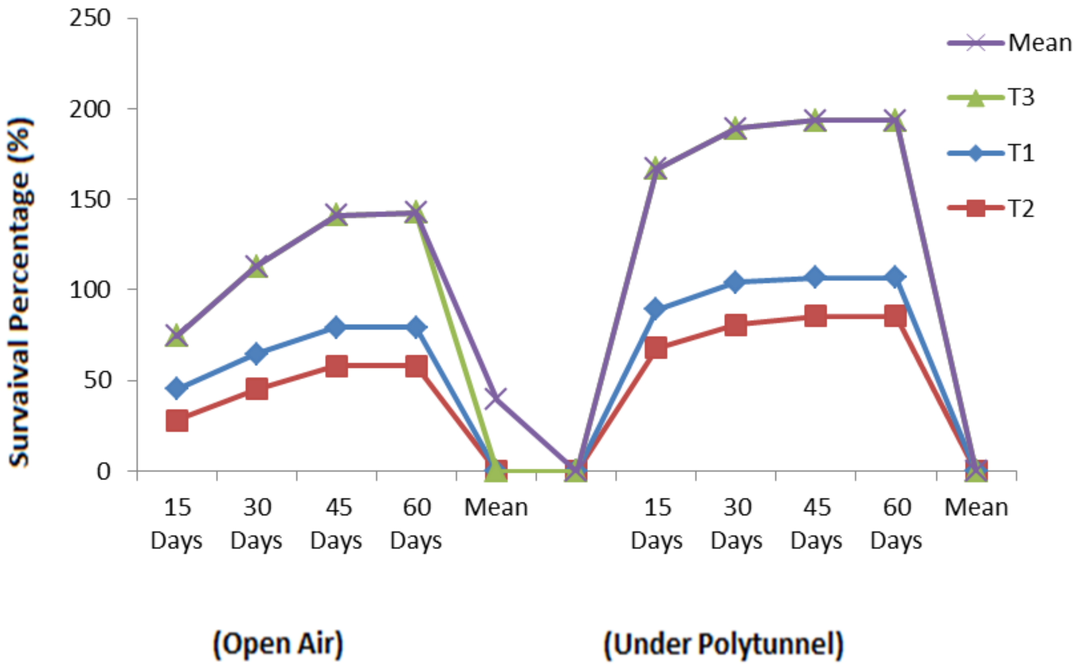

Figure 1. Sprouting percentage of *Tamarix aphylla* plant as affected by cuttings size in open air and under low polytunnel.

Table 2. Height of *Tamarix aphylla* plants (cm) as affected by cuttings size in open air and under low polytunnel.

Time interval after planting (days)	Treatments								Mean
	Open Air				Low Polythene Tunnel				
	T_1(cm)	T_2(cm)	T_3(cm)	Mean	T_1(cm)	T_2(cm)	T_3(cm)	Mean	
15	1.52	1.98	2.23	1.91^{g}	3.22	3.10	3.21	3.17f	2.54^{d}
30	4.69	4.89	4.98	4.85^{e}	7.33	8.65	9.35	8.44^{d}	6.65^{c}
45	8.23	8.63	9.22	8.69^{d}	10.55	12.22	14.78	12.52^{b}	10.60^{b}
60	9.65	10.75	11.03	10.47^{c}	13.96	16.45	17.52	15.98^{a}	13.23^{a}
Mean	6.02^{e}	6.56d^{e}	6.86^{d}	6.48	8.76^{c}	10.10^{b}	11.21^{a}	10.025	8.25

T_1: 2" long cuttings; T_2: 4" long cuttings; T_3: 6" long cuttings; cm: centimetre.

under low polythene tunnel the height of plants with 6" long cuttings achieved maximum height. These results also match the findings of Khan (2007).

Root length (cm)

The maximum root length of 20.14 cm was recorded in T_1 (2" long cuttings) under polytunnel. Even the mean value of T_1 in open air and under polytunnel is 19.63 cm which is higher than T_2 and T_3 mean values which are 18.67 and 18.24, respectively (Table 3). Length of roots were much better grown in the plants under low polytunnel (mean value 19.56 cm) than in the open air (mean value 18.14 cm) (Table 3). The results from T_1 shows that root length can be developed in a better way, under polytunnel (Figure 3). The reason might be conservation of moisture and heat/temperature under the sheet cover, enhancing growth of plant roots. These results agree with the findings of Trujillo (2002).

