

Hazelnut Seedling Pot Size Trial

Lois Braun, University of Minnesota

Introduction and Rationale

Dream of Wild Health is a program for Native American youth living in the Twin Cities to teach them about growing and eating healthy food, with an emphasis on traditional native foods. The organization owns a farm near Hugo, to which it buses inner city kids for a summer-camp like experience. As a native food, hazelnuts fit into their vision. However they lacked the funding to purchase seedlings. So we decided to teach them how to grow their own seedlings, with the help of Melissa Rainville, a University of Minnesota undergraduate who worked with them as a Green Lands Blue Waters intern in the second half of the summer of 2008 (after helping Lois with the propagation research in the first half). This built on a smaller planting established in 2007 by Katie Cafruny and Whitney Olson, who were GLBW interns that year.

Melissa's project was to test whether pot size is important for seedling transplant success, and to test whether a greenhouse is necessary for growing healthy seedlings. Our hypotheses were that larger root balls enhance transplant success, but that transplant success of plants sharing root space in open pots might be compromised by the necessary disturbance of roots at transplanting. We also hypothesized that seedlings can be grown just as well outdoors as in a greenhouse.

At transplanting we used the seedlings to test the limits of the kinds of situations that hazelnut seedlings can be successfully transplanted. Because DWH is a limited-resource organization, they did not have equipment capable of tilling the sites where they wanted the hazelnuts planted, so we resorted to no-till planting. Also, because they are organic, we were limited in our use of herbicides for site preparation. So we planted directly into ground that had only been mowed, relying on landscape fabric and woodchip mulch for future weed control. These were not planting conditions that we would normally recommend, but they gave us the opportunity to see whether it is feasible to plant hazelnuts with a minimum of mechanical equipment and pesticides. The 2008 planting was thus in contrast with the 2007 planting, which was into recently tilled ground that had just been given up by the neighbor farmer who had been renting it from DWH.

Methods

Treatments: 3 pot sizes x 2 locations = 6 treatments

Half of the seeds were planted in the greenhouse at Dream of Wild Health and the other half were planted outdoors. In each location:

- 98 seeds in small 6 by 1/12 inch tubes
- 98 seeds in larger black tubes (10 by 3 inch)
- 98 seeds in 2 gallon pots, spaced as if in the large black tubes

Seed Source: The best bush or two from Gibson's farm near Montevideo Minnesota

Stratification and Germination: After harvest, seeds were dried in a 95 degree F crop drier, then stored dry until early Jan. Starting Jan. 7, they were soaked in water for three days, with daily water changes, then placed in cold storage (~34-36 °F) until May 19. On May 19, seeds were taken out of cold storage, rinsed once (mostly to remove mold), then placed in a bucket in a warm humid growth chamber (60% humidity, 25⁰ C temp, or 87°F). The first radicles started

to emerge on May 22, just two days later!! This shows that the seeds were primed and ready to go. They were planted on May 29 into a commercial potting mix (SB 500) in a 3:1 ratio with perlite, plus 5 g/L Osmocote 15-9-12+micros slow release fertilizer.

Measurements: Prior to planting, Melissa measured the stem caliper and above-ground height of every seedling and attached an identifying plant label to it, so we will be able to track its success over the years. During planting, subjective ratings were made about root quality. Our hypothesis was that bigger seedlings will survive better than smaller ones, but that root quality is even more important. Finally, on June 22, 2009 we returned and marked each plant either dead or alive. Those plants that were alive were given a health rating on a scale of 1 (poor) to 3 (excellent).

Transplanting: Surviving seedlings were transplanted to the field on August 26-28. This is approximately the same time that seedlings were transplanted at DWH in 2007, with good survival. They were transplanted to three locations with different types of previous vegetation:

- 1) a reed canarygrass meadow adjacent to a wetland (69 plants),
- 2) along the border of the neighbor's soybean field, where various weed trees were starting to get established (72 plants),
- 3) in a ring around a small wetland, on land that was planted to buckwheat in 2007, but was now a mixture of a variety of herbaceous annual weeds, dominated by mare's tail (56 plants).

