13. Genetic Source

John Kelsey - - - 2024 May - - - Rev 7

There is a renewed interest afoot for creating plantations to grow black walnut for timber, preferably veneer quality timber. Understandably, growers would like to start out with genetic material somewhat better than random wild trees. The closures of state tree nurseries, has furthered the motivation for do-it-yourself genetics. How does one go about finding outstanding genetic sources?

Some Definitions

1. "Bed Runs" are seedlings from the state tree nursery. These seedlings are the lowest cost seedlings. Unless otherwise noted, the seed source for the state tree nursery is from the easiest collection source. For black walnut the easiest picking is trees with lots of nuts on city streets, cemeteries, and parks, with no regard to timber value genetics.
2. "Select" seeds or seedlings are collected from outstanding trees compared to nearby peers subjected to the same environment. Ideally the best of many hundreds of peers.
3. "Elite" plants should be a select tree that has proven significantly superior to other select trees during progeny or clonal field trials.

The Geneticist's Folly

The spectacular black walnut tree at the left is a treasure, and embodies the far-off objective of any new planting, but is it genetically superior? Despite its current charisma, there are a couple of reasons that genetically, it may be only average.

One: The tree is very old, even for a tree. Given enough annual growth rings, many youthful defects are long buried under sound wood. Old age is nice, but most plantation planners are unwilling to wait 150 years for their paycheck.

Two: This shade intolerant black walnut did not start its long life in an established forest, or in the open, but with heavy basal shading and clear sky overhead. Such a setting can be imagined, like an even-aged start, or response to a windfall. In any case, young black walnuts will not survive deep in a forest, and they will not grow pencil straight stems out in the open. This is a spectacular tree, but given the same rare environment and great age, most black walnut trees would look the same. In other words, it is mostly the rare environmental accident that can make such a grand tree. Our experience is that only ¼ of select trees are significantly better than bed run.

Superb trees like the one on the left, more often than not, have been disappointments in clonal and progeny testing plots – indistinguishable from wild control-case trees. However, after all these fancy arguments, I doubt I could personally resist collecting a few nuts (but with low expectations).

Figure 1. Photo and ball cap are the property of James McKenna

When You Walk South, Look South

One morning a young co-worker was walking past my desk and looking at me over his right shoulder. He walked right into the partition wall. He was a philosophical character, so I gave him some deep avuncular advice: "When you walk south, look south." What does this have to do with finding outstanding black walnut trees? My point is that we are looking for genetic material that will perform well in a specific setting, so don't look somewhere else. If the planting is to be a black walnut monoculture plantation, then look for trees that have shown outstanding performance in a monoculture plantation. Don't look in the wrong direction.

Figure 2. Tom Jones' 1992 Monoculture Black Walnut Plantation in Southern Ohio

A Walnut Council Membership

The target of the search should be a large existing black walnut plantation, at least 15 years old, and not too different in climate from the intended site. How does one go about finding such a black walnut plantation? I have no reservation in recommending the Walnut Council. We meet in a different state every year and always visit black walnut plantations. Also, there are state chapters that will get you even closer to home. Besides seeing established plantations, I am still picking up gems of silviculture knowledge after 20 years. Most of the plantation land owners I know (including me) are proud of their plantings, would be delighted at your interest, welcome visitors, and would be happy to let someone collect nuts.

Company Manners

The next step is to find the outstanding tree in the plantation. Hopefully, the landowner will give a tour. The general layout needs to be understood. How many trees are there? How many in a row? Is there a row and column numbering scheme? Are they all the same age? Have you marked your best trees? Is it okay If I put blue ribbons on your best trees? Which way is South?

Measuring each tree would be ideal, but is not worth the trouble. It takes a lot of time just to cover a big plantation at walking speed. Think of this as an October campaign, not just a quickie visit. It will take at least two passes – first to identify the best trees, then go back with buckets, re-find the winners, and pick up nuts.

Figure 3. Author's 1995 Black Walnut Plantation in West Virginia

A Little Arithmetic

Let's say we want 1000 **select** seedlings. Germination is generally good (90%) if they are planted right away and protected from squirrels, so 1100 seeds are needed. For timber, nut size is meaningless. A 5-gallon bucket averages about 500 hulled black walnuts, so a little over 2 buckets of hulled nuts would be needed. Nut volume shrinks 3-to-1 when hulled, so it would take 6 or 7 buckets of in-the-hull black walnuts, or 2+ buckets hulled to furnish the 1100 seeds. Hulls or no-hulls doesn't affect to germination.

