Organic Practices and Modern Growing of *Malus domestica*

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Abstract- Organic production of Malus domestica requires a comprehensive toolkit to finish a successful crop. New cultivars with low vigor face many challenges from a growth and vigor maintenance standpoint. Mixing traditional phosphate-based fertilizers proves to be the best solution for keeping the metabolic level at an acceptable rate.

I experienced many things first-hand with the orchard I planted. I learned that organic fertilizers need more time to become available to the plant, that pests and disease demand a comprehensive plan to successfully work, and that an integrative pest management is needed to manage insect pests with other organic products.

My abilities in problem solving became measurably strengthened during the past few years working on this project. Unknown factors like weather and drought impacted the project and required changes in my plans. Other factors forced me to alter the plan, like using a horticultural oil in the spring that also aided with pest and disease problems.

Lastly, I ran I to problems with the actual trees, specifically with rootstock and scion combinations. I found that I had growth problems with Honeycrisp and Geneva 969 rootstock. Moisture was historically low but when you compare with other cultivars it was still abnormally low growth. This was with organic and salt-based fertilizers. Dryness also created problems to have enough disease pressure to test correctly.

Introduction-The cultivated apple plays a large part of cultural significance of the United States and is consumed in many forms. Whether it be for the processed, juice or fresh market, there's a large market behind them. The management of Malus d. depends largely on geographic properties. Regions in the North Central and the East Coast battle high humidity and have more peat and disease concerns contrary to the west coast.

I spent two years planting the trees, maintaining them, and managing the health of the research orchard. I have learned quite a bit about managing pests and disease, expanded my plan and tools for doing that, and experienced unanticipated issues of planting during two years of serious drought. I would not be able to write about the orchard without discussing this impact.

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Pest and Disease management

Year One-2021-

- Once trees were planted, we were struck with a drought. I treated the trees with Regalia to help with plant stress every 14 days. This also helped with disease issues.
- I put my hormone treatments out at the desineted rate to prevent cottling moth reproduction. Organic and inorganic fertilizer was applied as explained in the discussion.

Year Two- 2022

- The drought lasted both years of my grant and this greatly impacted the pests and my treatment plans as well.

Materials & Methods- The project emphasized modern varieties of Honeycrisp. The cultivars used were Honeycrisp and descendants of Honeycrisp. 75 Premiar Honeycrisp, 75 Firestorm Honeycrisp and 20 Ludacrisp on Geneva 969 rootstock. The trees were planted 3 ft apart on a trellis system. The trees were fertigated with varies products noted in the discussion. Trees were netted with drape net product.

Results-

Figure I. Matt Milkovich from "The Good Fruit Grower Magazine" interviewing me about my project.

Figure II. Represented is an elevation view of the orchard.

Figure III. Trees in its second year of growth. Vertical wire attached to the leader for better growth potential.

Figure IV Represented are double leader Honeycrisp trees. Trees are grown the same but they're grafted twice.

Discussion- Once the trees were in place and on wires, the first pests arrived. Not in the form of bugs, but deer that ate the top of trees. The FFA Alumni sprang into action, helping install a solar powered electric fence. A few weeks later a neighbor reported that deer were crawling under the fence. We added another strip of electric fence lower to keep them out, and that has kept the orchard free of deer since.

Another issue I encountered was when my first spraying burned some of the trees, and I had to dial it back and spray at a different time of the day. I quickly learned how and when to spray. The Japanese beetles became overwhelming, and I bought traps at the hardware store to control them. This worked really well, filling the traps quickly and lowering the numbers to a controllable amount so that I could get my drape nets on top to keep them out.

The drought was probably the hardest thing I had to deal with. There is no running water at the orchard, so I had to buy a big water tank, and the FFA alumni filled it for me. I used a gravity hose to water the trees as often as I could. I still lost seven trees and the rest of the orchard to not grow the way I had hoped but I developed several programs for different situations.

Soil Fertigation program for new trees. Hybrid organic option.

-10 OZ of 10-8-8 every 5 gallons. @ 14-day interval.
-5 OZ of CLEAN SeaCal every 5 gallons @ 21-day interval.
(Note). If rainfall isn't consistent and are not able to irrigate, you may need to back off with fertilizer.

Supplemented foliar program for new trees. Hybrid organic option.

-Agrobest 10-8-8 every 14 days. Rotate with soil program 1.5 oz per gallon
-System Advance every 21 days. 1 OZ per gallon. (Spray by itself)

-System SeaCal at 1.5 OZ per gallon by itself. 1 OZ if mixed with Agrobest due to PH levels.

Fruit cropping program.
Before bud break apply Clean Biomax via irrigation. (As said before making sure the lines can take it as freezing can cause obvious issues. Along with this apply Clean Boron to the soil.

Rate-
Biomax @ 1 quart per acre.
Clean Boron @ 1 quart per acre.

At bud break apply Symspray and System Cal as foliar sprays. I know I stressed how you shouldn't apply foliar products this early but since it is a very low dose it is fine. Be sure to separate applications so there is not too high of a concentration. The System Cal must be applied at night like all the others. It contains Copper and can cause phototoxicity if not careful.

