FACTORS INFLUENCING SUCCESSFUL PROPAGATION OF YOUNG TAMARACK STEM CUTTINGS

A.J. Pottinger and E.K. Morgenstern
Graduate Student and Professor, Faculty of Forestry
University of New Brunswick, Fredericton, N.B., Canada

ABSTRACT. Experiments were conducted over three years to investigate factors that influence rooting and development of stem cuttings of tamarack (*Larix laricina* [Du Roi] K. Koch). These factors included age of ortet (3-10 years), cutting date (from early spring to late summer), cutting position (upper or lower crown), greenhouse irrigation system, and overwintering environment (shade hall or greenhouse).

Greatest success was achieved by taking cuttings from the lower crown of ortets no older than six years of age, either around the time of bud break or in mid-summer when the shoots were showing signs of lignification at the base. Propagation was most successful in an enclosed chamber under an automatic mist irrigation system. The possibility of overwintering the stock outside in their first winter in order to reduce greenhouse costs requires further investigation.

INTRODUCTION

Tamarack or eastern larch (*Larix laricina* [Du Roi] K. Koch), although not previously utilized on a large scale, shows great potential as a plantation crop when grown in short rotations (Puttock, 1983; Rauter and Graham, 1983; Vallee, 1983). It combines rapid juvenile growth with moderately high wood density and fairly good fibre characteristics (Balatinecz, 1983). If the species is to be grown on a large scale and to be improved by selection, methods of propagation must be well developed.

The conventional approach of mass propagation by seed is not as simple with tamarack as with other commercial conifers. Although tamarack begins to flower when four or five years old, the cones are small and open immediately after maturity so that ripe cones must be collected within a few days. Cone and seed insects also reduce seed crops, and often the germinative capacity of seeds is low (Armson, 1983).

In view of these difficulties, experiments with stem cuttings were begun in 1981. This is the second report on a series of experiments (Morgenstern et al., 1984).

OBJECTIVES

The objectives of the study were:

1. To investigate the influence of various selected factors on propagation and development of young tamarack stem cuttings.

2. To prepare a set of simple guidelines for the propagation of young tamarack by stem cuttings which could be easily incorporated into a tree improvement and production program.

The factors chosen for investigation were those considered to have greatest influence on the propagation process. These were:

a) age of ortet
b) cutting date
c) crown position
d) propagation environment
e) overwintering environment

METHODS

The general method employed throughout the various experiments was to take cuttings of about 6-8 cm in length at specified dates in the spring and early summer. From 30 to 50 clones were sampled, and cuttings (ramets) of these were arranged in 5-tree plots in 2 or 3 replications in completely randomized experiments. The cuttings were struck in a rooting medium of 2:1 peat and vermiculite in 330 cm3 - styroblock containers placed in a greenhouse for rooting. The 1981 experiment explored the roles of ortet age and cutting date (season), the 1982 experiment was concerned with crown position and rooting environment, and the 1983 experiment again with cutting date. Following rooting, the cuttings were overwintered outside or in a greenhouse, transplanted in a nursery for one year, and then established in a field experiment.

Assessments were made in the greenhouse three months after striking, at the end of the nursery period, and after one year in the field.

RESULTS

1. Age of ortet

It is well established that the ability to propagate trees vegetatively is related to their age. Generally, the more juvenile the ortet the easier it is to propagate (Bonga, 1982; Libby et al., 1972; Mott, 1977; Rauter, 1982; Roulund, 1981). In other coniferous species it has been found that ten years may be the upper age limit of ortets, beyond which high rooting percentages cannot be achieved (Girouard, 1974; Zsuffa, 1974). With this in mind, cuttings were taken from ortets that were three to ten years old, in two-year age classes.

Results from the rooting assessment indicated that the rooting percentages of cuttings taken from the younger age classes (3-4 and 5-6 years) were higher than those from the older ortets (7-8 and 9-10 years) (Morgenstern et al., 1984). The nursery assessment revealed that the greatest height growth had been achieved by cuttings of the younger age classes. No significant differences in the degree of plagiotropism exhibited by the different age classes were recorded, all following a fairly orthotropic growth pattern. Measurements taken following one year in the field trial showed a significantly greater mean height of cuttings taken from ortets of six years of age and younger than of the cuttings from the older ortets. Detailed figures are given in Table 1.

Table 1. Effects of ortet age on rooting and growth after one year in the nursery and one year in the field based on the experiment initiated in 1981.[1]

Character	Ortet age class (years)				Mean	Significance level
	3-4	5-6	7-8	9-10		
Rooting (%)	69	67	54	47	59	1%
Total height in nursery (cm)	21.3	22.8	19.5	19.3	20.7	-
Total height in field (cm)	38	39	32	33	36	5%

[1] Based on F-tests in the analysis of variance.

Results from the third (1983) experiment, which sampled ortets 3, 4, 5, and 6 years old, again showed that the rooting percentages of the youngest trees were significantly higher (Table 2).