A good picky target is one **select** tree out of 200 wild trees. If the plantation has 50 trees per row, that would mean picking the one best tree from every 4 rows. Put a blue ribbon on the **select** tree and write down its coordinates. If you have a scientific bent, keep the nuts from each **select** tree separate and labeled for progeny testing. Such a collection of nuts from one tree are termed "**half siblings**" or **"half sibs"** – mama known, papa unknown.

What do you mean "Select"?

How are competing good trees evaluated, and how are close ties between trees resolved? Our long-term objective is growing veneer quality volume. Young trees form the growing core of our future dream trees. Growth rate is important, and stem quality is important. Growth rate is usually measured as diameter breast high, DBH. Stem quality can be estimated as the height of the straight vertical single trunk, which forms the skeleton of the mature tree. All the trees in a plantation are usually about the same height, but the usable length varies greatly. Crotches, major side branches, bows, crooks, and sizable bumps are show-stoppers in estimating potential veneer length. For pole-sized trees, we usually create a tree score by multiplying DBH^2 by the usable length. (For our well-trained approach, most trees can be forced to grow straight, so we go more for size than form.) Only the very best trees need to be scored, but it is not unusual to have quarrels among top trees. Enough measurement precision is needed to resolve these arguments quickly and move on. Use a pi tape to measure the DBH and have one person make all the vertical length estimates.

Aaaargh!

You can now see that such a project is a lot of work. *(It is not too bad sitting here with my knees under the keyboard next to a nice warm computer.)* Luckily there may be a shortcut available. Some established growers have done all this work and have their **select** black walnut seeds and/or seedlings for sale. One such grower is Hugh Pence from Lafayette, IN. Hugh is a long-time Walnut Council member and has spent countless hours evaluating trees in his large plantation. Of the 44,000 black walnuts planted in 1989, Hugh has selected the top 200 as "**Pence Selects**". That is 1-in-220 or about one-half percent. Hugh usually has **Pence Select** seeds for sale, but recently **Pence Select** seedlings are available from Hensler Nursery. Pence Select Walnut Trees | Hensler Nursery, Inc. (henslernurseryindiana.com)

Figure 4. The Pence Monoculture 1989 Black Walnut Plantation in Central Indiana

Such **select** sources are from seed, **not clones**, and are open pollinated, so it's "Papa unknown", i.e., "half sibs". With these half siblings, only half of their genetic content is **select**. Expect a mix of results, but on the average, a new plantation with **select** Mama genetics should be a cut above a **bed run** source.

Above it was mentioned that a plantation should be at least 15 years old to be searched for select trees. This statement assumes a monoculture planting with wide spacing. In such a setting it is the nature of young black walnut to spread out with strong side branching. Such a setting is a great genetic tester. A single stem straight tree will be a rarity. If the target site is to be a monoculture planting with wide spacing, then a monoculture planting with wide spacing is the place to look for select seed.

There is another twist to this story. Well managed black walnut plantations are thinned to final crop trees by around age 50. The ugly trees are gone and only the best remain. Of the remaining trees maybe 1 in 40 is a select mother, but the quality of pollen source has been greatly improved – better unknown papa. An example of a well-managed older planting is Bill Hammitt's age-59 planting in southern Ohio, with blue ribbons already attached. By contrast the 1935 planting on Blennerhassett Island has some beautiful trees, but the plot is unmanaged, so all the ugly trees are still there too, and are still shedding pollen.

