Crop Cycle. Depending on the time of the year the microcuttings are produced, the production cycle varies from 9 to 18 months.

Shipment. Liners are available to ship from September through mid-May. Small orders or orders from outside our general 1000-mile delivery range are shipped UPS, while larger amounts are usually delivered by our shelved, refrigerated, and air-ride semi trailers.

We are applying the same basic system of rooting microcuttings to lilacs and other species where profitable. Most of these microcuttings are being purchased from commercial labs.

SUMMARY

In summary, tissue culture has become an integral part of our production scheme. It has allowed us to quickly introduce new cultivars requiring asexual reproduction into the market place at a profit and maintain our niche in the production of quality liners.

Two Ways to Crack the Nut — *Aesculus parviflora*

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INTRODUCTION

Aesculus parviflora, bottlebrush buckeye, is a native shrub that grows 8 to 10 ft tall and 8 to 12 ft wide. While being native to much of the southeastern U.S.A., it is hardy in much of the eastern United States as far north as Zone 4. Panicles of large white flowers, 6 to 12 inches long are carried in profusion above the foliage in midsummer (in the mid Atlantic states usually in early to mid July). The plant prefers a moist well drained soil, but will adapt to lesser conditions. As this past summer has shown it is very drought tolerant once established. *Aesculus parviflora* grows well in full sun or shade.

Plants in the landscape are pest free and appear to be highly resistant to deer browsing.

Because of all these attributes the demand for *A. parviflora* has been huge, but there is a problem, the supply has not been able to keep up with the demand.

In a presentation, given to this group in Philadelphia in 1994, Dick Bir talked about "Why Some Natives Aren't Mainstream...Yet". He talked about the need for the plant to have market appeal and to be marketable; it must also be possible to produce the plant profitably. How many of us grow plants we like that are not really profitable.

Interestingly, he discussed *Fothergilla* as a native that was not widely known and had the reputation for being difficult to propagate. He also stated that in the near future, *Fothergilla* would be better known and more widely available. Guess what? Five years later *Fothergilla* is now listed in most container nurseries catalogs and considered a staple production item at many nurseries. The propagation problems once associated with the plant have been overcome with the selection of easier-to-root cultivars such as *F.* 'Mount Airy'.

Those who listened to Dick Bir in 1994 and got *Fothergilla* into production have been well rewarded.

We have not been so lucky with *A. parviflora*, 5 years later we still have a shortage of plants and no easy-to-root cultivars, despite the fact we have a plant with market appeal and one that is easily marketable.

Why is this still a problem? In a word, propagation has been the problem.

For a number of years I have been propagating and growing *A. parviflora* and have watched with interest the work Bill Barnes and Dick Bir have carried out with timing and hormone trials. I have also followed the methods used and discussed by the *Aesculus* King, Phil King of Greenwood Propagation.

We have not solved all the problems, but we are finally producing larger quantities of liners by attacking the problem from two directions.

SEED AND CUTTING PROPAGATION

Both these methods have problems and limitations. However, by establishing stock plants at the nursery and searching for established plantings in public and private gardens, we now have a reasonable source for seed and cutting collections. I am still amazed how many large plants exist in older private gardens. A few years ago we let our landscape customers know that we were looking for plantings of *A. parviflora* and ended up being told of a number of local gardens that had large plants; we now collect seed from them. I also found a large plant growing on the side of a recently established rail trail, a biking and walking trail established along a site of a former railroad track. You never know when you are going to find the plant so you need to keep your eyes open.

Seed Production. *Aesculus parviflora* is not known for producing large quantities of seed on a regular basis. Various suggestions have been offered for the irregular seed set, it is generally believed that cross pollination and a long and warm growing season is needed for viable seed production. Various kinds of butterflies, bees, bumblebees, and wasps all appear to help pollinate the flowers. We have tried to track the seed production levels of a number of plants and have not found any consistent pattern to seed production. This year the seed set is better than average, we had a hot and very dry summer so that may have helped. But we have had good seed production in cooler and wetter summers. What is confusing is that one plant can have a heavy seed set and the plant next to it has a poor seed set.

This is one seed that can fool you if you are unaware of how to handle it. It takes knowledge, speed , and awareness to collect the seed on time and beat the forces that are working against you.

The seed is usually ready for collection in late September. The fruits are loosely attached to the old flower stalk and drop to the ground easily once the seed ripens. Timing your collection is critical because if the seed is allowed to drop to the ground it can be eaten by mice or carried away by squirrels. The seed has a very short period of viability so if not collected and processed quickly it can dry out.

Treatment of Seeds. Once collected the seed needs to be sown immediately, as the radicle will emerge within a few days of collecting. In a few weeks the food reserve in the cotyledons are exhausted by the rapid development of the large, carrot-like root system.

We place the seed in a bag of slightly damp peat moss and perlite, and check the seed daily, as soon as the radicle starts to show we sow the seed. We take this extra

step as it guarantees that the radicle is straight and pointing down when planted; if the seed is sown prior to the radicle showing a curled root could occur. We sow the seed in flats or crates filled with regular potting compost and place them in a cool greenhouse. We like to use a mesh-bottom flat so that the root will air prune when it reaches the bottom of the flat and will, therefore, not produce a long taproot.

The most critical thing at this stage is to protect the seed from mice. If the seed is not protected in some way the mice will eat all the seed within a few weeks. We cover the seed flats with wire mesh. Protecting the seed cannot be understated; it's amazing the speed at which the mice move in.