2. Cutting date

Four cutting dates were initially investigated (23 May, 3 July, 22 July and 14 August). The 22 July cuttings exhibited the highest rooting percentages and the greatest height growth in the nursery (Table 3). Successes have been obtained with other <u>Larix</u> species by taking cuttings around mid-summer when lignification is just beginning at the base of the cutting (Calvert and Rauter, 1979; Wunder, 1974). Unfortunately, taking cuttings at this time can lead to difficulties in overwintering. As they will not be mature enough to be overwintered outside, expensive greenhouse space must be made available. In order to investigate the possibility of avoiding this added cost, the 1983 experiment investigated the earlier cutting dates of 3 May, just after the buds had burst, and 19 May, when the new needles were about 1 cm long. The objective was to produce stock which would be mature enough to be overwintered outside in its first winter. It has been demonstrated with other conifers that the time of bud burst is a stage in the trees' annual development cycle when cuttings will root well (Rauter, 1982). Results indicated that although the 3 May cuttings rooted better than those taken on 19 May, the difference was not significant. This may be a reflection of the similarity of the trees' physiological states at these times.

Table 2. Effect of ortet age on rooting, based on the experiment initiated in 1983.

Character	Ortet age (years)				Mean	Significance Level
	3	4	5	6		
Rooting (%)[1/]	51	50	21	25	39	1%

[1/]Based on F-tests in the analysis of variance.

Table 3. Effects of cutting date on rooting and early growth, based on the experiment initiated in 1981.

Character	Cutting date				Mean
	23 May	3 July	22 July	14 August	
Rooting (%)	48	65	77	48	59
Total height in nursery (cm)	20.2	22.6	23.3	16.8	20.7

3. Crown position

In order to investigate the influence on rooting and development of the region on the ortet from where the cutting originated, cuttings were taken from the upper and lower crown of six-year old ortets in 1982.

In general, the closer a shoot apical meristem is to the base of a tree, the more juvenile it is (Bonga, 1982; Olesen, 1978). This gradation in juvenility is manifested in cuttings from lower branches rooting more easily than those from the upper crown.

The 68 percent rooting success of cuttings taken from the lower crown (Table 4) was not significantly higher than the 60 percent obtained from the upper crown. Furthermore, height growth and degree of plagiotropism measured after one year in the nursery failed to reveal a significant difference between cutting positions. However, there were significant clonal differences for these characters.

Table 4. Effect of crown position on rooting in the greenhouse and on other characters after one year in the nursery.[1/]

Character	Crown Position	
	Lower	Upper
Rooting (%)	68	60
Survival (%)	39	30
Height (cm)	19.7	19.3
Plagiotropic score[2/]	1.33	1.26

[1/] Differences were not significant at the 5% level.

[2/] A score of 1 indicates vertical while 3 corresponds to horizontal growth.

4. Propagation environment

In order for cuttings to root successfully, a relative humidity of between 70 and 100 percent must be maintained during the rooting period (Boeijink, 1974; Lepisto, 1977; Kleinschmit, 1974). Automatic misting systems are commonly employed to achieve this.

Three different environments were created. In Environment 1 the cuttings were placed on open benches and irrigated with mist from nozzels controlled by an electronic leaf sensor. Environment 2 incorporated an automatic mist system, based on moisture build-up between electrodes, within an enclosed chamber of transparent plastic. In Environment 3 cuttings were watered daily by hand while corrugated cell packs kept moist by trickle irrigation maintained a high humidity. The system was enclosed in a chamber similar to Environment 2.

The value of 97 percent rooting obtained in Environment 2 was significantly higher than for either Environment 3 or Environment 1, which produced 80 and 75 percent rooting respectively.

5. Overwintering environment

As the objective of taking cuttings in early May was to investigate their survival when overwintered outside, half of the cuttings were placed outside in a shade hall while the other half remained in an unheated greenhouse in the fall and were moved into cold storage at 2-3° C during the winter. Unfortunately, heavy mouse damage inflicted on the cuttings overwintered outside rendered the survival assessment inconclusive.

CLONAL SELECTION

Analysis of variance recorded significant levels of clonal variation throughout the various experiments. This indicates the importance of clonal selection. In order to investigate the possibility of selecting ortets on the basis of certain phenotypic traits, measurements of ortet height, length of leading shoot, number of cones, number of sylleptic shoots, and an ocular vigour rating were taken for the of six-year-old ortets sampled in 1982. Cuttings taken from the ortets were assessed for rooting, shoot growth and condition, number of roots longer than 3 cm, length of the longest root, and height growth and level of plagiotropism in the nursery. Correlation analysis between ortet and cutting characteristics revealed very few significant correlations. This suggests that the ortet characteristics assessed may not be indicative of the performance of the cuttings they produce, and, as such, can not be used as selection criteria.

RECOMMENDATIONS

The three years of study have revealed that successful vegetative propagation of tamarack can be obtained with relatively simple methods and equipment. Although precise guidelines for a propagation program cannot be recommended until further work on the possibility of overwintering the stock outside is completed, some preliminary suggestions can be made. These include taking cuttings from trees preferably less than six years old, either around the time of bud break or in mid-summer, and propagating them under an automatic misting system within an enclosed chamber. Special greenhouses which are designed for rooting and have effective means of temperature and humidity control would facilitate the work.

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