

# Growing Scab Free Apples Without Fungicides

## Final Report for FNE11-722

Project Type: Farmer

Funds awarded in 2011: \$6,732.00

Projected End Date: 12/31/2011

Region: Northeast

State: New York

Project Leader:

[Louis Lego, Jr.](#)

Elderberry Pond

## Project Information

### Summary:

Apple Scab is perhaps the most devastating of all disease or insect disorders impacting apple production in the Northeast. While there are many new scab fungicides including some with systemic and reach-back capabilities (can be applied post infection), none of these spray materials are permitted in organic production. In addition the cost of these fungicides is often prohibitive in conventional orchards. One of the fundamental premises of apple scab control whether organic or conventional, is that orchard floor clean-up at the end of a season can help prevent serious infection the following year. This is based on the fact that the scab fungus, (*Venturia inaequalis*) overwinters only on fallen debris.

So the question that you might ask is, What if you cleaned up ALL debris through brushing, vacuuming, applying early compost to decay remaining bits of leaf and fruit debris? Could you eliminate apple scab in the orchard and not have to spray fungicides at all? Or alternatively would there be some residues in adjacent fields or orchards that would move into your orchard and cause infections. The purpose of this project was to try an extreme cleanup in a small 2 acre orchard that was somewhat isolated from other orchards on our farm that are managed organically. This orchard was thoroughly cleaned, compost applied in spring to accelerate ground leaf decay, and early, vigorous pruning to allow air and sunshine to infiltrate the orchard (a standard organic orchard procedure). The results were very encouraging even in a very wet year with many scab infection periods. The test orchard (with no fungicide sprays) had less apple scab than the organically managed orchard where 5 sulfur sprays were applied. Comparisons were made on the same varieties (Macoun, Empire, Honeycrisp, Fuji, Red Yorking and Northern Spy).

The results were encouraging enough that we have purchased a large vacuum system to begin applying the ultra clean practices demonstrated in this project to all of our orchards. The remainder of this report details the methods used and the results obtained.

# Introduction:

## 1. Goal

The goal of this project was to determine if Apple Scab (*Venturia inaequalis*) could be controlled or even eliminated in a two acre isolated orchard by using three processes aimed at removal and/ or destruction of overwintering fungus on the orchard floor. If all or nearly all of the overwintering scab fungus could be destroyed or removed there would be no primary or secondary infections and no need for fungicide sprays during a growing season. This could result in saving the labor and material costs associated with from five to ten sprays in a given season. It would also be very good for beneficial insects including bees which can be harmed by fungicide sprays both conventional and organic (sulfur).

## 2 Farm Profile

Elderberry Pond is a 100 Acre certified organic farm. In any year we have about 35 acres of certified organic fruits, vegetables and pastures. Our mission at Elderberry Pond is to use the farm as a model of how sustainable agriculture can operate to fuel local food systems. The farm is operated by my wife and I and our son Christopher. We hire a few summer students and interns to work with us during the summer months.

We market our produce and meats through an on-farm country food store, at local farmers' markets and through a fine dining restaurant "The Restaurant at Elderberry Pond" which is located in a woodlot overlooking the farm. The farm produces a very wide variety of produce and meat to meet the needs of the store and restaurant. All of the salad greens, vegetables, potatoes, dessert fruits and many of the meats for the restaurant are grown on the farm. Apples are one of the most important crops grown on the farm. We grow about 100 varieties of apples. Because we believe orchards serve many purposes on a diversified farm our fruit trees are not planted in large single blocks, but rather are scattered around the farm in long thin plantings serving as windbreaks and as habitats for beneficial insects as well in small blocks that can be used for pastures and shade for livestock.

Because our orchards are spread around the farm, and we have summer help working it is important that we find ways to control insects and disease using as few organic spray materials as possible. With this objective in mind we have tried each year to have one on farm research grant aimed at methods to reduce or eliminate the use of sprays. We have pursued spore exclusion, unique trapping techniques, and in this case a way to reduce or eliminate overwintering disease spores. These on farm research efforts are very important to the operation of our farm and to our mission of improving and promoting sustainable agriculture practices. See figure 1.

## 3. Participants

Along with my own work on this project, my son Chris helped with orchard mowing, flaming and pruning, and our Technical Advisor, Brian Caldwell advised us on issues of scab overwintering and the vulnerability of specific cultivars.

