

has been in print since the early 1800's on the vegetative propagation of beech and of linden.

Dr. Creech presented his paper entitled: "A Review of Vegetative Propagation of Beech and Linden." (Applause).

## A REVIEW OF VEGETATIVE PROPAGATION OF BEECH AND LINDEN

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Beech and linden are among the deciduous shade trees that generally are propagated from seed. At least in the case of beech, vegetative propagation is very difficult while linden falls into that category of plants for which layering, a practice only occasionally used in this country, can be substituted for seedage. A review of some of the literature pertaining to the vegetative propagation of these two trees has been suggested as an appropriate subject to present to the 4th Annual Meeting of the Plant Propagators Society. Most of the observations were made by European nurserymen and we find that discussions of beech propagation appeared frequently in such periodicals as the *Garden's Chronicle of England*, and *Moller's Deutche Gartner-Zeitung*, a German publication. Because some of our earlier colleagues were aware of techniques that may not have been passed down, a discussion of observations made by horticulturists during the past century is worth our consideration.

*Beech* — In 1889, the *Wiener Illustrierte Garten-Zeitung* (4) listed 55 varieties of the European beech. Eleven years later, Bean (6) described only 21 distinct varieties which he classified on the basis of (1) tree habit, (2) leaf form, and (3) leaf color. Wyman (22), regarded as our current authority on recommended varieties of ornamental plants, lists only 8 clones of the European beech worthy of cultivation.

While the main reason for this reduction in the number of clones is due to the discarding of duplicate and inferior varieties, some of the disappearances undoubtedly were brought about by the difficulty encountered in vegetative propagation. This problem is emphasized by the fact that in the trade papers of the past 100 years only rarely are methods other than grafting encountered. Rooting of beech cuttings has not been practical although Doran (10) stated that when summer cuttings were treated with indoleacetic acid (200 mg./l., 24 hrs.) 50% rooted in 37 days, in a sand-peat medium.

Only two instances of beech layering were noted. Temple (20) observed that natural layering of the low branches of *Fagus sylvatica* occurred in Kew and Eckstein (11) reported that young beech trees could be saved following mice-girdling by mounding leaf-mold over the damaged area.

The preponderance of literature on beech propagation relates to grafting. As early as 1844, the *Gardener's Chronicle* (1) answered a correspondent by advising that one-year scion wood generally failed but that two-year scions would unite with certainty. In an 1857 visit to the French nursery of M. Cochet, M. Pepin (17) was impressed with the results secured by

approach-grafting. At this establishment, grafting by other than this method was never employed due to the difficulties encountered.

Here in United States, the Gardener's Monthly (2) reported on beech propagation in 1869. At the nursery of Dingee and Conard, West Grove, Pennsylvania, great success was obtained with the blood-leaved beech by whip-grafting in the greenhouse in winter, setting the grafted plants out the following spring. Parsons (16), writing in the Rural New Yorker in 1881, stated that budding of beech was entirely out of the question but that bark-grafting was entirely successful in the open in April, provided that the scions were made of one-year wood, attached to a portion of two-year wood.

Approach-grafting was used in German nurseries around 1890 and Friedlander (12) described his method. Seedlings were planted around the mother plant in the early fall, with grafting carried on the following March or April. In the same issue of Moller's, Demuth (8) also reported on approach-grafting. He used potted seedlings which were plunged around the variety in early spring and grafted in May. Using a technique familiar to many of us today, he nicked the scion branch below the union one month after grafting and in two more months cut the scion branch entirely free. In order to align the varietal branch properly, it was staked to the ground and then bent up parallel to the seedling stock.

In 1895, Alfred Rehder (18) and two colleagues presented a discussion on beech propagation. Grafting under glass was the most successful method and more stress was placed on the selection of grafting-wood than on the kind of graft. Two-year wood made the best scions but in some instances, one-year wood with short internodes was suitable. Thin one-year wood with long internodes invariably failed. Whip-grafting and bark-grafting were the preferred techniques. Grafting was on potted stocks, as soon as they became active. It was essential that the grafts be placed in a warm, humid location and syringed daily. The following May, the successful grafts were set out in the cold-frame.

The Gardener's Chronicle of 1896 (3) suggested a method that was certain to succeed. Grafting was done in the field in early spring, using whip-grafts. These were made as close to the ground as possible and two-year scion wood was used. Immediately after the grafts were tied, the soil was mounded up over the union to prevent drying out of the graft.

Winter-grafting was again suggested in 1898 by Trobchen (21). Stocks were potted in the fall and brought into the greenhouse about 3 weeks before leafing out. As soon as the old leaves adhering to the seedlings fell at the slightest touch was regarded as the proper time to graft. Whip-grafting and cleft-grafting were used, depending on the size of the scion wood. Again we find that two-year scions with short, one-year side twigs were selected. The grafts were kept in the greenhouse until they had hardened off in late summer.

In the same issue of Moller's, Muller (15) described a similar method but recommended that the stocks stand in pots an entire summer before they were adequate for grafting. Greenhouse grafting gave the best results and although outdoor grafting was difficult, it succeeded if done at the proper time. Stocks should be 5 cm. in circumference and solidly rooted in the nursery, having been set out the previous spring. Scions were cut in Febru-

ary and stored until late March or early April, at which time bark-grafting was used. Scions should be made of two-year wood with short internodes and should have three or four buds.