Root branches

The numbers of root branches were counted immediately after the completion of 60 days. The maximum number of root branches (21.23) were produced by T_1 (2" long cuttings) in open air (Table 4). On the other hand, plants grown under polytunnel had slightly less root branches (18.75) than in open air. It is shown (Figure 4) that T_1 (2"

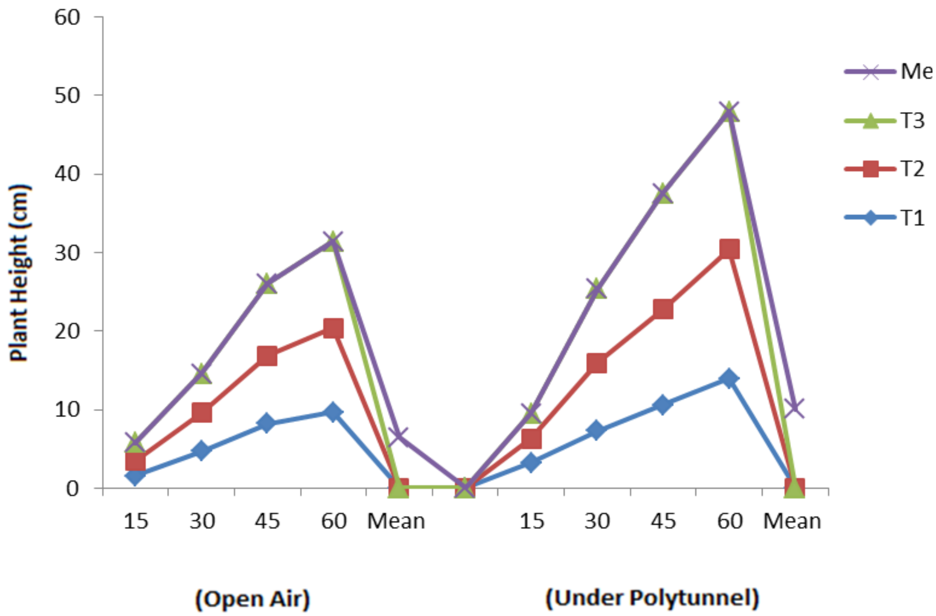

Figure 2. Height of *Tamarix aphylla* plants (cm) as affected by cuttings size in open air and uner low polytunnel.

Table 3. Root length (cm) of *Tamarix aphylla* as affected by cuttings lengths in open air and under low polytunnel.

Blocks	Treatments			
	T_1 (cm)	T_2 (cm)	T_3 (cm)	Mean
Open air	19.12	18.13	17.16	18.14
Polytunnel	20.14	19.22	19.32	19.56
Mean	19.63	18.67	18.24	18.85

T_1: 2" long cuttings; T_2: 4" long cuttings; T_3: 6" long cuttings; cm: centimetre.

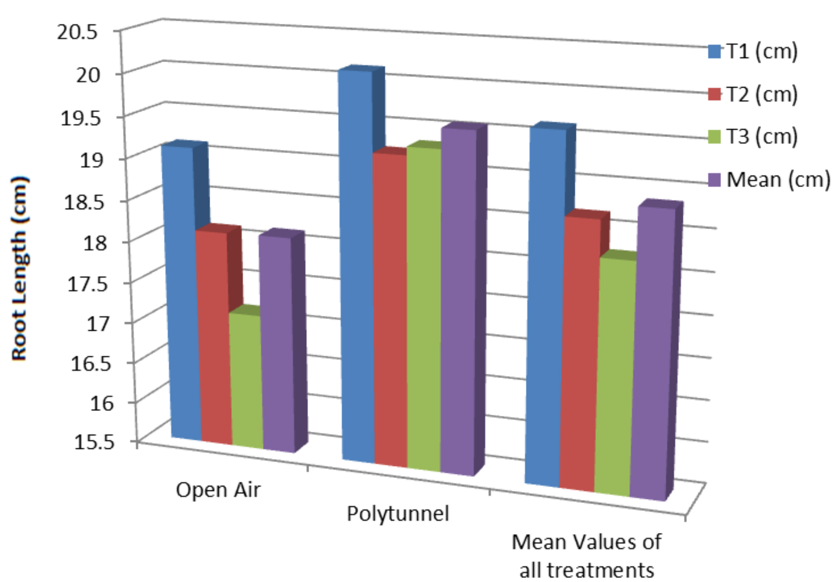

Figure 3. Root length (cm) of *Tamarix aphylla* as affected by cuttings lengths in open air and under low polytunnel.

Table 4. Number of root branches of *Tamarix aphylla* as affected by cuttings length in open air and under low polytunnel.