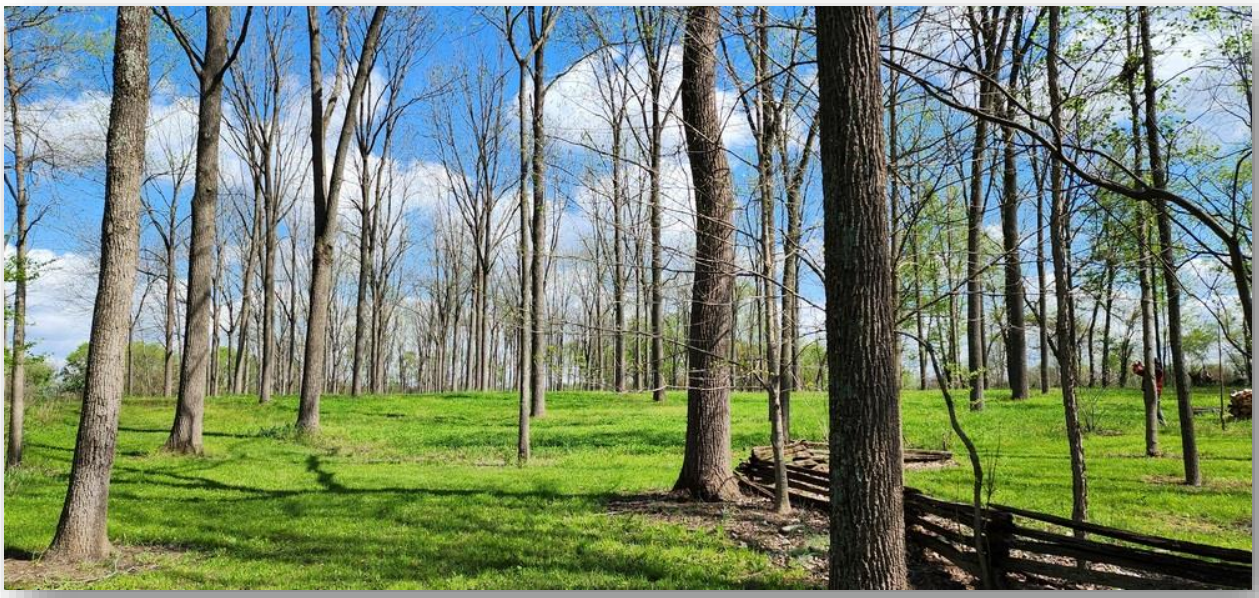

Figure 5. Bill Hammitt's well-managed black walnut planting in southern Ohio

Going Genetically Further

The next step of improvement would be a **select seed orchard** of grafted select mothers, where wild pollen is excluded. Then both halves of a seed's genetic content would be **select**. Some state tree nurseries have established seed orchards for some species, but I don't know how selective they are for the black walnut species. This is likely not a very good idea, since "select" doesn't mean superior. Three quarters of selects are average or worse, and progeny testing is easy to identify the ¼ really superior trees.

"**Elite**" is a major grade above "**select**" – maybe 1-in-1,000, rather than 1-in-200 for **select**. To become an **elite** tree, a **select** tree needs to dominate clonal and progeny tests against a field of **select** peers. Then it gets to have a name. **Select** trees should never get a name, maybe just a number for testing. Beware of trees named by backyard geneticists - maybe just a big street tree, or the best of 10. There

are some named timber-type black walnut cultivars, but the question is, do most deserve to be considered **elite**? I think not. Ask to see the data.

The Hardwood Tree Improvement and Regeneration Center (HTIRC) in West Lafayette, Indiana is obviously in the business of identifying and evaluating outstanding trees. Since full cloning (tissue culture) is impractical for multiple and questionable individuals, we are left with two evaluation methods:

1. Grafting, which is termed a "clonal trail", although only the top half of the tree (scion) is cloned. The rootstock comes from seedlings. The HTIRC has several clonal trials of their select selections underway. One such trial is on the Scot Brundage property in central Missouri.
2. Progeny testing involves planting seeds from several select mothers, in a randomized way. All the trees from a single mother are termed a "family" of half-sibs.