## 4. Project Activities

The project followed our proposed approach with a few adjustments that were due to the very snowy fall and the wet spring we had in upstate New York... the wettest on record. The very wet spring was good in a sense because the disease pressure was extreme, with over 7 scab infection periods. We started the project in the beginning of April with orchard floor cleanup. We found that our large three blade mower with hi lift blades was not picking up much of the debris. This was due to the fact that the ground was soaked and the leaves were stuck together. We then tried a small "Billy Goat" we rented from Taylor Rental. This was a much smaller machine

with more suction per unit area. It worked better, but was still not doing the job. We then tried a small (20") rotary mower with an ultra- lift mulching blade and a bagger. With a blade height setting of 3 inches, this worked well, sucking everything except the earthworms from the orchard floor.

Doing the 2 acre orchard with a twenty inch mower took many hours (days), particularly since the bag filled every 10 to 12 feet. The result however was really good. Except in the very close proximity of the trees, there was almost no leaf debris remaining. See Figure 2. In the vicinity of the tree trunk we carefully flamed the remaining debris with a hand wand flamer.

Following Orchard Floor Cleanup we began pruning. The idea here was to prune the trees early and more aggressively than we normally would. The purpose of this aggressive pruning is to allow more sunlight penetration onto the well cleaned orchard floor and to permit more airflow through the orchard. This is exactly opposite to what happens in a conventional block orchard or in a high density orchard. An example of our pruning is shown in the before and after photos of Fig. 3. The final Step in the process was to spread compost on the orchard floor. We used a combination of composted cow manure (Fessenden TLC) which we put in the vicinity of the tree and pelletized chicken manure (Kreher) which we used in the rows between the trees. Both are approved for Organic production. In this system the compost serves three purposes:

1. Help to decay the remaining debris which may contain overwintering scab spores
2. Provide spring nutrients for the health of the trees
3. Provide for very rapid growth of the orchard grass early in the spring

This third advantage was one that was discovered during the project. With the grass mowed very low during the pre-growth period in the spring, and then fertilized, the spring rains in early May cause an amazing spurt in growth of the grass. I believe this rapid grass growth helps to shield the new spring growth on the trees from ascospores that may be released from the fruiting bodies of any remaining overwintering fungus. We allowed the grass to grow until the spring primary scab infection period was over.

To provide for a comparison of the results of the scab infection rate in this orchard we had a second orchard plot which we maintained using standard organic orchard maintenance (5 sulfur sprays). This second control plot had many of the same scab susceptible varieties as the test orchard including Macoun, Honeycrisp, Fuji, Empire and Northern Spy as well as inter-planted disease resistant varieties such as Pristine and Jonafree. We have traditionally mixed scab free varieties with scab susceptible varieties to decrease the overwintering infected leaves in the orchard. There is however some risk to mixing scab resistant varieties with the Vf M.Floribunda gene resistance gene with standard cultivars. The risk is that a rare mutation of the normal scab fungus could infect the resistant variety and cause the breakdown of the resistance in that cultivar.

## 5. Results

The results of the test were fairly dramatic in one of the worst scab years we have had in 20 years. We began looking for primary scab infections when the leaves were just beginning to form on the early varieties. Early in the season there were no signs of infection on any of the trees in the no spray test orchard or in the organically managed orchard. We believed that we had prevented primary scab infections in all orchards, however in August we began to see both leaf and fruit lesions on Pink Pearl, Caville Blanc, and Summer Treat in the sulfur treated organic orchard. These very susceptible varieties were not in the no-spray test orchard. It was not until

September that we found very small scab infections on Macoun in both the test and organic orchards. See figure 4.

The small scab spots were few and far between and were mostly in the line of trees that were adjacent to the clover field just to the east of the orchard. It is possible that some overwintering leaves had been trapped in the clover and spores from these infected this first row of trees. In the main part of the no spray orchard there were no visible scab infections. We cut branches from similar sized trees of the same variety in both the no-spray and the sulfur treated orchards, and compared them for visible infections. In all varieties that were in both orchards (N.Spy, Honeycrisp, Macoun, and Fuji) there were slightly ( about 5%) fewer visible infections in the no spray orchard. This may have been the result of the badly infected Caville Blanc and Pink Pearl trees that were present in the sulfur treated orchard and not in the no-spray test orchard. In any event I now believe that extreme sanitization may be the best approach to scab control in an organic orchard. It may be that these very susceptible heirloom varieties should be planted in a separate orchard and managed differently. I have begun to reconsider mixing the varieties of differing susceptibilities to lower overall infected debris on the orchard floor. Perhaps separate orchards ,each with different management practices is the best approach.

