things that you should not do while looking for things that you should try to apply to your own buisness."

I am sure that you will all agree with me that Carl Orndorff deserves to receive this Award.

Thursday Morning, December 11, 1980

The Thursday morning session convened at 8:15 a.m. with John Havis serving as moderator.

Editor's Note William Snyder moderated a group of short presentations on the propagation of certain woody plants The papers by William Flemer, E.A Dixon, Robert C Simpson, Timothy Brotzman, and Edward H Losely were part of that session.

LINDEN PROPAGATION — A REVIEW

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Because of their tolerance of city conditions, ease of transplanting, reasonably rapid growth, and fragrant flowers, lindens (*Tilia* spp.) continue to be among the most popular shade trees. There is a wealth of published data on linden propagation, so this short paper will be merely a review of the methods used.

SEED PROPAGATION

All *Tilia* species can be propagated from seed, which is the source of understock for budding, but is not usually used for specimen trees because *Tilia* seedlings vary so greatly. *Tilia* seed is usually considered to be "double-dormant", with a combination of a hard seed coat and a dormant embryo requiring cold treatment. The common procedure is to collect seed after it ripens in the fall, mix it with damp sand, put the seed mix in a box and bury it in a stratification bed out-of-doors in the winter. The boxes of seed are dug up the following fall, the seed is sieved out of the sand and sown in beds. The seed is best sown in shallow rows in the beds and covered with sand to aid in seedling emergence. The emerging seedlings are very delicate and subject to sun scald, so lath screens or shade netting over the seed beds greatly improves seedling stands.

An alternative method of seed treatment is to remove the hard pericarp by scarification or sulfuric acid treatment, as soon as the seed is collected in the fall. Then the seeds are sown

immediately. Good stands of *Tilia cordata, T. platyphyllos,* and *T. tomentosa* are normal, but *T. americana* seed exhibits great variation in germination from year to year, for no very clear reason. When poor stands occur, it pays to dig the one-year seedlings by hand, carefully, leaving most of the bed undisturbed. Often there will be better germination occuring the second spring.

VEGETATIVE PROPAGATION

Very few shade trees vary so greatly in shape, leaf size, and growth rate as do the lindens. It is not unusual to see seedlings of the same age varying from 5 to 6 feet tall to 12 to 14 feet in the same nursery row. Therefore, at a very early date in Europe, and later in the U.S.A., nurserymen began to propagate the best trees vegetatively, thus greatly increasing ther utility and the demand for lindens.

LAYERING

This ancient method is still employed on a small scale in Boskoop, Holland. "Mound layering" is the preferred method, the mother plants being cut back to the crown each year and the bases of the new shoots being covered with a low mound of soil when they are 6 to 10 inches high. The soil is carefully dug away and the rooted shoots are cut off with shears early the next spring before growth starts. The shoots are usually so lightly rooted that they are cut back and bedded for a year to build a sufficiently large enough root system for out-planting in the field. Layering involves too much hand work, especially weeding the layered plants, to be practical on a large scale. It also works best in the cool summers and abundant sub-soil moisture of Boskoop and is much less effective in the hot, dry summer weather so common in the U.S.A

CUTTING PROPAGATION

In general, linden stem cuttings do not root readily in mist beds, and they are very prone to drop their leaves, after which they will not root. *Tilia cordata* clones are the most likely to propagate by stem cuttings but results with these also vary greatly from year to year. Some clones root more readily than others. Best results (but by no means invariably good stands) seem to occur with 6 inch, pencil-size cuttings made in early July, treated with Hormodin No. 2 powders or by IBA quick dip, and stuck in a very porous medium under intermittent mist. Bottom heat seems to increase rooting percentages and speed of rooting. The cuttings are best over-wintered in the rooting flats, under cold but not freezing storage conditions. The cuttings grow slowly after planting, and should be cut back the following winter and

trained to a single stem. Some trees, like *Platanus* species have better root systems if grown from cuttings rather than from seed. Others, such as *Malus* species, *Sophora japonica*, and *Picea pungens* produce very poor, sparse root systems from cuttings. Lindens are quite prone to wind-throw in wet weather when grown from seed or grafted on seedlings, and cutting-grown plants are even more so. It is probable that bedding-out rooted cuttings for one year and then carefully trimming the roots before transplanting them to the field will be a necessary practice.