Once sown the radicle grows rapidly and becomes well established. It is critical not to over water this crop as the seed and root can rot very easily. Once the radicle is established, it is not unusual for a shoot of about ½ inch to grow, this usually then goes dormant.

We overwinter the plants in a frost-free environment to provide the seedling with a stress-free winter. In early spring we remove the seedlings from the flat and pot them into a 3-inch pot. At this point they are just a short thick root and a very short stem. The potted seedlings are then kept in a warm house until fully rooted in about 4 weeks.

The problems associated with seedling production are not over yet. Anywhere from 10% to 20% of the seedlings can be albino. At first everyone is interested in these unusual looking plants, but without chlorophyll the plants cannot survive for very long and slowly die. It is generally considered that inbreeding causes this problem. The large plants of *A. parivflora* spread by sucker growth and the clump is usually one clone.

Interestingly, I have not seen as large a percentage of albino seedlings with *A. parviflora* f. *serotina* (a later-flowering form).

THE OTHER WAY TO CRACK THE NUT

Cuttings. In the late 1970s research (Dirr and Burd, 1997) indicated that rooting of softwood cuttings had great potential. In 1976, 80% rooting was obtained using 1000 ppm IBA in an alcohol quick dip, but in 1997, this same treatment produced no rooting while a 5000 ppm IBA quick dip produced 60% rooting. These differences were attributed to the rapid maturation of the cutting wood. In 1994 Dick Bir and Bill Barnes carried out extensive trials to try and overcome the problemof when and how to treat cuttings of *A. parviflora*.

Their results were presented to the Southern Region of I.P.P.S. in 1994. We took their work and put it into a commercial situation.

Their results indicated that seasonal timing is very important and that rooting was best within the first 6 weeks after bud break. They also found that auxins were not essential for rooting, but significantly enhanced rooting percentages.

We have been planting stock plants for a number of years so it has become easier to collect larger quantities of cuttings. We used to try to have it both ways, take cuttings and leave enough flowering shoots to provide us with hopefully some seed. Having improved the percentage take on our cuttings, we don't gamble with seed on nursery-grown stock plants. The sources we have located in private gardens provide us with most of our seed while the field-grown stock plants provide us with our cuttings.

The key to rooting *A. parviflora* from cuttings is juvenility, timing, and adequate stock plants — sounds familiar. Since our stock plants are all young and are cut back each year we are only collecting juvenile wood. With older clumps collecting the sucker growth will also provide suitable wood. As much by accident than by design we now collect cuttings from sucker growth that has grown up from a number of trees we dug and sold a few years ago.

Since timing is critical we watch for bud break, which is usually about 1 April in our area. This means we aim to collect cuttings around 15 May – 6 weeks after bud break.

At about Week 4 we start to check the wood to see how it is developing and at about Week 6 the wood is usually ready to collect.

We cut the wood early in the morning and process the cuttings immediately. The cuttings are made using clippers, the cutting is usually a two-node cutting with a cut made below the lower node and one pair of leaves left at the upper node.

The leaf area is reduced by 65% to 70%. If the internodes are very long we will make a single-node cutting. We grade cuttings by size so that large cuttings are stuck together and small cuttings are stuck together.

Prepared cuttings are given a quick dip of 2500 ppm of KIBA, stuck in 3-inch pots filled with a mixture Scotts 510 mix and perlite (1 : 1, v/v). The cuttings are placed in a mist house and a high level of humidity is maintained for the first 2 weeks. Within a couple of weeks you will be able to tell if the cuttings are going to root, defoliate, or rot. After about 4 to 5 weeks the cuttings are wellenough rooted to leave the mist house and be hardened off and fertilized. We normally get a good flush of growth during the summer months on each cutting.

We have tried higher rates of KIBA and obtained lower rooting percentages. In fact for many other plants that we were experiencing inconsistent rooting percentages, we lowered the KIBA rate and greatly improved rooting percentages.

The rooting percentages for *A. parviflora* are usually in the 80% range, except for this year when they dropped to 60% due to the extreme summer heat. Two days after we stuck the cuttings this year the temperature went to over 90°F and stayed there for a couple of weeks, the cuttings did not enjoy it.

Each year we evaluate what we did and how it worked, in the hope of improving the crop the following year. If it had not been for the research work that Dick Bir and company did a few years ago we would still be guessing when to take the cuttings and wondering why we failed.

LITERATURE CITED

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FRIDAY GENERAL SESSION QUESTION BOX

PAUL READ: Question for Tom Pinney. I am interest in knowing about your birch tissue culture. What is your plant material, timing, etc.? Also do you do recycling?

TOM PINNEY: I would be more comfortable having Ron Amos answer that question.

RON AMOS: It is all shoot-tip culture from plants forced in the greenhouse. After harvest a certain number are utilized for new cultures. The basal shoot mass is not recycled as we are afraid of what might happen.

BILL BARNES: Tom Pinney described putting the explants in a growth chamber, can you describe that chamber for us?

TOM PINNEY: We constructed a shelf and put lights on it with the ballasts outside. We then drape it with plastic. The containers are covered for humidity control.

TIM WOOD: Question for Bob Geneve. Does a different model have to be developed for each species?

BOB GENEVE: Yes. There is, however, basically one parameter that would have to be established for each species. You have to establish canopy resistance which is the resistance of water leaving the leaf. We are looking to see if we can do that on a more global scale. For example, one category might be low canopy resistance and the other could be high.

TIM WOOD: Question for Brad Rowe. I know that the correlation was not high, but there were differences between cultivars. Would it be possible to distinguish cultivars from each other?

BRAD ROWE: I do not think that would be reliable.