All sites were mowed prior to planting (and the tree stumps treated with a systemic herbicide). Holes were dug with a shovel, and seedlings planted by hand. All were watered thoroughly after transplanting. Landscape fabric of varying quality (some new, some scrounged) was laid after planting, and all seedlings were caged to protect from predation over the winter. We plan to spread woodchips over the landscape fabric next spring.

Landscape Fabric: Three kinds of landscape fabric were used because we did not have enough money to purchase enough new material as we needed, particularly of the more expensive DeWitt fabric. We used the heaviest fabric where we believed weed pressure would be worst, such as in the reed canary grass, and also in the hedgerow, though all three planting sites were a patchwork of different kinds of fabric.

1. New woven nylon, manufactured by DeWitt and purchased from JR Johnson. The salesperson there warned me that this nylon does not allow water to permeate until it has been broken down for a year or so. So he recommended irrigation of these plants during establishment. Fortunately there were heavy rains after planting and through the fall, so we did not need to worry about this.
2. New light-weight spun fabric from Menards. This material came with a 10 year warranty, but certainly didn't seem that durable. I'm highly skeptical about its effectiveness. It came in two widths: 3 ft and 4 ft. We cut the 4 ft in half and applied it in two strips down both sides of a planting.
3. Scraps of used fabric lying around DWH. Some of these were quite good quality, but others were not. If the landscape fabric had many holes, it was doubled.

Results and Discussion

Transplant production. The seedlings in the greenhouse were outstandingly healthy, but the seedlings outdoors were heavily damaged by squirrel activity, even though we tried to protect them. The seedlings in the greenhouse were significantly taller than the ones outdoors. This may have been because the ones indoors were reaching for the light, or it may have been a positive growth response to the more sheltered conditions in the greenhouse. Conversely, the seedlings outdoors had slightly thicker stems, possibly a response to wind.

As expected, seedling size was strongly related to pot size, with the open pots producing the largest seedlings, followed by the larger tree tubes, and with the small tree tubes producing the smallest seedlings. This was true for both shoot height and stem caliper ($p < 0.0001$). Root quality was rated relative to pot size, so no comparisons of root quality between treatments can be made. However, the best root systems were observed on seedlings grown in the open pots outdoors, because high mortality in these pots meant that competition was eliminated and the survivors had access to much larger volumes of soil.

Transplant Survival and Vigor

Overall survival was 50% across all locations, seedling container and weed fabric types. Survival was 80% when the best of all of these were combined (seedlings from pots planted in the wetland, with porous weed fabric). Many of the dead plants had dead leaves, demonstrating that they had successfully overwintered and broken bud in the spring, but had succumbed a fairly short time before we evaluated them on June 22. Because it had been an exceptionally dry spring and early summer, and because the staff at DWH had failed to water them, we suspect moisture stress as the cause of death.

Transplant size and type of container: Both transplant survival and transplant health were highly correlated with shoot height and stem caliper at time of transplanting ($p < 0.0001$ for both parameters). When modeled together, shoot height was more predictive of survival than stem caliper. Root rating at transplant time was not correlated with survival, probably because it was too subjective a measure. Type of planting container also had a highly significant ($p = 0.0005$) effect on survival. Survival of seedlings from open pots was significantly higher than survival of seedlings grown in either large or small tubes, even though the roots of the seedlings from open pots were disturbed during transplanting. All of the plants that were rated “vigorous” on June 22 2009 had been grown in open pots. There was no difference in survival or plant vigor between seedlings from large and small tubes. Modeling transplant size together with planting container type demonstrated that the effect of container size was entirely due to its effect on plant size.

Weed fabric: The new nylon fabric significantly reduced survival relative to the other two types of fabric ($p = 0.0006$). Only 29% of transplants in the new nylon fabric survived, relative to 58 and 60% in the old and new mesh respectively. This was probably because it interfered with the ability of rain to filter to the plant roots, as we were warned. This problem could have been alleviated with irrigation. There was no difference in survival between the new mesh fabric and the old mesh fabric (though the new mesh fabric was not at all effective in suppressing weeds, which may affect future survival.)

