ROOT CUTTING TRIALS OF THREE FOREST TREE SPECIES UNDER DIFFERENT PROPAGATING CONDITIONS

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ABSTRACT

Vegetative propagation of silkoroi *(Albizia procera)*, lohakath *(Xylia kerrii)* and sal *(Shorea robusta)* from root cuttings was tried. The results on the propagating environment with silkoroi root cuttings showed that a mixture of sawdust-sand medium in open bed was found more suitable than the sand medium in open bed and gravel medium in the mist bed. The age of the stock plant from which lohakath root cuttings were collected appears to have an important influence on their success rate and sucker production. Rooted cuttings taken from the three years old transplants regenerated more successfully than the cuttings taken from the mature trees. Sucker production is higher in longer and thicker cuttings, but when a thin (4-5 mm) and longer (10 or 15 cm) cuttings or thick (5.1-10 mm or 10.1-15 mm) and small (5 cm) cuttings were used poor regenerative capacity was observed. All successful cuttings of silkoroi and lohakath produced both roots and shoots. Regeneration of sal from root cuttings was not successful.

সারসংক্ষেপ

শীলকড়ই, লোহাকাঠ ও শাল প্রজাতির গাছের শিকড় দ্বারা অংগজ বংশ বিস্তারের পরীক্ষা করা হয়। শীলকড়ই প্রজাতির গাছের শিকড় হইতে অংগজ বংশ বিস্তারের পরীক্ষায় দেখা যায় যে, করাতের গুড়া ও বালির মিশ্রণে তৈরী উন্মুক্ত কেয়ারীতে শুধু বালির মিডিয়াম ও মিষ্টিসংযুক্ত নুড়ি পাথরের কেয়ারী অপেক্ষা রুট কাটিং অধিক সফল হয় ও অধিক চোষক তৈরী করে। লোহাকাঠ প্রজাতির পরীক্ষায় দেখা যায় যে, শিকড়ের উৎস গাছের বয়সের উপর শিকড় কাটিং এর কৃতকার্যতা বিশেষভাবে নির্ভর করে। কম বয়সের গাছ হইতে সংগৃহীত শিকড় কাটিং অধিক বয়সের গাছ হইতে সংগৃহীত কাটিং অপেক্ষা অধিক কৃতকার্য হয় ও বেশী চোষক তৈরী করে। শিকড় কাটিং এর অধিক দৈর্ঘ ও ব্যাস কৃতকার্যের হার ও চোষক সংখ্যা বাড়ায়। তবে পাতলা (৪–৫ মি মি) অথচ লম্বা (১০ সে মি বা ১৫ সে মি) শিকড় কাটিং অথবা মোটা (৫·১–১০ মি মি ও ১০·১–১৫ মি মি) অথচ ছোট (৫ সে মি) শিকড় কাটিং এ ক্ষীণকৃতকার্যের হার ও কম চোষক উৎপন্ন হয়। শীলকড়ই ও লোহাকাঠের শিকড় কাটিং হইতে শিকড় ও চোষক উভয়ই উৎপন্ন হয়। শাল প্রজাতির শিকড় কাটিং দ্বারা অংগজ বংশ বিস্তার সম্পূর্ণ অকৃতকার্য হয়।

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INTRODUCTION

In the recent years, the demand for improved propagules for the plantation programme in Bangladesh has been increasing sharply. For this reason, clonal Seed Orchards were established and vegetative propagation techniques of various plantation species were tried to develop. Sal (*Shorea robusta* Roxb. ex Gaertn. f.), silkoroi (*Albizia procera* Roxb. Benth.) and lohakath (*Xylia kerrii* Craib et Hutch.) are some of the most important plantation species of Bangladesh and are included in the seed orchard programme. Extensive studies on grafting and cutting were tried with scions taken from mature trees of sal and silkoroi without any success. However, a high percentage of success was found on grafting of lohakath. All the three species were found to regenerate from suckers naturally when the trees are cut or the root systems are heavily disturbed. Moreover, seed production of lohakath is very low, and the fruit is damaged by insects and pathogens or eaten by squirrel before maturity. Therefore, an attempt has been made to investigate the propagation success of the above three species from root cuttings.

Among different factors of success in root cuttings, the physiological condition of cuttings and propagating environment (Hartmann and Kester 1983) and endogenous auxin and carbohydrate levels of the cuttings (Eliason 1971b; Farmer 1962; Schier and Zasada 1973; Robinson and Schwabe 1977b) were found important. In addition, reports are also available that rate of success is related with the age of the donor plant and decreased progressively with the age (Garner and Hatcher 1958). Moreover, there are instances that regenerative capacity is also related with the length of root cuttings (Way *et. al.* 1955), diameter of root cuttings (Taylor and Murray 1981) or both (Robinson and Schwabe 1977a). Regeneration from root cuttings of a particular species also depend on inserting position (horizontally or vertically) in the rooting media (Way *et. al.* 1955; Robinson and Schwabe 1977a). A variety of rooting media in different proportions has been used for propagating root cuttings of different species (Robinson and Schwabe 1977a; Taylor and Murray 1981 and Way *et. al.* 1955). Robinson (1975) reviewed the regeneration of different plant species from root cuttings, but there is no information on the above three species.