## 6. Conditions

As mentioned previously the spring/summer of 2011 was one of the worst for scab infection periods. Our first infection period was on April 26th when we had unusually high temperature of 67 degrees and a leaf wetness period of about 10 hours. Then on May 16th and 17th we had temperatures in the high 40's and a leaf wetness period of over 28 hours. Figure 5 shows the timing of these infections.

There were of course many more scab infection periods but all of these were following the primary infection period. The primary infection period is usually over by approximately 1000 degree days at Base 32 degrees. This occurred on about May 20th at Elderberry Pond. If all of the primary spores were expended and no primary infections occurred there would be no secondary infections. This was not the case in our orchards. Our scab infections, although minor were most likely caused by secondary infections following June 22nd, from a small number of unobserved primary infections.

## 7.Economics

The Time it took us to thoroughly clean the two acre orchard with a 20 inch rear bagger mower offset any cost advantage from not having to apply 5 sulfur sprays. Having said this the time in the late fall and early spring when this cleaning is taking place is not as busy a time for us during April, May and June. I believe that with a more efficient vacuum cleaner we can greatly reduce the cleanup time.

## 8. Assessment

This project has convinced me that extreme cleanup is the most practical and sustainable approach to organic orcharding. I believe that the continued use of large numbers of copper and sulfur sprays will not work in the long run. I also have come to believe, in part based on the results of this project, that it may be better to separate orchard plantings by scab susceptibility. Perhaps all scab resistant varieties should be planted together and managed with no scab sprays. Those varieties that have very high susceptibility like Caville Blanc and Pink Pearl should be planted in a separate orchard and managed as required using sprays to minimize resistant fungi development. All other varieties (with moderate scab susceptibility) should be managed using the techniques I have tested in this project.

## 9. Adoption

We do definitely plan to use the approach we tested on this project on our orchards. To this end we have purchased at our own expense a used leaf collection bin and vacuum fan which we have just finished adapting to an older Gravely Lawn Tractor. The Lawn Tractor Deck was modified to take high lift mulcher blades and feed the vacuum fan through a large flexible hose. See figure 6.

The plan is to use a smaller zero-turn mower to lay the debris from near the trees to a middle isle where the vacuum machine will pick them up. We are also configuring a manually held hose attachment to the vacuum machine to use directly under the trees. We will continue to spread compost on the orchard floor for decomposition of remaining leaf debris, and to fertilize the trees and grass.

## 10. Outreach

We are scheduled to present the results of this project at the NOFA Organic Research Symposium in Saratoga Springs, NY on Friday, January 20th, and at the PASA Farming for the Future Conference at Penn State University on Saturday, February 4th. We will also present and demonstrate the extreme cleanup process at our 2012 Organic Orchard Class here on the farm in April 2012. The extreme cleanup method of scab prevention will also be described to those attending our weekly farm tours at Elderberry Pond.

- [Sustainable Farm Practices at Elderberry Pond](#)
- [Fig.2 Cleaned Area on the Right](#)
- [Figure 4: First Scab Evidence](#)
- [Figure 5: Scab infection periods at Elderberry Pond during the spring of 2011](#)
- [Figure 3. Before and After Pruning](#)
- [New leaf cutter and vacuum photo](#)

## Project Objectives:

The test orchard was planted in 1994 (See document 3 Project Test Orchard). It is approximately 2 Acres and has about 80 trees. It is on the northwest side of the property and is flat, well drained and open to winds from the north and west. The trees are a mixture of dwarfing M9, Mark and a few M7 rootstocks. The trees are planted on a wider than normal grid to allow for good air circulation. Apple varieties are mixes of disease resistant varieties with disease susceptible varieties in alternating rows to minimize the amount of scab infected debris. The orchard floor is a mixture of fine bladed grasses. For more apple Scab information, see Document 1: Scab Cycle and Document 2: Leaf Wetness/Apple Scab Control, below.