GRAFTING PROPAGATION

Although lindens can be easily budded, they are very slow and difficult to propagate by bench grafting. Even when the stands are acceptable, the young grafts grow very slowly and take, at best, two years longer to reach saleable size (6 to 8 feet) than do budded trees. Stands are much better if dormant scions are grafted in February or March on seedlings previously established in pots, but the initial growth in the field of such young grafts is slow and, of course, their root system leaves much to be desired. This method does have value for increasing stock of new cultivars because much smaller twigs can be pot grafted than will serve for bud sticks. Linden species, like maples, are very exacting as to which scion-understock combinations will succeed, and which will not. Successful combinations are listed under the next section on budding lindens.

PROPAGATION BY BUDDING

Lindens are among the easier trees to bud successfully and are comparable to apples or pears in bud stands. Unlike red and silver maples or pin oaks, incompatibility is extremely rare if the proper understock-scion combinations are used. If improper combinations are attempted, the bud stands look excellent through the first winter but subsequent growth the first summer after cutting back the understock shows the trouble immediately.

Budding is by the normal process, making a T-shaped incision and dewooding the buds prior to insertion. Best stands occur in the East by budding onto vigorously growing understocks about August 15th. Earlier budding can be unsuccessful on very vigorous understocks because the seedling bark may heal over and bury the bud. Later budding can be a problem because reduced sap flow can make the understocks or bud sticks refuse to peel. If the bud sticks will not peel but the understocks will, "flat" or unpeeled buds are almost as successful as peeled or dewooded buds. Several English growers use chip budding for lindens, but in the U.S.A., stands using this method have never been as good as by "T" budding. The rubbers should be cut 2 or

3 weeks after budding. If they are not cut, they will rapidly be overgrown by the expanding seedling bark and late wind storms will snap off the seedlings. Understocks are normally cut back in January or February and the buds sprout the following late April. Linden seedlings, especially those of *Tilia cordata*, sucker abundantly form the base, and the young budded trees should be suckered several times during the first summer after cutting back. Final bud stands are greatly enhanced by inserting an inexpensive 3 or 4 foot light bamboo cane into the ground beside the understock and tying the scion sprout to it in several places to prevent blow-off in thunderstorm gusts. Also, tying to a stake or using Frank Schmidt's "Grow Straight" irons will produce far superior trees because linden buds tend to grow out horizontally for a few inches before bending up, thus causing an unsightly bow in the trunk.

As noted earlier, scion-rootstock compatibility between linden species is critical. Thus, *Tilia cordata* will grow on *T. cordata* or *T. vulgaris* (*T. x europaea*) understocks and vice versa. *Tilia x euchlora* will grow on *T. cordata*, *T. platyphyllos*, or *T. americana*. *Tilia americana*, *T. platyphyllos*, *T.x euchlora 'Redmont'*, *T. tomentosa*, and *T. petiolaris* will all grow on seedlings of *T americana*, *T. platyphyllos*, and *T. tomentosa*. Curiously enough, although *T. cordata* and *T. platyphyllos* will hybridize (thus producing *T.x vulgaris* or *T. x europaea*), neither will grow on the other as an understock.

PROPAGATION OF CERTAIN *CHAMAECYPARIS* CULTIVARS AND OF *ACER JAPONICUM* 'ACONITIFOLIUM'

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In general, all Chamaecyparis cuttings were stem cuttings stuck in sand with a bottom heat of 70 to 75°F. Air temperature was maintained generally at 55 to 65°F but reached 80°F on sunny days. Cuttings were kept under intermittent mist 12 seconds every 6 minutes controlled by a photo-electric switch set so that a misting occured only when cuttings were subject to direct sunlight. All cuttings were taken after the first hard frost; that is, in November and December in Pennsylvania.

Chamaecyparis obtusa 'Nana Gracilis'. Cuttings were taken from tips of terminal or lateral stems and were approximately 10 cm long. As this cultivar has a tendency to revert to the species, care must be taken to insure that no cuttings are taken from