MATERIALS AND METHODS

Intact root systems from trees were obtained by careful digging and lifting without causing any damage to the major roots. When collecting roots from older trees, major roots were located near the base of the tree and excavation allowed the collection of several such roots without inflicting any damage on them. The intact root system/roots were gently washed free of soils. After cleaning they were cut into appropriate sizes as stated under species for the experiment. Any injured parts of the roots were discarded, and proximal and distal ends of the cuttings were marked during preparation. Root cuttings were kept moist during transportation and before insertion by wrapping them in moist blotting paper and gunny bags. Root cuttings of sal and silkoroi were collected from mature trees growing at Barshijura Reserve Forest, Moulavibazar and Ichamati Reserve Forest, Chittagong respectively. Root cuttings from six years old and mature trees of lohakath were also collected from Barshijura Reserve Forest, Moulavibazar and three years old transplants were collected from Kaptai, Chittagong Hill Tracts.

All the experiments with root cuttings were carried out at Bangladesh Forest Research Institute nursery, Chittagong. Excised root cuttings were inserted either in a specially prepared beds with sawdust and sand (1:1 ratio) or in 15 cm x 10 cm polybags filled with sand and burried in the sawdust-sand bed or in the gravel medium bed having misting facilities. The

cuttings placed in the sawdust-sand beds were watered after insertion, and twice in a week from then onwards.

Root cuttings of silkoroi, lohakath and sal were studied in a number of different experiments, and methods used for them are described separately as follows :

Silkoroi *(Albizia procera)*

Propagating environment : To study the effect of propagating environment on suckering, cuttings (10 cm) taken from mature trees were inserted vertically exposing 2 cm proximal ends above the medium in the following propagating environments :

1) Sawdust-sand medium (1 : 1 ratio) bed shaded by bamboo mats.
2) Sawdust-sand medium (1 : 1 ratio) bed without shading.
3) 15 cm x 10 cm polybags filled with sand medium and the bags burried in sawdust-sand medium bed, without shading.
4) Gravel medium bed having misting facilities.

The four treatments (propagating environments) were replicated five times in a completely randomised design and each replicate consists of five cuttings, giving 100 cuttings for the experiment. The experiment was set up in February, 1989 and the data were recorded after six weeks of insertion.

Lohakath *(Xylia kerrii)*

Age of the donor plant : Root cuttings (10 cm) taken from 3 years old transplants, 6 years old plants and mature trees were arranged in a completely randomised design in five replicates; each replicate consisted five cuttings, giving 75 cuttings for the whole experiment. The experiment was conducted in February, 1989 and result were recorded after six weeks.

Root cutting length and diameter : Root cuttings of different diameter classes (4-5 mm, 5.1-10 mm and 10.1-15 mm) taken from six years old trees were divided into three length sizes (5 cm, 10 cm and 15 cm) and arranged in a split plot design with four replications. Cutting length sizes formed the main plots and the diameter classes the subplots; groups of five cuttings from the three diameter classes were randomly arranged within subplots, giving 180 cuttings for the whole experiment. The experiment was conducted in February, 1989 and results were recorded six weeks after insertion.

Sal *(Shorea robusta)*

Insertion method : To study the effect of insertion method on suckering, 10 cm root cuttings taken from mature trees were inserted in four ways : vertically, exposed (proximal end 2 cm above the surface of the medium); vertically, burried (proximal end 2 cm below the surface of the medium); horizontally, exposed (inclined at 10° to the horizontal, proximal end 2 cm above the surface of the medium) and horizontally burried (inclined at 10° to the horizontal, burried 2 cm below the surface of the medium). The four insertion treatments were replicated five times in a completely randomised design. Each replicate consisted of five cuttings giving a total of 100 cuttings for the whole experiment.

RESULTS

Silkoroi *(Albizia procera)*

Propagating environment : The results of the experiment on propagating environment with silkoroi root cuttings are shown in Table 1. Analysis of variance showed that there was no significant difference between propagating environment on percentage of successful cutting, but total number of suckers originated showed significant differences between the four propagating environments.

Table 1. Effect of propagating environment on the success of silkoroi *(Albizia procera)* root cuttings.