Planting Location: After eliminating from the data set data from those areas where the nylon weed fabric was used, survival was highest in the wetland and the canarygrass and lowest in the hedgerow ($p < 0.005$). This is consistent with our expectations because the wetland and canarygrass areas were both lower-lying and had finer textured soil which was more likely to retain moisture, whereas the hedgerow was at the crest of the hill where the soil was lighter and more droughty. Survival was lower in the canarygrass than in the wetland, though not significantly. This was probably due to competition from vigorous reed canarygrass, though the landscape fabric was suppressing it very effectively. It will be interesting to see what survival is like in future years, as we assume that the canarygrass will eventually overcome the landscape fabric.

Conclusions

This study definitively proves what we have suspected for several years, that seedlings are best grown in larger containers. We did not expect, however, that this pattern would also include multiple seedlings grown together in open containers with intermingled root systems, which necessitate disturbing the roots for transplanting. The fact that this was successful has important implications for nursery producers, especially of bare-root dormant seedlings, as they try to keep seedling production costs affordable by growing seedlings in open seedbeds outdoors.

The study also shows that care must be used in selecting and using weed fabric. The heavy duty woven nylon weed fabric manufactured by DeWitt Company does an excellent job suppressing even tough weeds such as reed canarygrass, but, as the salespeople at J.R. Johnson warned, water that falls on top of it runs off instead of infiltrating, at least in the first year. Thus it is only recommended if growers have the time and resources to water diligently. That said, I am aware of several growers who have used it successfully (Larry Fickbaum, Dave Minar, Michael McNeil, Jeff Jensen, the SWROC). Jeff Jensen combined it with drip irrigation, which seems to be a good option. By contrast, the lightweight weed fabric available from stores such as Menards and Fleet Farm is almost worthless in situations where weeds are not completely eliminated before planting. The weeds simply push up underneath it and poke holes in it. The best compromise appears to be a heavy duty spun fabric. Unfortunately I was not able to locate it for purchase. It would help if I knew what to call it.

The final conclusion from this study is still pending, and that is whether it is possible to plant hazelnuts directly into standing vegetation with minimal pre-plant ground preparation. Although our results from the wetland are encouraging, answering that question definitively will depend on survival two or three years from now.

Postscript, July 18, 2010

In April 2010 the folks at DWH transplanted hazelnuts from the 2007 prairie planting into the gaps left by mortalities in the 2008 planting. The reasons for this were that they wanted to convert the prairie planting into garden space and that this way they would have a more complete hedge of hazelnuts. The transplants were placed into the holes in the existing landscape fabric. But because no record was kept of which plants were transplanted where, it means that further data analysis of either planting will be impossible (unless one wants to dig underneath the plants for the old and possibly illegible tags). Some observations are still worthwhile.

- 1) Because rains have been good in 2010, it looks like survival of the transplants has been very good, even in (especially in) the area with the nylon landscape fabric. This landscape fabric is even holding its own against the reed canarygrass. Where this fabric was not used the hazelnuts were almost completely smothered out by weeds. This does not contradict earlier recommendations that this fabric only be used with irrigation or if there is abundant soil moisture.
- 2) In the hedgerow area, where woody weeds were mowed and treated with trichlopyr before planting, the woody weeds are returning. Apparently we missed some. They need to be cut out.
- 3) In the "Ring around the Wetland" the planting row is barely discernable. However, a few relatively healthy hazelnuts can still be found in the weeds. It will be interesting to see whether they can ultimately emerge from this intensely competitive environment.



Seedlings in the Greenhouse



The mass of roots in an open pot.



Seedlings Outdoors (the same number of seeds were planted, but they were decimated by squirrels)



A healthy root system from an open pot, after disturbance to get it separated from the roots of other seedlings.



What the reed canarygrass looked like on planting day, a couple of days after mowing it.



Planting the "Ring around the Wetland". Note the mare's tail to the right and the wetland vegetation to the left.



What the reed canarygrass looked like three weeks later when we installed the landscape fabric—it was starting to re-grow. Note that the new woven nylon fabric used here is durable, but poses serious problems with moisture penetration.



The ring around the wetland after the landscape fabric was installed. Note that we used scraps of old fabric at the end.