Organic apple production in the northeast and Mid-Atlantic regions is increasingly feasible as new methods are developed for orchard floor management, fruit thinning, and insect and disease management. Researchers at Penn State, Cornell, North Carolina State University, Iowa State University, and West Virginia University are continuing to study and improve options for organic apple production. Below are summaries of the current state of knowledge and links to other research that may be of interest. We will add to this page as new information becomes available.

THINKING ORGANIC?

(David A. Rosenberger, Cornell University, Dept. of Plant Pathology, Highland, New York)

During the past year, we have received many inquiries from both existing and “wanna-be” apple growers about the feasibility of producing apples for the organic market. While I have no first-hand experience with organic apple production, I have heard numerous presentations on the subject at winter meetings and have reviewed (at least partially) information available on the internet. The latter is a daunting task: Enter “organic apple Cornell University” in a Google search and you will get 33,300 documents that contain all of those words. Despite the seeming abundance of information relating to organic apple production, finding practical “how to” info is surprisingly difficult. We still lack a good comprehensive, science-based organic production guide for apples.

Because organic apple production is in a state of flux, no one can provide a “how to” list that will work for all growers in all locations. Therefore, this article provides only general observations that I hope will stimulate further thinking and questioning by those considering organic apple production. The good news is that methods do exist for producing apples organically in Northeastern United States. The bad news is that profitability of those systems remains questionable.

Planning for organic production: A critical first step for anyone planning to start an organic orchard is to consult with the organization that will provide organic certification for your orchard. Methods acceptable in organic production have been standardized by federal law, but many details are left to the discretion of the local certifying organization. Any land formerly used for traditional agriculture (i.e., receiving conventional fertilizers and/or pesticides) must go through a three-year transition period before crops produced on that land can be certified as organic. Misunderstandings about what your certifying organization will accept can result in an extended transition period. Get all recommendations in writing so that they will be available for future reference.

A second critical step in organic production (as for any other agricultural enterprise) is determining how the crop will be sold. Selling several hundred bushels of locally produced organic apples is relatively easy right now. However, the market is likely to become more competitive as more growers attempt to capitalize on the premium currently offered for organic apples. A well-managed block of organic apples should produce at least 800 bushels of apples per acre, so a marketing strategy will be critical for anyone planning a five or 10-acre block of organic apples.

Planning the orchard: To date, most growers interested in organic apple production have focused on transitioning existing orchards over to organic production. BIG MISTAKE! Existing orchards usually contain the wrong varieties at the wrong spacing in the wrong location with soils that need major fertility and/or pH
adjustments. Furthermore, the three-year costs of transitioning to organic are substantial and the crop during those three years has no increased value compared to conventional fruit.

A more logical approach is to plan an organic orchard as a new planting. The new orchard will include cultivars that are resistant to apple scab (for reasons described below), and some of these will need to be custom-budded by nurseries. While the trees are being produced in the nursery, the land can be properly prepared for planting by adjusting soil pH, adding fertility via animal manures, and planting cover crops that will increase soil organic matter. Using the orchard establishment and training systems developed by Terence Robinson and other horticulturists, newly planted orchards should produce a substantial harvest the third year after planting. If trees are planted during the second year of transitioning land to organic, then the first organic apples should be available for sale less than three years after trees are planted.

Selecting varieties: Identifying the right mix of varieties may be the greatest challenge in orchard establishment. Scab-susceptible cultivars such as McIntosh have no place in organic orchards because they will require constant spraying with sulfur and liquid lime-sulfur (LLS). Repeated applications of sulfur and/or LLS will reduce yield by at least 20 to 25%, and there are no other organically approved fungicides that will control apple scab. Furthermore, the fuel costs associated with spraying sulfur/LLS ten or 15 times during the season will only increase in coming years. If consumers begin buying products based on energy use or "carbon footprint", then organic apples sprayed 15 times per year with sulfur may ultimately prove no more acceptable than conventional non-organic apples.