Propagating environment	Cuttings inserted	% of success	Total suckers originated
Sawdust-sand medium (partial shade)	25	80	11.6^{a}
Sawdust-sand medium (sunlight)	25	76	9.6^{ab}
15 cm x 10 cm polybags filled with sand medium placed in sawdust-sand bed (sunlight)	25	52	7.0^{bc}
Gravel medium (open mist bench)	25	72	6.0^{bc}

Cutting inserted in sawdust and sand medium (partial shade) produced significantly higher number of suckers than the cuttings inserted in 15cm x 10 cm polybags (sunlight) and gravel medium (open mist bed) but there was no difference with cuttings inserted in sawdust and sand medium (sunlight).

Lohakath *(Xylia kerrii)*

Age of the donor plant : Results of the experiment on suckering in root cuttings collected from three years old transplants, six years old trees and mature trees are presented in Table 2. Analysis of variance showed that there were significant differences between age of the source plant in both percentage of successful cuttings and total number of suckers originated. Cuttings collected from three years old transplants produced significantly higher successful cuttings and total number of suckers than the cuttings collected from mature trees and cuttings collected from six years old trees.

Table 2. Effect of age of source plant on suckering of lohakath *(Xylia kerrii)* root cuttings.

Age of donor plant	Cuttings inserted	% of success	Total suckers originated
Three years old transplants	25	72^{a}	7.4^{a}
Six years old plants	25	56^{b}	4.6^{b}
Mature trees	25	44^{bc}	3.2^{bc}

Cutting length and diameter : Results of propagating from root cuttings of different length and diameter are shown in Table 3.

Table 3. Effect of length and diameter on the success of lohakath *(Xylia kerrii)* root cuttings.

Cutting diameter / Cutting length	Cuttings inserted in each group	% of success				Total suckers originated			
		4-5 mm	5.1-10 mm	10.1-15 mm	Mean mm	4-5 mm	5.1-10 mm	10.1-15 mm	Mean mm
5 cm	20	15	25	30	23.30	1.00	1.25	2.25	1.50
10 cm	20	25	65	70	53.33	2.00	5.75	6.75	4.83
15 cm	20	25	65	80	56.67	1.25	5.75	7.00	4.66
Mean		21.7	51.7	60.0	44.50	1.42	4.25	5.33	3.66

Analysis of variance showed that there were significant differences in percentage of successful cutting and total number of suckers originated between cuttings of different length. Cuttings of different diameter also showed significant difference in percentage of successful cuttings and total number of suckers originated. Interactions of length x diameter in percentage of successful cutting and total number of suckers originated were also significant.

Sal *(Shorea robusta)*

Insertion method : All root cuttings died without any regeneration of sucker and roots.

DISCUSSION

It is necessary to maintain root cuttings in a protected environment if regeneration is to be successful. The selection of a suitable medium for insertion of cuttings and control of light, temperature and humidity conditions are essential. The result of the experiment on propagating environment with silkoroi root cuttings showed no significant differences in success rate but there were significant differences in the total number of suckers developed (Table 1). Williams *et. al* (1957) suggested that the medium is less important than the moisture content of the medium, but emphasized that excess water in the medium is always harmful. Probably, sawdust-sand medium showed better performance providing better aeration and optimum moisture content than sand medium and gravel medium in the mist bench. In sawdust-sand medium and sand medium root cuttings developed highly branched and flexible root systems but root cuttings inserted in gravel medium produced numerous brittle roots. Rooted cuttings with brittle roots are sometimes difficult to transplant from rooting beds, because brittle roots often break during lifting or planting. Hence, a highly branched and flexible root system of the propagules is desirable (Copes 1977). For the mass production of root cuttings sawdust-sand medium should be used, because the materials are readily available, low cost and give commercially acceptable levels of success rate. Cuttings inserted in sawdust-sand medium with partial shade and direct sunlight showed no differences in success indicating that root cuttings can withstand considerable loss of moisture stress without any harm.

Age of the stock plant from which lohakath root cuttings were collected appears to have an important influence on their success rate and number of sucker production (Table 2). Total number of suckers produced were significantly higher in cuttings taken from three years old

transplants than in cuttings taken from mature trees. From practical stand point, the age of the stock plant from which the cuttings are taken for propagation is important for two reasons : Firstly it affects the success rate and secondly because it is possible to obtain greater numbers of root cuttings from older, larger plants (Garner and Hatcher 1958). Although a better selection of trees can be made from an older stand (Teunissen and Voorheeve 1973) selection method for clonal planting in this species is less effective as root cuttings taken from mature trees regenerate less successfully than those taken from young trees (Garner and Hatcher 1958).

