ECOLOGICAL FARMERS ASSOCIATION OF ONTARIO

SOIL HEALTH
2020

RESEARCH REPORT

Assessing methods for nutrient application to prevent chlorosis in chestnuts

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IN A NUTSHELL

To prevent chlorosis in chestnuts, Derick compared broadcasting and localized application of nutrient amendments to no amendment controls. After a year of growth, he measured tree height and leaf nutrient status.

- Derick detected no difference in plant health or leaf nutrient status between the two amendment methods. Given the extra labour involved with the localized treatment, he will not broadcast any amendments moving forward.
- He detected higher leaf potassium levels in the amended trees, which is important for iron availability in the plant.

MOTIVATION

Many Ontario agriculture soils are limestone-based and neutral in pH, which presents challenges when attempting to produce economic yields of alkalinity-sensitive species like blueberry, peach and chestnut. Iron tie-up in calcareous soil leads to chlorosis and unsatisfactory growth and broadacre application of sulphur to correct the issue is expensive. For example, sulphur is upwards of $700/acre plus application costs for blueberries in Northumberland County.

In 1986, Carl Whitcomb developed a technique for solving chlorosis problems in new and established trees. This technique even solved nutritional issues for species with pH sensitivity in extremely alkaline conditions with lasting effects (i.e. pin oaks surrounded by concrete). The method involves applying small amounts of sulphur and micronutrients using a bulb planter in a circular pattern around the tree. Compared to the broadcasting method, this localized method applies less nutrients and, therefore, is less expensive.

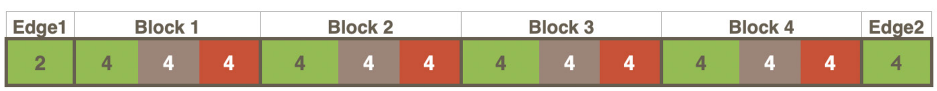

Figure 1. Diagram of Derick's randomized complete block design. He had 4 replicate blocks with 4 trees per treatment section, 2 trees in edge1 and 4 trees in edge2.

DESIGN

In 2019, Derick planted new chestnut trees, all of the same age, variety and rootstock. Before planting, he tested soil pH, which was 7.4, and regenerated the field with careful mowing and some clover seeding.

- **Control** of native soil: no amendments;
- **Broadcast** application: entire-row surface sulphur application @ 20#/1000 sq. ft, with basalt dust, sul-po-mag and boron mix applied at the same rate by weight as the sulphur;
- **Localized** application: 8-inch-deep sulphur cores with minute amounts of sul-po-mag, basalt dust and boron, arranged in a circular pattern around the plant.

Derick established a line of 54 chestnut saplings and divided them into 4 replicate blocks of 12 trees with 4 trees/treatment (4 trees x 3 treatments x 4 blocks = 48), with 6 trees remaining on the edge, as shown in **Figure 1**.

In spring 2019, Derrick planted all trees at a starting height of 45.7 cm (18”) from the soil surface and applied nutrients by broadcasting or drilling localized holes

Photo 1. Derick drilling holes for localized application of nutrients.

Photo 2. Overhead picture of Derick's localized application of nutrient amendments.

(**Photos 1-3**). He measured plant growth in spring 2020 (winter tip dieback), and again in fall 2020 along with stem diameter at ~ 2 cm from the soil surface (**Photo 4**). In July, Derick sampled "a good handful of the most recent mature leaves" and sent them to A&L Canada Laboratories Inc. for tissue analysis.

FINDINGS

With respect to plant growth, he detected no statistical difference among the treatments - neither between the two amendment methods nor between the amended plots and the control plots, as shown in **Figures 2 & 3**. Using a simple statistical model called analysis of variance (ANOVA), we found that there was a 70% chance that any difference in plant height or stem diameter that he observed was not a result of the treatments.

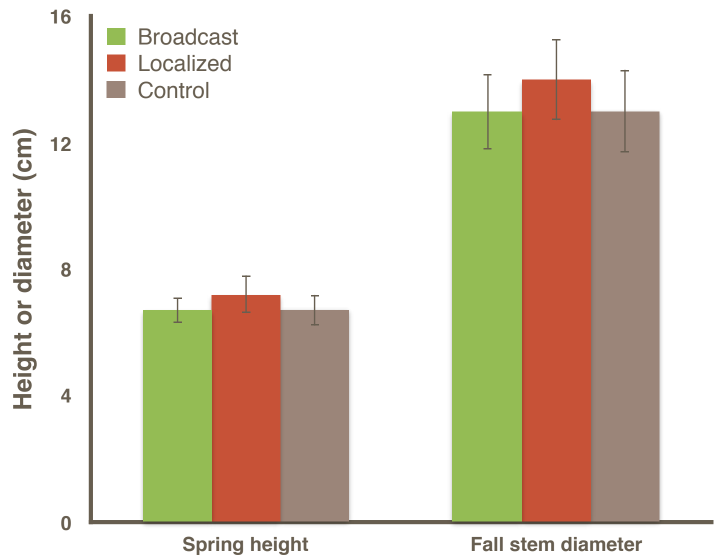

Figure 2. Spring plant height and fall stem diameter for Derick's three treatments. Bars denote means and lines denote standard error.

