VEGETATIVE PROPAGATION OF BIRCH

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ABSTRACT

All methods of vegetative propagation can be applied to birches. Both summer and winter cuttings will root but the winter cuttings take longer. Hormones are useful in stimulating rooting. In addition, birch can be rooted by layering. Virtually all methods of grafting can be applied to the birches. Following grafting suitable scions will flower quickly and produce large quantities of fruit.

INTRODUCTION

Birch (*Betula* spp.) is a fast-growing, pioneer woody plant with considerable genetic variability. Many forms with valuable wood (curly birch, flamy birch, etc.) are regenerated by vegetative propagation and these techniques are also used for seed orchard and tree bank production. The vegetative reproduction of birch is rather difficult, and thus research into propagation techniques is important.

Apart from the vegetative propagation of decorative birch forms practised by horticulturists, the period during which birch has been propagated vegetatively is comparatively short. Some of the earliest literature reports were from Larsen (1940), and Meurman and Pohjanheimo (1940), who worked on vegetative propagation of the curly birch (Karelian birch, Wisakoivu, Braunmaserbirke). After the Second World War more papers on birch propagation were published, especially in the Soviet Union (Kalnins and Berzins, 1950; Avotin-Pavlov and Bander, 1952, Tomsone, 1955), but also in Austria (Wettstein-Wasterheim, 1952), Germany (Klaehn, 1954), Sweden (Persson, 1954) and other countries. Most of these papers were concerned with valuable wood forms, mainly curly birch.

Birch can be propagated by stem or branch cuttings, root cuttings, grafting (budding and approach graft), and finally layering; summer and winter cuttings, grafting and budding are mostly used. A range of chemicals, substrates and environments has been used, and cuttings have been taken at different times of year. Grafting is done in the greenhouse or the field by the side veneer method, with top cleft grafting and inlay grafting also being common. Grafts from young or old parent trees are equally successful. Budding is usually done outside in summer.

In this paper I shall review the different vegetative propagation methods used with birch and provide some examples of each.

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TECHNIQUES

(1) *Cuttings*

a) Summer (softwood) cuttings

Most workers with softwood cuttings have made extensive use of rooting chemicals: Kalnins and Kundzins (1957), for example, used two kinds of growth-stimulating agents: the most successful was an aqueous solution of 50 ppm heteroauxin with added Knop's solution, 2% sugar, 5 ppm thiamine and 0.5% glycerol. The cuttings (taken at the end of June from 8-year-old curly birches) were immersed in the solution for 18 hours, and then planted in a greenhouse with an air temperature of 18-25°C. Rooting was 80%, first taking place in 55 days. Replacing the heteroauxin by a 100 ppm aqueous solution of indole-acetic acid (IAA) reduced the rooting to 32%. In subsequent work these solutions have been slightly modified.

Bander (1964) used a lanolin paste containing 20,000 ppm α-naphthalene acetic acid (NAA) for every graft, or 20,000 ppm IAA, 15,000 ppm indole-butyric acid (IBA) and 15,000 ppm 2,4-dichlorphenoxy-acetic acid (2, 4-D) in lanolin. In aqueous solutions he reduced the concentrations to 50 to 400 ppm for 24-48 hours. He recommended intensive irrigation and fertilizing during the rooting period together with an adequate application of hormones during irrigation.

Lepistö (1970) in his studies used the hormones Floramon (NAA) and Rhizopon (IBA). Cuttings were placed in a plastic-covered greenhouse in a 1 : 1 mixture of peat and sand, with a soil temperature always above 10°C. The average percentage of rooting was 33%, varying somewhat with the time of setting (between March and July).

b) Winter (hardwood) cuttings

Winter stem cuttings usually require a longer time to root than summer ones, with cuttings from trees older than 3 years often taking more than two years to root.

Pre-severance treatments are useful: Bander (1964) pre-treated parent trees by strangulation (with copper wires) and etiolation of the shoots (shielding them from the light with paper), in each case 3-4 weeks after opening of the first leaves. The cuttings were subsequently planted horizontally, obliquely and vertically.

The rooting compounds reported in the previous section may be used on winter cuttings as well. Lignified cuttings after a pre-severance treatment and soaking in a rooting solution with NAA and IBA may root up to 80% in the second year after setting. The highest activity in rooting was observed at the end of July and the beginning of August.

Winter cuttings may be used especially when propagating curly birch, as traces of the original curls can be seen on the older lignified sprouts. A very successful method is to plant the cutting in plastic tubes. Root cuttings taken in winter have not been very successful.

(2) *Layering and Inarching*

When the pre-severance treatments mentioned in the previous section are used, rooted cuttings can be obtained directly on the tree as well, if the shoot is packed into soil substrate or bent down to the ground and partly covered with soil.

These methods may be applied under field conditions, even if the temperature is not very favourable. The procedure is recommended for curly birches with long branches by

Sokolov (1950). In Germany experience with layering has also been good (Scholz, 1960). The soil around the birches has been cultivated in a square 1.5 × 1.5 m. The sprouts were carefully layered into 10-cm-deep furrows so that only 10-20 cm of their upper parts were showing. Layering has been tried both with softwood (1 year) and hardwood (2 years) shoots, which were fastened with wire clamps and covered with a 3-cm-thick layer of soil. After rooting, the rooted parts of the sprouts are cut off and planted into a frame. With soft sprouts roots develop after 3-4 weeks (Scholz, 1960), with on the average 3-11 sprouts rooting from each tree. It is also possible to cut off the main stem at the age of 5-6 years and to layer the sprouts which develop from it. After rooting these sprouts too are cut off and planted in frames.