The Righer success rate and more suckers were obtained by using longer and thicker root cuttings of lohakath (Table 3). Many authors tried to explain regeneration capacity in terms of reserve carbohydrate levels of cutting material (Robinson and Schwabe 1977b; Hartmann and Kester 1983) and it is possible that longer and thicker cuttings contain more carbohydrate than small and thin ones, resulting in the production of more numerous suckers and higher success rate. The present study also indicates that regenerative capacity depend on both length and diameter of root cuttings, but none of the factors alone increase regenerative capacity (Fig. 1). Fig. 1 shows that when a thin (4-5 mm) but longer (10 cm, 15 cm) cuttings or thick (10.1-15 mm or 5.1-10 mm) but small (5 cm) cuttings were used poor regenerative capacity was observed. A sharp increase in success rate and sucker production was observed when thicker (5.1-10 mm) and longer (10 cm) cuttings were used, but further increase of diameter (10.1-15 mm) or length (15 cm) of such cuttings did not response very much.

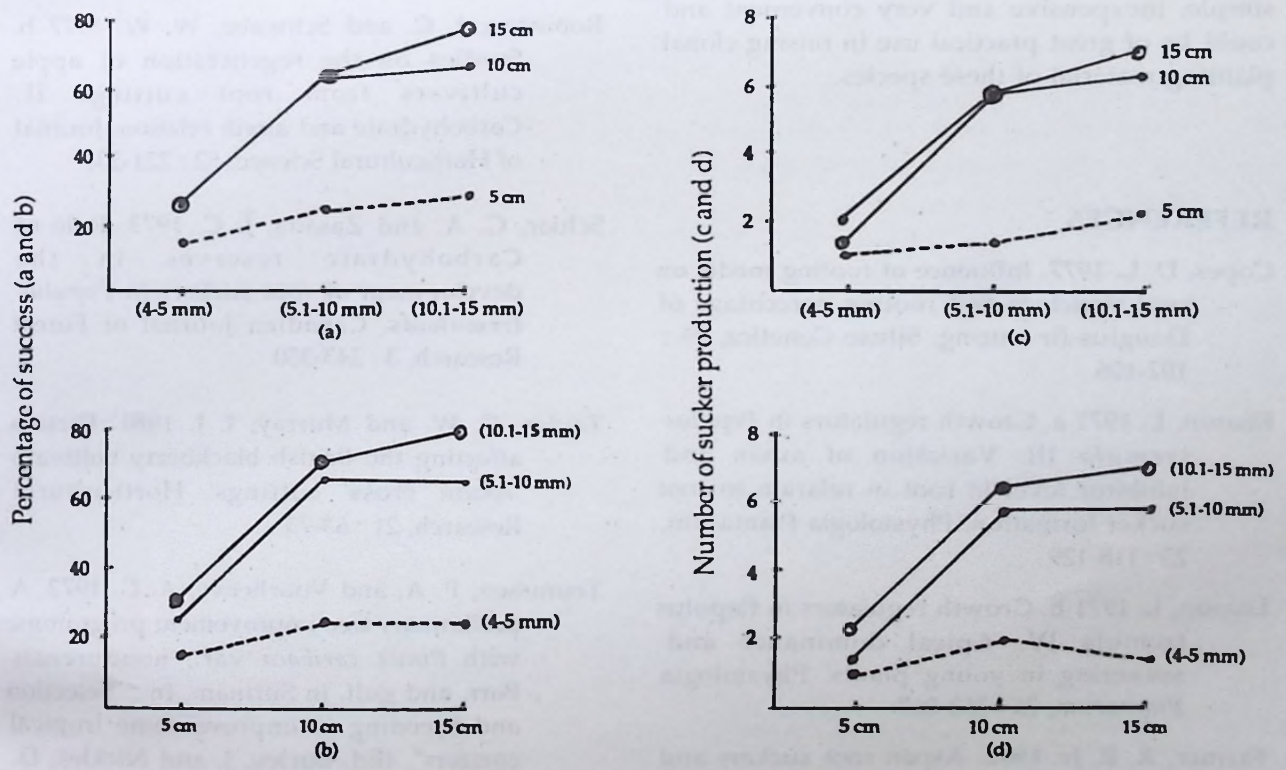

Fig. 1. Relationship between root cutting length and diameter on success rate (a) and (b) and sucker production (c) and (d) of lohakath (Xylia kerrii)

The failure of regeneration of sal from root cuttings is not clear. But the cuttings inserted remain alive for more than two months which indicates that some physiological factors or age of the source plants may be involved for failure of regeneration.

Since silkoroi and lohakath root cuttings produce both shoots and roots they can be used directly as planting material of selected clones. If this is to be done, shorter (5 cm) and thin (5 mm) root cuttings should be used to obtain maximum number of new plants from limited number of roots. It would also be possible to use thicker and longer cuttings, which produce more than one suckers in the first flush; some of the larger suckers could be rooted separately, leaving only one on the root cuttings which could then be used directly as planting stock. The method used in the present investigation for the propagation from root cuttings of silkoroi and lohakath is simple, inexpensive and very convenient and could be of great practical use in raising clonal planting material of these species.

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