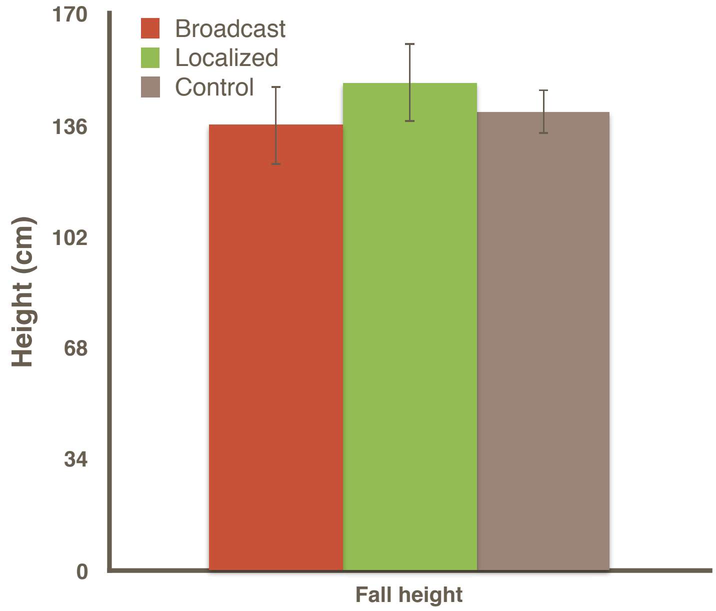

Figure 3. Fall plant height for Derick's three treatments. Bars denote means and lines denote standard error.

Table 1. Leaf nutrient status of chestnuts that Derick amended using two applications compared to unamended controls. Bold for K (potassium) denotes a statistically significant effect of amendment compared to control; **bold** and ***italics*** denotes a trend towards higher nutrient status in the amended plots. "se" = standard error.

Nutrient	N	S	P	K	Mg	Ca	Na	B	Z	Mn	Fe	Cu	Ai
Control mean	1.68	0.13	0.11	**0.11**	0.23	1.60	0.01	19.67	19.75	71.50	77.50	5.75	47.75
se	0.19	0.01	0.02	**0.02**	0.02	0.17	0.00	10.07	4.59	22.71	10.35	0.94	12.00
Broadcast mean	***2.32***	0.15	0.16	**0.16**	0.22	1.23	0.02	***24.43***	***30.25***	***101.50***	78.25	7.40	34.25
se	***0.28***	0.02	0.02	**0.02**	0.01	0.09	0.01	***2.27***	***5.38***	***33.60***	11.51	1.98	6.79
Localized mean	***2.16***	0.15	0.13	**0.13**	0.26	1.18	0.04	***30.58***	***23.75***	***376.00***	75.00	5.11	41.75
se	***0.26***	0.02	0.02	**0.02**	0.02	0.14	0.02	***3.09***	***5.51***	***252.55***	8.50	0.42	16.69

He did observe a block effect, meaning tree growth varied depending on where in the row it was planted. Trees in the middle of the row tended to be taller and have greater stem diameter.

For the nutrient status of the chestnuts, Derick found that leaf potassium (K) was statistically higher in trees amended by either broadcasting or localized application, as shown in **Table 1**. Interestingly, potassium levels are related to chlorosis since a shortage of potassium in the plant will reduce the availability of iron to the plant. While not statistically significant, he also observed a trend towards higher concentrations of N, B, Z and Mn.

TAKE HOME MESSAGE

Derick detected no difference in plant height, stem diameter or leaf nutrient content between the standard method of broadcasting nutrients to prevent chlorosis in young chestnuts compared to localized application.

NEXT STEPS

With the measured effect of the two treatment types being nearly equal, Derick thinks the additional labour involved with localized application would be better spent on an increased broadcast sulphur application. In other words, rather than adding 2-3 hours of labour per row of trees at planting (augering and filling holes), he would rather add another 110-165 pounds of sulphur to the same area with a broadcast spreader at the same cost.

Over the years, Derick will continue to observe chestnut growth in response to the three treatments he established.

Photo 3. Chestnuts at time of planting in spring 2019.

Photo 4. Chestnuts in fall 2020.

This project was funded by the Canadian Agriculture Partnership, a five-year federal-provincial-territorial initiative.