Fortunately, we now have many good apple cultivars that are either fully or partially resistant to apple scab. Paulared, Sansa, and Honeycrisp are commercialized cultivars with sufficient scab resistance to make them attractive for organic farms. (Note, however, that it may be difficult to control summer fruit decays on Honeycrisp planted in warmer regions such as the Hudson Valley). Redfree, William's Pride, Priscilla, Enterprise, Crimson Crisp, Sundance, and Goldrush are all scab-resistant cultivars from the Purdue-Rutgers-Illinois breeding program. All of these except Enterprise are highly susceptible to cedar rust diseases. Topaz and NovaSpy are other cultivars worth considering. All of these cultivars have their limitations, some of which are described in a 1995 summary that is available at http://orchard.uvm.edu/sap/srcupdate.html. If I were establishing an organic orchard today, I would probably plant Paulared, Sansa, Honeycrisp, Crimson Crisp, Enterprise (although the skin is too tough to eat without peeling), and Goldrush.

Weed control: Plans for weed control should be in place prior to planting the orchard. Many options have been investigated, and the perfect option remains elusive. Hay mulches and synthetic mulches harbor vole populations, and controlling weeds along edges of synthetic mulches is difficult because mowers snag the mulches. Some burn-down herbicides are approved for use in organic plantings, but these are expensive and must be reapplied frequently. Propane flamers sound like fun for pyromaniacs but are expensive and have proven only marginally effective over the long haul.

Weed badgers are also expensive to operate, damage tree roots, and tend to create dips and ridges beneath the trees. A better cultivation tool may be the "Wonder Weeder," a rotating tine cultivator pictured on page 9 of an organic apple production report by Ian Merwin and Greg Peck (see: www.organic.cornell.edu/research/tsfsumms/2005/apples.pdf). Peck and Merwin reported recently that two or three cultivations per year are often adequate in their Ithaca test orchard.

Wood chip mulch has provided acceptable weed control without harboring voles, but the transport and installation costs for a wood chip mulch can be substantial. Wood chip mulches must be renewed every several years, and perennial weeds such as Canada thistle can become a problem in wood chip mulches. Wood chip mulches provide some benefits for fertility and moisture retention, but long-term management is more complex than for weed control by tilling. Wood chips should never be tilled into the soil because they will tie up all of the available nitrogen for several years after incorporation. Thus, one cannot mix wood chips and tillage.
An option worth exploring would be a removable and re-usable synthetic mulch. Several companies manufacture durable plastic and/or fiberglass-based ground covers that have worked well to suppress weeds. When left in place during winter, these mulches harbor damaging populations of voles. However, it should be feasible to design a machine that would mechanically install the mulch in spring (perhaps in early May) and then recover that mulch onto a roll in mid-August so that it could be stored until it is reinstalled the next spring. A plastic mulch installer like those used for vegetables might be modified and offset so that a ground cover could be installed on one side of a tree with the outside edge buried in soil to hold it in place. After installation was completed on both sides of a tree row (with separate 3-ft-wide strips of mulch on each side), the center overlap along the tree row would need to be manually stabilized to resist wind by inserting long wire “staples” into the ground or by weighting the center edge with rocks, wood chip mulch, or a long water-filled hose. Wood chip mulch installed over removable synthetic mulch could presumably be shaken to the ground when the synthetic mulch is removed in fall and then covered over with the synthetic mulch the next year. However, removable synthetic mulches need to be tested experimentally and will become practical only if their installation and removal can be mechanized.

Crop load adjustment: Work by Jim Schupp and Terence Robinson showed that back-to-back sprays of LLS plus oil can effectively thin the crop in organic apple orchards. More work will be required to fine-tune thinning regimes for different cultivars and to determine how thinning sprays with LLS+oil should be adjusted for weather conditions. Nevertheless, we have enough information to know that organic growers need not depend solely on hand thinning to adjust crop load.

Disease control: Various plant pathologists working with organic apple production have all agreed that the two most problematic groups of diseases in organic apple production are rust diseases and summer fruit rots. Sulfur and LLS can be used to control most other diseases, although, as noted before, using these fungicides at the rates and intervals needed to control apple scab will cause yield reductions. To date, all of the organic fungicides promoted as alternatives to sulfur are more expensive and less effective than sulfur.

Controlling scab with sulfur and LLS will not be discussed here because, as indicated earlier, scab susceptible cultivars should not be included in organic orchards. Fire blight is another potential problem with many cultivars, but streptomycin is currently acceptable within organic programs so long at is used only on an as-needed basis. Strategies for fire blight control are therefore similar in organic and conventional orchards.

