10.   Conifer Trainers:

Conifers in General:

Conifers	TOTAL	SHADE	SITE	GROWTH	JUGLONE	SIZE	SHAPE	SUPPLY	pH 5.5 to 8	RANGE	MARKET	COMMENT
Bald Cypress	9	1	1	1	1	1	1	1	1	1	0	
Dawn Redwood	5.5	1	1	1	0	1	1	0	0.5	0	0	
Douglas Fir	6	1	1	1	0	1	1	0.5	0.5	0	0	
Eastern Hemlock	8.5	1	1	1	1	1	1	1	0.5	1	0	
Eastern Spruce	8.5	1	1	1	1	1	1	1	0.5	1	0	
European Larch	5.5	1	1	1	0	1	1	0	0.5	0	0	
Loblolly Pine	8.5	1	1	1	1	1	1	1	0.5	1	0	
Pitch x Loblolly	8.5	1	1	1	1	1	1	1	0.5	1	0	
Red Cedar	6.5	1	1	0	1	0	1	1	0.5	1	0	too small
Scot's Pine	6.5	1	1	1	0	1	1	1	0.5	0	0	can't survive juglone
Short Leaf Pine	8.5	1	1	1	1	1	1	1	0.5	1	0	
Virginia Pine	8.5	1	1	1	1	1	1	1	0.5	1	0	
Western Cedar	6	1	1	1	0	1	1	0.5	0.5	0	0	
White Pine	8.5	1	1	1	1	1	1	1	0.5	1	0	

Table 1. A matrix showing the author's guesses of various conifers meeting the trainer criteria for a West Virginia bottomland. The first 8 criteria are essentially required. The last 2, less so.

SHADE:

Conifers in general have the dense shade we are looking for. Bald Cypress defoliates in winter, but that doesn't matter. With the shading we are looking for, the ground will be covered with needles and no weeds.

SITE:

 We are not trying to match black walnut's preferences here, just trying to find the best site/conifer pairing. Typically in a flood plain black walnut will do better than most conifer species. On upland sites conifers will outgrow walnuts resulting in a conifer forest. The difference is mostly due to conifer's preference for acidity soils.

GROWTH:

This is not a very entertaining document, so I assume if you gotten this far, you have a good black walnut site. The challenge now is to identify a conifer species that will have strong growth on the chosen site. Just average growth will not be good enough to accomplish our training goals. The chosen specie needs an annual height growth 30 inches or more to be effective.

JUGLONE:

I have an unproven theory that trees who evolved (common native range) with black are tolerant of juglone toxicity. Our Scots (European) pine succumbed. Our American hazels are okay, but our European hazels didn't survive. It would probably be smarter to Goggle "Juglone toxicity of Conifers".

SIZE:

We need trainer that can grow as big as walnuts. Giant sunflowers might work for a couple of years, but then they will not get big enough to create the tall clear black walnut stems we are after.
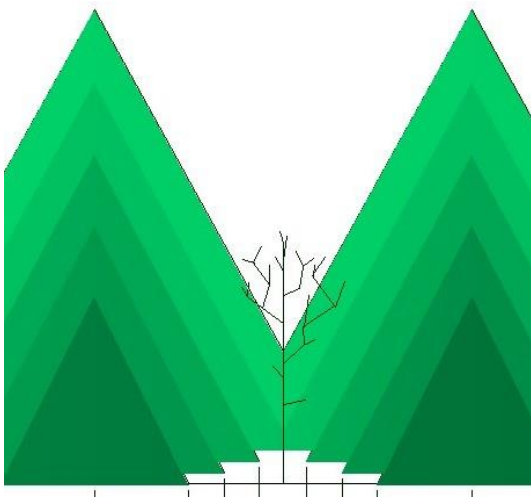
SHAPE:

Figure 1.   A cross-section diagram showing the growth of conifer trainers closing the aisle way toward young black walnuts.

Conifers have the shape we are looking for. The growth and shape diagram in Figure 1 shows the importance of the growth rate and geometry in designing trainer spacing and timing. Conifers have the pyramidal shape we want. They don't reach out and try to overtop their little neighbors.

For geometric details see Appendix A.

SUPPLY:

If crop trees are to be surrounded by trainers, it will take a lot of trainers. Retail nursery prices hover around $25 in 2022 for potted trees. Bare rooted seedlings in bulk are generally less than $1 from state tree nurseries. Start your species list by checking availabilities at the state tree nurseries of nearby states.

pH:

Common Name	Scientific Name	pH Range
Baldcypress	Taxodium distichum	4.6-7.5
Pine, Shortleaf	P. echinata	4.5-7.0
Pine, E. White	Pinus strobus	>4.0
Pine, Scots	P. sylvestris	4.5-6.0
Pine, Loblolly	P. taeda	4.5-7.0
Pine, Slash	P. elliottii	4.5-7.0
Pine, Longleaf	P. palustris	4.5-7.0
Pine, Virginia	P. virginiana	4.6-7.9
Pine, Pitch	P. rigida	3.5-4.5
Redcedar, Eastern	Juniperus virginiana	6.0-7.5

Table 2. Preferred soil pH ranges for selected softwood forest tree species

(Adapted from Burns and Honkala, 1990a and Williston and LaFayette, 1978)

Other sources note that white pine will not survive above pH 6.5. Further, our results on a 7.3 pH flood plain site are that only bald cypress and dawn redwood prospered in a plating which also included shortleaf, white, loblolly, loblolly x pitch, and virginia pines, plus eastern hemlock, douglas fir, and european larch.