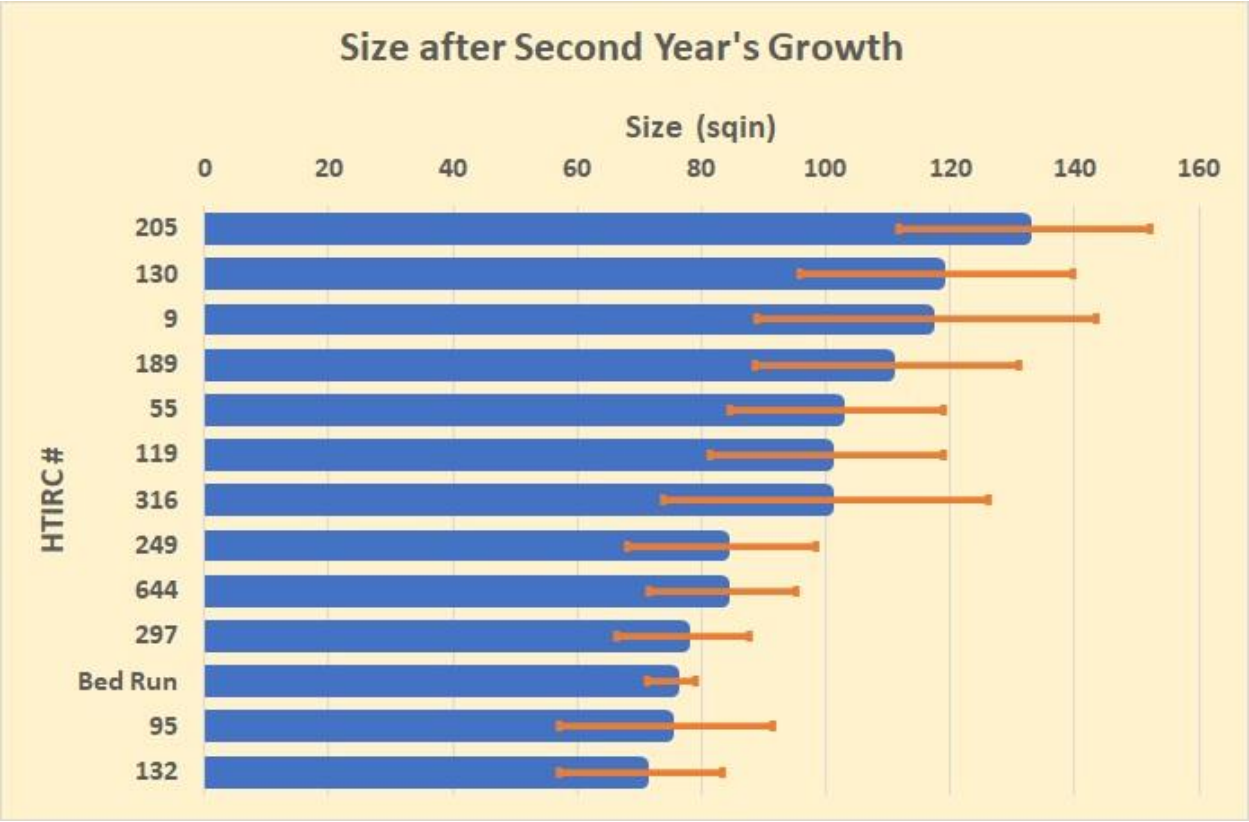

Figure 6. Preliminary results from a progeny test of HTIRC selections at Blennerhassett State Park in West Virginia. Do not be too quick to draw conclusions. If the error bars overlap, we <u>cannot</u> say one is better than the other with 95% confidence. Is early to confidently say any family is the best or any families are worse than bed-run. The differences will become clearer by age 15. "Size" is diameter times height, both in inches.

In Figure 6, notice that the error bar (margin of Error) for "bed run" is small. That is because there are lots of bed run trees, i. e., n is big. n is about 10 for each of the select families. To calculate the margin of error the square root of n is in the denominator. If n is 100, you get to divide the deviation by 10. If n = 9, you only get to divide by 3. For either clonal or progeny testing to be definitive, requires lots of

trees, 10 of each family is hardly enough, and these bars will not get tighter with tree age. N is not going to increase.

We have collected 20-year growth data from the HTIRC/Wilson clonal trial in Missouri. The analysis looks about like Figure 6. Half the HTIRC selects perform below bed run and only ¼ are significantly better.

With good grafting technique clonal testing doesn't seem difficult. Progeny testing even easier. However, it is not at all easy, and extremely rare. The whole elite testing process involves at least 8 essential steps in a span of 20 years: identification, genetic collection, propagation, organize a uniform site, planting, maintenance, data collection, and data analysis. People move, accidents happen, data gets lost. Miss one step and it's kaput. The HTIRC/Wilson Missouri test is the only one I know of to make it to completion.

So far, we have only covered the seed source, one tiny aspect of successfully starting a quality black walnut plantation. Other aspects include: layout, planting, protection, trainers, and biodiversity. Considering all these aspects at once is like riding the "Buzz-Bomb" at the county fair. It makes my head spin. If I had a second chance to start a black walnut plantation, which is unlikely, I would contract a planting expert like Jim McKenna, (mckenna3216@gmail.com), to plan and establish my plantation while I sit back with my feet up by a warm fire, a good book in my lap, and my dibble rusting away in the barn.