Rate-
Symspray @ .75 oz per gallon (agitate well)
System Cal @ 1 oz per gallon.

Balloon stage- Repeat the same cycle as before. Every 7 to 10 days through bloom.

Petal fall- Apply the same program as you did before but spray Clean- Micro mix if you want. It is not crucial as a lot of planting already has enough of these micros in the soil.

Rate- @ .75 oz per gallon.

Every 10 to 14 days after petal fall. Apply Calcium dextro-lac. After cell division is done there is no reason to spray a calcium phosphate as the cell walls of the fruit will not take up any more calcium. This will just help with the fruit firmness.

Rate-
Calcium dextro-lac @ 1.5 oz per gallon.

Pre harvest. One month out, apply CLEAN potassium to help with amylose conversion.

Rate- 1.5 oz per acre.
Follow up two weeks later.

Post-harvest- Biomax @ 1 quart per acre.

For netting of the trees, it's important to understand the trellis size. I used 8-meter (26') netting which provides 12 feet on each side of the trellis. Depending on how the netting is applied you go around it in different ways. My trellis is 12' tall which gives you extra netting under the bottom wire. The bottom should be secured with zip ties to prevent the netting from flying in the wind.

Moisture was a large problem during the past two years. We had historically low rainfall in both 2021 and 2022. This resulted in droughts in June that affected the first critical push for growth. The trees relied on the first growth period. It helps establish the root systems and recover from shock. I supplemented the moisture with irrigation. I used drip tubing and I zip tied it to the bottom wire of the trellis. Every week if we didn't get .5" of rain per week I would fill the dividend to get it up to that threshold. It ended up not being enough to get maximum growth. The Honeycrisp didn't compare with growth of the other cultivars. The other cultivars such as Triumph and Roseland Red Honeycrisp, had impressive growth. Even in a drought.

The number of insects was extremely low because of the drought. This in a normal situation would be good. It was hard to understand the complete and normal threshold of insects. It's also hard to understand what specifically is affecting the numbers of insects per species population.

It's also important to take low moisture and foliar disease considerations. Our climate is normally very wet in the summer. This high moisture aids in the disease triangle. It helps the process of building inoculate. It was hard to tell if the successes I had with low disease levels was because of my treatments or just because there's little moisture. From what I can tell with my controls it looks like the low moisture helped.

I had a big problem with Japanese beetles (Popillia japonica). I found that if you net your fruiting trees, you can keep the beetles from the fruit and foliage. It would be interesting to net the growing trees and see if there's an impact with growth. 95% of the red and blue light still can get it. My concern is constricted branches. I used Japanese beetle traps on the corner of the property. I was able to drive the beetles away from the orchard. This is a similar technique to what has been done at the orchard I work at. Instead, we have traps for Spotted wing Drosophila (Drosophila suzukii).

The planting of the 170-tree orchard, including the high-density poles and wires was a lot of work. I received help from FFA Alumni, students, and family.

I started by meeting with the schoolboard in April 2021 to get permission to plant the orchard on the agriculture plot. I didn't know that the land value was 2 million. The meeting about my orchard being planted on a small part of it opened a much larger a conversation about the use of that land and their plans for it. For the past decade FFA alumni farmers in the area rented it and farmed most of it except for the area I planned to

use. The school board discussed ideas like adding a greenhouse, creating outdoor classrooms, and making it an area that all the K-12 schools could use. I attained full support of the school board to use the land.

The trees I ordered were due to arrive in early May 2021 and the land had not been cleared yet. The FFA alumni farmers brought their equipment and helped clear the plot so that I would be able to plant. One of the farmers drove one of his big trucks to help me get the poles for the orchard. I had friends, family and FFA Alumni help me get the holes dug for the poles. Next, I had to get the wires in place before planting. All of this took happened very quickly to be ready for the tree arrival on May 4, 2021. It would have been impossible for me to have done this myself. My friends and family helped me dig the holes and plant the trees on a rainy, mucky spring day. I had no idea that a severe two-year drought was about to happen.

The first issue after planting the trees were pests in the form of deer. They found the trees before we had time to put up the electric fence. The FFA alumni helped me install a solar powered electric fence around my orchard. This worked well for a few weeks until the deer figured out how to crawl under it. We added a lower band of electric fence, and this has kept the deer out since. Unfortunately, the deer chewed off the tops of several trees.

By the time we reached July, the drought hit. There is no electricity or running water on the plot, so I needed to problem solve quickly. I bought a used water tank, moved it to the plot and an FFA alumni farmer brought a big truck over to fill the tank.I used gravity to water the trees, and it barely enough to keep them alive. The result was low growth in year one and this was a major setback.

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I overall had good success with my project despite the drought. The challenges made me a much better problem solver, and expanded my ability to grow and overcome obstacles. I am starting college in Fall 2023 at The University of Wisconsin- River Falls, the same town that the research orchard resides in. This will give me a few more years to maintain it and learn from it through when it starts producing fruit. It also gives me time to train the instructor and new generation of students on how to continue maintaining the orchard using organic practices.

Progress Photos