RANGE:

Range is normally just a curiosity. Due to my crackpot juglone theory, my matrix entries of RANGE match my JUGLONE entries 1 to 1.

MARKET:

The Market is poor-to-nil for conifers over most of the black walnut native range. Since trainers will be removed before they get to marketable timber size, the market will likely be pulpwood. If appearance is not an issue, trainers can be killed standing and will eventually have value to the planting as humus.

White Pine Experiences:

White pine has been a great trainer in northern Indiana (Bruce Wakeland), central Ohio (Carl Young), and western West Virginia (the author). White pine may grow poorly above pH 6.0, and will not survive above pH 6.5 – ask me how I know. White pine tolerates juglone, but is looking a sick at 60 feet tall and 20 years age. It is still growing, but is no longer producing heavy shade it has had up until now. The understory weeds tell the story.

Around the year 2000 there were two presentations made at the Walnut Council annual meeting concerning conifer trainers. One was by Bruce Wakeland, who had pictures of his white pine trained black walnut plot in northern Indiana. He had never pruned the walnuts and they were beautiful.

The second presentation was by Carl Young from Yellow Springs, Ohio who had good results using white pine trainers. He said to give the white pine a 5-year head start on the walnut. The object being to shade out the lower black walnut branches while leaving clear sky overhead.

It is amazing to see how fast young black walnuts can catch up to towering white pine competition. In Figure 2, not only is the black walnut being stretched upward, its lower branches are small diameter and will soon be completely shaded. We are achieving our goal – shading out lower branches while small and the crown of the black walnut thinks it is in a fully open setting.

Another advantage of the white pine method is the wide spread and intense shade of white pines. In more open plantings we see all kinds of objectionable invasives: multiflora rose; autumn olive; oriental bittersweet; and bush honeysuckle. The white pines, however, exclude everything, including the owner. What is under a white pine is white pine needles. After about 15 years, enough lower pine branches fall off to allow walking access.

Figure 2. A black walnut seedling being challenged by white pine trainers

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To be effective, training (i.e., lower shading) needs to begin early in the black walnut's growth. The lower branches of the pines should be close-by when the black walnuts are planted. The white pines will need a head start depending on the row spacing. On good sites both species grow fast. Our experience is that the white pines grew about 2.5 feet in both height and shade diameter per year after a slow start. If white pines are planted in rows 16 feet apart, the alleyways should close up in about 7 years. The walnuts should be planted just before the alleyways close. For alternate 8 foot row spacing, a 5 year head start for the white pine is the typical recommendation. Due to the variable nature of things, it would be better to keep track of the white pine closing rate and delay the black walnut planting until the pines were a year or two from touching. There surely are other ways to accomplish this shading, but this is the way we did it, and it worked.

Figure 3. An 18-year old black walnut trained to veneer quality by white pines.   Note that the white pine shading has begun weakening and some weeds are taking advantage of the new lighting.

Figure 4.   Over-the-hill white pines Christmas trees training black walnut while author was far away, and his pruning shears were rusting in the garage.

In 2004 we had a few acres of over-the-hill white pine Christmas trees. They were 12 years old, but we had annually trimmed them to one foot of growth per year. They were about 15 feet tall on 8' x 8' spacing. Encouraged by the two Walnut Council presentations, I planted 4 black walnut seeds around the stump of each white pine that had been removed.   I was away for several years, and the plot was impenetrable anyway, so it was a very pleasant surprise to find the beautiful pencil straight walnuts 15 years later. By accident we had roughly done the delayed start as recommended by Carl Young.

More or less by accident we ended up with a plot of pine-trained black walnut. We wanted to get out of the Christmas tree business, so when we sold a Christmas tree, I planted walnut seeds around each pine stump. I'll spare you all the dreadful details of the Christmas tree business. We had two species of Christmas trees, white pine and Scot's pine. I think both species did their shading job early on, but the Scot's pines were soon poisoned by the black walnut's juglone in the soil. Both the walnuts and the white pines were 53 feet tall in 2018. Almost all the white pines are still alive. The white pines may be slowing down, because the walnuts now seem to be winning.

There are plenty of failure stories using white pine trainers. I think bad timing or bad site favoring either direction would explain the majority of the failures. There are a few success stories; one in northern Indiana, one in mid-Ohio. I've lost track of most of them. One success is Casey Calvert in south east Illinois. The Calvert white pines were planted in the early 1960's and the black walnuts were planted in 1973. White pines are usually not recommended south of 41 degrees north latitude. Luckily, the Calvert's and I didn't get the word. We are at 37.6 degrees north, and the Calvert's are at 37.9, both with healthy white pines.