Blacks	Treatments			Mean
	T_1	T2	T3	
Open	21.23[a]	18.45[b]	16.21[c]	18.63
Covered	18.75[b]	18.10[bc]	20.24[ab]	19.03
Mean	19.99[a]	18.27[b]	18.22[b]	18.83

T_1: 2" long cuttings; T_2: 4" long cuttings; T_3: 6" long cuttings.

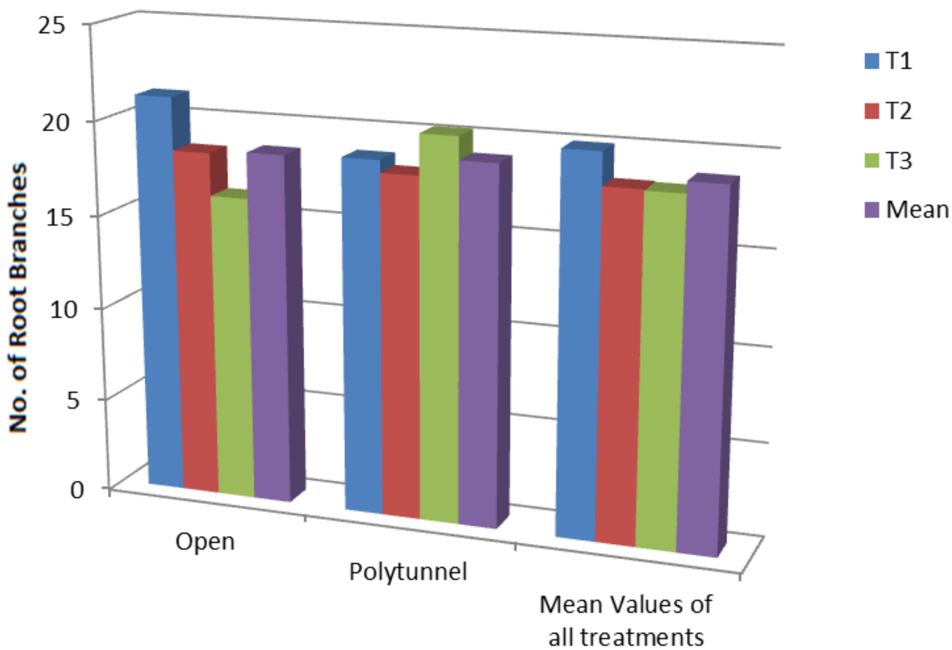

Figure 4. Number of root branches of *Tamarix aphylla* as affected by cuttings length in open air and under low polytunnel.

long cuttings) in open air produced more roots than the the longer cuttings possibly because there was more space available to grow for them as compared to larger cuttings. Irfan (2011) concluded that 2" long cuttings produced more branches than others and in different mediums. Different researchers have previously observed that shorter cuttings lead to the development of more and better roots (Foster et al., 2000). It shows again the success rate of T_1 with the number of root branches (mean value 19.99) is higher than other treatments (T_2 and T_3) is as similar to the results of measurement of roots length.

Conclusion

Although seedlings still costs less in most regions of the world, propagation through cuttings could be the best alternative to it to prepare more vigorous plants and more flowering in some cases in less period of time. The overall growth of plant cuttings under polytunnel was better as compared to the open air. The reason that under polytunnel, moisture was conserved and proper temperature for plant growth was maintained which resulted in the best results of sprouting percentage, plant height and root growth except the number of root branches. The numbers of root branches were higher in the open air than under low polytunnel which can be the result of small space available. All the growth parameter indicates that the performance of T_3 treatment (6" long cuttings) is better than all other sizes of cuttings. So, keeping in view the conclusion, planting of 6" long cuttings of *T. aphylla* under low polytunnel is recommended for nursery raising.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Ahmed I, Siddiqui M, Khan R, Kashif M, Butt T (2011). Root Growth of Morus alba as Affected by Cutting Size and Low Polythene Tunnel. J. Hortic. Plants 1(1):34.

Arriaga V, Cervantes V, Vargas-Mena A (1994). Manual de reforestación con especies nativas. SEDESOL, UNAM. México, D. F. Mexico P. 186.

Arrington D (2015). Asexual Reproduction in Plants: Advantages, Disadvantages & Types. [online] Study.com. Available at: http://education-portal.com/academy/lesson/asexual-reproduction-in-plants-advantages-disadvantages-types.html

CABI (2015). *Tamarix aphylla*. In: Invasive Species Compendium, Wallingford, UK: CAB International. www.cabi.org/isc.

Cobbina J (1990). Effect of direct sun rays on the growth of *Leucaena leucocephala* and *Gliricidia sepium* seedlings in nursery. Luceana Res. Rep. 11:88-90.