Kache (13), in 1929, recommended quite similar methods as did his predecessors. He used the greenhouse method on slightly active, potted stocks and applied whip-grafting and cleft-grafting. Two-year shoots made the best scions, cut just prior to the time that they were needed. While earlier writers were usually optimistic over their results, Kache reported that success varied from 20 to 50% depending on the variety.

Sheat (19), author of our best modern propagation manual, recommends approach grafting on stocks planted around the varietal tree 18 months in advance. Grafting is carried on in the spring just before the leaves unfold. Waxing the union is advised and staking is essential to secure maximum rigidity. The scion is cut free the following autumn. Grafting under glass is also described. Potted stocks are used similarly to what has already been described. However, for scion wood, Sheat recommends clean-growing terminal shoots, 8-14 inches long. The grafts are placed on their sides in a heated propagating case and syringed occasionally. Union is completed in five weeks at which time the case is gradually aired. Undoubtedly the close control over environmental conditions has permitted the use of 1-year scions in place of the customary 2-year wood. For spring grafting in the nursery, the scions are of 2-year wood, grafted close to the ground as possible to avoid the ugly union that results from top-working.

*Linden* - Lindens are generally raised from seed even though germination is slow and uneven. Vegetative propagation is used mostly in European nurseries and both layering and grafting have been tried.

Loudon (14) says that the linden is seldom propagated other than by layering, putting down the branches in the autumn and removing the rooted plants after one year. Mound blocks are started by cutting off an old tree in the nursery close to the ground, and a quantity of vigorous shoots are soon sent up. Among these, the nurseryman throws a quantity of peat soil in which rooting takes place. In 1902, the *Gardener's Chronicle* (5) reported that the D. Thomas Nursery, of Wimbledon, layered about 3500 lindens every year by this method.

Summer grafting of linden was described by Muller (15). Three, and 4-year seedlings of finger-size were grafted in August as soon as the varietal wood had ceased to grow. The seedlings were worked about 10-15 cm. above the ground by bark-grafting, using scions 12-18 cm. long. The leaf blades were removed at once, leaving a piece of each petiole. As ties, strips of paper smeared with wax were used. Rarely did a bud break during that same year and after the shoots developed the following spring, they were staked. Stocks were not cut back until later in the season. *Tilia platyphyllos*, secured from French nurseries, was the best stock.

Budding was preferred by Trobchen (21), who also worked the various species onto *T. platyphyllos* in August. He observed that when *T. ulmi-folia* (*T. cordata*) was used, the scion often overgrew the stock. We find that Kache (13) also commented on this point, stating that nurserymen first used *T. platyphyllos* for stock, switched to *T. cordata*, and then reverted to *T. platyphyllos*. Sheat (19), however, recommends that *T. vulgaris* (*T. cur-*

*opaea*) be used and that the stocks should be produced by layering. As far as he is concerned, grafting should be used only to supplement layering. It is interesting to note that in 1874, a Belgian nurseryman, Burvenich (7) found that grafting *T. argentea* (*T. tomentosa*) onto common linden (*T. vulgaris*) was unsatisfactory in that the scion overgrew the stock to form a disagreeable "bourrelet" (ridge).

Two supplemental notes on budding of linden are those by Parsons (16), in the *Rural New Yorker*, and Desportes (9), a Frenchman. There is agreement to the effect that the proper time for budding lindens and similar difficult shade trees is when one can no longer lift the bark without tearing it. This is because of the fact that at the height of the growing season, the buds are likely to be "drowned out". By delaying budding until the bark has tightened up, one is most likely to succeed.

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MODERATOR CREECH: I think what we should do next is to hear from Mr. Crawford of the Willis Nursery Company, Ottawa, Kansas, on his method of propagating the Buisman elm and, after that, I would like to discuss my own observations on root cuttings and on air layering Mr. Crawford.

MR. HAROLD CRAWFORD (Willis Nursery Company, Ottawa, Kansas) presented his paper, entitled: "The Propagation of the Buisman Elm." (Applause).

## THE PROPAGATION OF THE BUISMAN ELM

HAROLD CRAWFORD

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Members of the Propagators Society and visitors: I don't have a lot of scientific information to give you this afternoon in regard to percentages and data of that kind. What I can give here this afternoon is merely our own personal experience in the propagation of this tree.

As you know, the Buisman elm, and I am referring to the same thing sometimes called the Boisman elm, was introduced from Europe, I think in the early twenties. It was used there as a tree resistant to the Dutch elm and they later discovered it is also resistant to phloem necrosis.

The only way that we can propagate this tree and maintain the resistant qualities is, of course, vegetatively. There are several ways that have been tried with more or less success, such as budding, grafting, top cuttings, hardwood cuttings, and root cuttings. Our own experience has been confined principally to that of root cuttings and softwood cuttings in the greenhouse.

We have been very unsuccessful in taking the wood cuttings from plants in the field, and therefore, we have had to resort primarily to the use of root stocks.

After we get our root cuttings established, we have been quite successful in propagating from softwood shoots developing from these roots.