Bald Cypress Experiences:

Bald cypress has been a good trainer in southern Ohio (Tom Jones), southwest Indiana (Curtis Peters), and is looking good on Blennerhassett Island in West Virginia.

Tom Jones' bald cypress was planted 5 years after the walnut, where the walnuts were poor due to wet conditions. The cypress was planted late, so not much help in training, but now at least we know that they are unaffected by juglone and provide intense shade in the summer. They have a sharper cone angle than white pine, so that would change the spacing/timing design. Tom has done a lot of thinning and pruning here, so I'm not sure what they would look like if left untouched. Tom is of the opinion that the cypress and some swamp white oaks have dried up the area, and the walnuts have been doing better.

Figure 5.   Black walnut surrounded by bald cypress. Notice the weed population – zip!

In 2021, with support from the Walnut Counsel, several local walnut enthusiasts started an experimental planting on Blennerhassett Island State Park in the Ohio River near Parkersburg, WV. The project is the topic of chapter 23. This is an outstanding black walnut site, with a site index over 100. The soil is Huntington loam with 7.3 pH. Early results show that both the black walnut crop trees and the bald cypress trainers have made amazing early growth.

Figure 6.   The author with bald cypress trainers on his right and a black walnut monoculture control block on his left. The planting is just starting its second growing season. Our experimental rule is "no pruning".

Another success story is Curt Peters in southern Indiana, who has both white pine and bald cypress training black walnut on the Ohio River flood plain.

Conclusion:

After some compression, we might simplify our requirements down to 2 ½ criteria.

1. Offered by state tree nurseries - who could afford 1000s of sacrificial trees at retail prices?
2. Capable of a matching growth rate on the chosen black walnut site soil and hardiness zone.
3. Somewhat resistant to soil juglone.

Conifers seem a better solution than hardwoods for two reasons. Their tops are pointed, leaving more canopy space for the walnut crowns. Second, conifers have denser foliage, often shading out understory weeds.

By itself, finding a compatible species is not enough. Trainers can be too far away and/or too late to stimulate vertical growth and side branch natural pruning of our black walnuts. Even with the right species, if trainers don't do these two objectives, they are useless. There is a sweat-spot which is on-time and close enough to work. It's tricky. If the trainers are too close or too early, the walnuts can't compete. Besides timing and spacing, the soil of the site can tip the scales to favor or hinder the trainer's vs. the walnut's growth rates.

Figure 6   A healthy black walnut crown surrounded by conifer trainers of equal height. (At the time of the picture the walnut foliage is sparse due to anthracnose.)

With the right species, spacing, and timing, using conifer trainers is a splendid idea. Obviously, a good black walnut site is essential. Then a compatible conifer trainer species needs to be found for the site. Step #1 is a soil test, then check candidate conifer species' native range, hardiness and compatibility with the soil test results. Drive around and look for healthy conifers on similar sites. Use the plant and soil science that others have developed, or proceed like us, planting a mix and wasting a few years slowly learning from our own mistakes.

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Appendix A:

The following is a mathematical argument for the advantage of cone shaped trainers;

Many foresters use the Crown Competition Factor, (CCF), as a guide for the timing and extent of thinning. The US Forest Service has published a clever CCF table. Based on stem diameters (D), the CCF table gives the crown area an acre of trees need to grow at unrestricted speed. I did a regression on the USFS CCF table and got a fit with crown diameter (feet) = 5 + 2 * DBH (inches) with $R^2 = 1$. R^2 is a measure of the goodness of fit. $R^2 = 1$ is a perfect fit. You never get $R^2 = 1.00$ in nature. Obviously, the CCF table was created by pure math in the opposite direction, and I had just worked the process backwards.

Anyway, to achieve full speed growth, we need to let the crown diameter ,C, expand like C = 2 * D + 5 feet. That is exactly the same as CCF = 100%, except for an individual tree, rather than an acre.

Consider the case of a 14' x 14' monoculture planting, or with equal height hardwood trainers. The crowns reach 7 feet each way (half way), so when the canopy closes the crop tree gets a 14' x 14' crown, and no more space is available without thinning.

Solving C = 2 * D + 5 for D gives:

 D = (C - 5) / 2,

 so (14 – 5) / 2 = 4.5" DBH.

So for full speed growth, 14' x 14' spaced hardwoods need to be thinned when their stem diameters reach 4.5 inches.

Now consider conifer trainers with the same spacing and height. Since the tip of a conifer is just a point, the crop black walnut tree can overtop much of the conifer foliage and reach out most of the 14 feet. Let's say that instead of reaching 7 feet each way the crop tree can reach out 10 feet each way, the D = (20 – 5)/2 = 7.5" DBH before growth starts being depressed. This is a big difference in when to start worrying about thinning, and CCF table knows nothing of this difference.

 It is our intention to do-in at least one adjacent trainer when black walnut crop tree crowns are being squeezed smaller than 2D + 5 feet. That is still a good plan, but based on actual crown measurements, not tree spacing. Thinning is the subject of chapter 20 - Pampering Crop Trees.