(3) *Grafting*

Birches can be grafted by a number of different methods, both in the field and the greenhouse, and on young and old stocks.

In field grafting the usual combination is a sprouting stock and dormant scion of two-year-old wood. The graft union grows together after 2-3 weeks. The veneer side bottle grafting method, in which the lower part of the graft is put into a suitable vessel of water, has been used a great deal. This method, which is in reality a form of inarching, was used by Wettstein-Wasterheim (1952) and Persson (1954). Subsequently Bander (1964) used the technique. He compared the veneer side bottle method with root grafting and with the Burmistrov method. With this latter technique grafting is done onto 3 to 5-year-old lifted stock at the end of February or beginning of March either by cleft grafting or inlay grafting. The plants are then placed into wet conifer sawdust and after snow melt they are planted out. With veneer grafting Bander got a successful take of 78%, with root grafting 81% and with the method of Burmistrov 87%.

An important component of birch grafting experiments is the production of curly birch grafted plants for the formation of seed orchards. In Sweden a seed orchard was established with 23 grafted plants using the veneer side bottle graft method (Persson 1954), and in both parts of Germany curly birches have been grafted (Klaehn, 1954; Scholz, 1960). Curly birches are also propagated with grafts in the Soviet Union. Jermakov (1970) used cleft and veneer side grafting on 4-5-year-old wilding stock and got a success of 60% with the best clone (26% average). In a greenhouse, however, he obtained 52% average success and several clones showed 100% success. May-June grafting was most successful.

Ljubavskaja (1969) summarises her numerous experiments with curly birch grafting into the following conclusions: (i) the best grafting method is the side veneer one, on low strong *Betula pubescens* stock. After grafting the cut is treated by plasticine and wrapped with PVC. *B. verrucosa* stock can also be used. (ii) success is best with scions having a thickness > 4 mm, a length 4-5 cm bearing 3-4 buds. The root-stock should be 4-5 years old with a stem diameter of 3-5 cm. (iii) success depends on the grafting time and on prior storage of the scions which must be dormant. The best grafting period was in February, but summer grafting is recommended if air temperatures of 15 or 16°C occur for a period of 3 weeks or more. In curly birch grafts the texture of the scion wood is not transmitted to the stock.

In the Forestry Science Institute at Prague experiments with curly birch grafting began in 1962 and were continued in 1966 and 1967. On January 18th-19th, 1962, we

grafted in a greenhouse 28 curly birch grafts onto 2-year-old stock by the side veneer grafting method (Václav, 1963). Of these, 26 grafts were successful and 24 were put out in an experimental plot (See Table 1). The grafts were taken from a plus-tree growing in the Beskydy Mountains in central Czechoslovakia. On February 9th, 1966, 578 curly birch were grafted similarly. These scions partly came from the seed orchard, established

TABLE 1—Height, flowering intensity and number of harvested strobiles on grafts of curly birch plants in the years 1964 and 1965. (Grafting was in January 1962).

Grafted plant no.	Height (cm) 1963	Height (cm) 1964	Number of strobiles 1964 Counted (22.5)	1964 Harvested	1965 Counted (2.5)	1965 Harvested
1	80	195				
2	50	135			3	—
3	50	159	3	1	2	—
4	50	135	2		3	2
5	50	138	1		2	—
6	140	162	13	5	9	3
7	120	199	19	10	21	8
8	120	205			41	16
9	100	179	79	42	62	23
10	100	178			8	3
11	90	168			12	6
12	50	145	2	1	3	1
13	100	173	2		2	2
14	140	155	3		13	9
15	120	195	17	9	48	28
16	50	130	19	11	2	—
17	80	152	1		9	4
18	140	200			3	2
19	70	155			2	—
20	100	180			3	—
21	100	144	4	1	17	8
22	100	153	4	3	33	30
23	100	120	2	2	4	—
24	100	153			80	49
(Means) and totals	(91.2)	(163.5)	171	85	382	194
Number of female flowering trees	1	15			22	
Number of female fruit-bearing trees	1	10			16	
Number of male flowering trees	15	22			22	

in 1962, and partly from individuals with outstanding curl, growing in an experimental plot, planted in 1957. As a result, 358 grafted plants were planted in 1968, forming a second seed orchard. The third grafting, in February 1967, consisted of 180 curly birch grafted plants, which in 1971 were planted out in an experimental plot. These grafts also were taken from the 1957 experimental plot.

In the first seed orchard (grafted in 1962) we studied the flowering behaviour in the first years after grafting, and the results are presented in Table 1. From this table it can be seen that the flowering of grafted plants increased quickly and was comparatively early; two years after grafting 40% of the trees had flowered and by the third year the figure was 66%. The height increment of the plants was rapid, with three-year-old trees reaching a mean height of 163.5 cm. This growth rate was not maintained, and at 9 years of age the average height was 271 cm, with the grafted trees having ideal spherical shaped crowns with abnormally rich flower crops.

CONCLUSION

From results in several different European countries—Czechoslovakia, the Soviet Union, Finland, Sweden, Austria, and East and West Germany—it can be seen that most methods of vegetative propagation are possible for birch in reproduction of the more valuable birch forms. The most suitable method for seed orchard establishment is grafting: it is easily carried out, particularly in greenhouses, and can be universally recommended.

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