Crushes S (2008). *Pest Plant Risk Assessment Athel pine*. Queensland: Biosecurity Queensland, Department of Primary Industries and Fisheries P 6.

Department of Agriculture and Fishries, (2013). *Athel pine (Tamarix aphylla)*. The State of Queensland: Queensland Government P. 1

Department of Land Resource Management (2014). *Athel pine (Tamarix aphylla)* NT Weed Risk Assessment Technical Report. Darwin:Department of Land Resour. Manage. pp 1-20.

Edson L, Wenny L, Lauren F (1991). Propagation of Western Larch by Stem Cuttings. Western J. Appl. For. 6(2):47-49.

Foster G, Stelzer H, McRae J (2000). Loblolly pine cutting morphological traits: Effects on rooting and field performance. New For. 19(3):291-306.

Guler C, Copur Y, Akgul M, Buyuksari U (2007). Some Chemical, Physical and Mechanical Properties of Juvenile Wood from Black Pine (Pinus nigra Arnold) Plantations. J. Appl. Sci. 7:755-758.

Hamilton D, Midcap J (2003). Propagation of woody Ornamentals by Cuttings. University of Florida. Available at: http://polk.ifas.ufl.edu/hort/documents/publications/Plant%20propagation%20of%20woody%20ornamentals.pdf.

Haq R (1992). Effect of light and weed competition on the survival and growth of Abies pindrow seedlings of various ages in different soils media in the moist temperate forests of Pakistan. Pak. J. For. 42(3):148-162.

Hashemi S (2011). Variation of within-stem biometrical and physical property indices of wood from *Cupressus sempervirons* L. BioResources 6(2):1843-1857.

Hudson K (1997). Overview of Plant Propagation. [online] University of Auburn. Available at: http://www.rooting-hormones.com/hudson.htm

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

Kundu S (2009). A synopsis of Tamaricaceae in the Indian subcontinent: its distribution and endemism. Acta Botanica Hungarica 51(3-4):301-314.

Leakey B, Newton C, Dick M (1994). Capture of genetic variation by vegetative propagation: processes determining success. In: Leakey, B., Newton, C., eds., Tropical trees: the potential for domestication and the rebuilding of forest resources. London: HMSO pp. 72-83.

McCormack J (2006). Rootinf of 'Illionois Everbearin' Mulberry Cuttings. Quart. North Am. Fruit Explorers 18(1):1.

Mebrathu T, Hanover J (1990). The effect of root cutting size on time of sprouting of Black locust. Nitrogen Fixing Tree Res. Reports 8:156-158.

Mitchell A (1998). Acclimation of Pacific yew (*Taxus brevifolia*) foliage to sun and shade. Tree Physiol. 18(11):749-757.

Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S (2009). Agroforestree Database 4.0: a tree reference and selection guide. World Agroforestry Centre, Kenya. Available at: http://www.worldagroforestry.org/af/treedb/). [Accessed 8 Feb. 2015].

Qaisar M (1982). Tamaricaceae. In: E. Nasir and S.I. Ali, ed. Flora Pak. Rawalpindi: 4:1-65.

Rafay M, Abdullah M, Hussain T, Ruby T, Akhtar S, Fatima I (2015). Germination percentage and growing behaviour of *Salix tetrasperma* (Willow) as affected by size of branch cutting and low polythene tunnel. J. Biodivers. Environ. Sci. 6(4):318-325.

Ritchie G (1991). The commercial use of conifer rooted cuttings in forestry: a world overview. New For. 5(3):247-275.

Sadegh A, Samariha A, Kiaei M (2012). Experimentl Characterisation of Shrinkage and Density of Tamarix aphylla Wood. Cellulose Chem. Technol. 46(5-6):369-373.

Steel R, Torrie J, Dickey D (1997). Principles and Procedures of Statistics: A biometrical approach. 3rd ed. New York: McGraw-Hill Companies.

The Plant List (2010). *Tamaricaceae*. [online] Available at: http://www.theplantlist.org/

Trujillo F (2002). Mulberry for rearing dairy heifers. In: Sánchez, M. (2002). Mulberry for Animal Production. ed. Rome: FAO Animal Production and Health Paper 147:203-206.

Weber F, Stoney C (1986). Reforestation in Arid Lands. [online] Virginia: Volunteers in Technical Assistance pp. 1-300.

Welch-Keesey M, Lerner B (2009). New Plants from Cuttings. [online]. Purdue University.Available at: http://www.hort.purdue.edu/ext/ho-37web.html