### Task 1 - Late Winter and Spring Orchard Cleanup.

As of this writing in November, the orchard (figure 2 in appendix) is wet, and not all of the leaves or even unpicked apples have fallen. During dry, windy days in December the orchard will be mowed to break up leaf and fallen apple debris. This effort will be done by myself and my son (Chris) and will proceed the beginning of any grant effort.

In early spring, approximately mid to late March we will begin the grant project if awarded.

Task 1.1 The first effort will be to modify our 48 inch zero turn commercial mower to a mower/mulcher/vacuum. This project will involve the installation of newly available "high lift" mower blades which create a strong suction under the mower, a skirt to prevent debris from leaving the mower deck sides, and a Husquavarna designed

adapter to connect the mower grass chute to a flexible pipe that connects to 2 large (40 gallon) collection vessels (Rubbermaid Brutes). This modification is a take-off on a commercially available grass bag attachment that is available from the mower manufacturer for about \$2000. I believe our design will be more effective for debris pickup than the grass bag attachment and our well equipped shop and my own engineering background will help make this an effective new tool for organic orchardists.

Task 1.2 This mulcher/vacuum will be used to scour the orchard floor and pick up as much debris as possible from the orchard floor before bud break in the orchard. Over the period of about a month the orchard floor will be cleaned (and the debris burned at a remote site) three to four times. Even if some debris is missed on a pass it will at least be turned over randomly allowing air and sunlight to help destroy ascospore sites.

The mulcher/vacuum machine will also be used in the other apple orchards on the farm to prevent drift of infected material from these orchards into the test orchard. Just before bud break these other orchards, which are about a quarter of a mile away, will be sprayed with organically approved fungicides hopefully preventing any early primary scab infections. Note: there is little possibility of primary scab infections prior to any green appearing at the bud tips and at temperatures below 40 deg F. See Mills chart (Figure 4 in the appendix).

#### Task 2. Orchard Tree Pruning and Cleanup

This is the most time consuming and perhaps the most difficult part of the project. In our normal pruning operations we simply prune the tree using thinning cuts to prevent crossing branches, branches that are growing toward the center of the tree, and heading cuts to shorten branches that are too long to support the weight of the fruit or put the fruit too high for us to pick with our orchard ladders. For this project we will pay particular attention to preventing tight clusters of branches or leaves that may not get sufficient air circulation to dry quickly after a wetting period. Ascospore production is a function of both the temperature and of the time a particular leaf is wet (figure 3). Our intention will be to prune this orchard more and more carefully than our others to allow for exceptional sun and air penetration of the tree canopy. Our normal spring pruning time per tree is about 30 to 40 minutes per tree and for this orchard this year we will estimate about 60 minutes per tree.

Immediately following pruning the cut branches will be removed from the orchard and the orchard will be again be "swept" with the vacuum/mulcher.

#### Task 3 Orchard Fertilization and Debris Breakdown

This is the part of the task that equates to the use of Urea to speed up decomposition of any remaining leaf or apple debris. There is probably no organically approved material that has as high nitrogen content and quick release as urea to perform this function. We must find an organically approved substitute for our decomposer and fertilizer. On the other hand in the tests where urea was used successfully, much less attention was paid to debris pulverization and removal than we will be doing in this test. Also, the material we do use to perform this function will be far safer to apply and will provide more balanced and slower released nutrition to the trees and undercover. In some tests of the use Urea for a leaf matter breakdown, the high nitrogen pulse accelerated leaf tissue emergence increasing the susceptibility of the trees to early scab infection. We believe the best organic solution is to apply a fairly high N product that will aid in rapid leaf matter breakdown and also provide some tree fertilization as well.

For this project we have decided to use an application of certified organic OMRI approved cow Compost- Fessenden TLC mixed with our own green compost and

chicken litter and apply it with a compost spreader, or to brew a tea and apply it with a sprayer to the orchard floor.

The Fessenden compost is produced here in Cayuga County and we can purchase it directly from the Fessenden farm. We also like the idea that we can specify the maturity of the compost for our particular application. Approximately 50 cu yards of the compost will be used in our mixture

- [Scab Cycle](#)
- [Leaf Wetness/Apple Scab Control](#)
- [Project Test Orchard](#)

## Cooperators

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## Research

Materials and methods:

8. Assessment

10. Outreach

### Participation Summary

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture or SARE.



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