Cedar apple rust and quince rust are very difficult to control with sulfur. Therefore, organic plantings that include rust-susceptible cultivars should be located at least 300 ft away from the nearest cedar trees. Powdery mildew can become a problem on some cultivars, but three or four applications of sulfur at 5 to 8 lb/A beginning at petal fall may suffice to keep mildew in check. Where mildew becomes established, however, the sulfur program should be initiated no later than pink.

Sooty blotch and flyspeck can be controlled by using low rates of LLS during summer. In trials in the Hudson Valley, we found that LLS applied at 1 qt/100 gal of dilute spray was very effective when applied on a 10-day schedule during July and August, whereas 2 qt/100 gal were required for good control on a 20-day schedule. In regions where conditions favor development of flyspeck and sooty blotch, sprays with LLS must be continued into late September to prevent disease on late-maturing cultivars.

Unfortunately, LLS does not control summer fruit rots such as black rot, white rot, and bitter rot. Low rates of copper fungicide can be tank-mixed with LLS during late July and August LLS to increase activity of these sprays against summer fruit rots. However, organic apple growers may need to resort to sanitation measures to control summer fruit decays as plantings mature. In the northeast, much of the inoculum for summer fruit decays comes from fruitlet mummies that are retained after fruit set and that remain on the trees over winter. Manually removing all of these fruitlet mummies during winter pruning should significantly reduce problems with summer fruit rots. However, as is the case with many other aspects of organic production, that hypothesis has not yet been tested.
Organic Disease Management Guide

Insect control: (see below).

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THINKING ORGANICALLY: INSECT PEST MANAGEMENT
(Peter Jentsch, Cornell University, Dept. of Entomology, Highland, New York)

In “unsubsidized” agricultural businesses, success equates to profitability. In organic apple production, success then hinges on maintaining high yields of marketable fruit and keeping the high price of management reined in, while creating a market niche of selling less-than-perfect fruit at premium prices.

Northeast organic apple production was not economically feasible prior to the commercial availability of kaolin clay (Surround WP) in 2000. Federally approved organic materials, such as pyrethrum (Pyganic), were available for control of fruit feeding insect pests. However, they were ineffective against plum curculio (PC), the principal fruit pest responsible for significant yearly crop loss in organic apples. Surround WP creates a barrier film of kaolin clay on the fruit and foliage, acting to inhibit egg laying of plum curculio and apple maggot, while reducing fruit feeding by a variety of insects. From recent insecticide research come organic materials such as azadirachtin (Aza-Direct, Neemix), a seed extract from the neem tree effective as an antifeedant, also disrupting insect growth, and spinosad (Entrust), an excellent lepidopteran material derived from the soil-dwelling bacterium, Saccharopolyspora spinosa. With the advent of these new materials emerges the possibility of organic apple production in the Northeast, cost notwithstanding.

The arrival of new organic insecticides, scab-resistant cultivars (SRCs), and larger-fruiting varieties, brings the prospect of economically viable production of organic apples in New York. In past studies conducted at the Hudson Valley Laboratory, we observed varying levels of disease, insect and mite populations in our NE-183 planting without the use of pesticides. These included new varieties of SRCs, some of them developed by the Purdue Rutgers-Illinois cooperative breeding program. Through the selection of both SRCs and varieties demonstrating inherently lower disease and insect susceptibility, as well as larger-fruiting varieties not as sensitive to organic thinning measures, the potential for dramatically reduced applications of organic fungicides and insecticides, increased fruit size and yield may be achieved. Details of these studies can be obtained in the Summer 2003 issue of the NYS Horticultural Society Fruit Quarterly Journal: http://www.nyshs.org/fq/summer03/NYFQ%20Summer03.pdf.

For several years, university researchers have conducted studies evaluating the impact of organically acceptable materials on the insect complex in both apple and pear. If one is considering organic apple production it is prudent to consider the past works of Agnello, Reissig, Nyrop, Merwin, Peck, Rosenberger and Straub, on the use of Surround WP, mating disruption for managing the lepidopteran complex, and disease management listed here: http://www.nysaes.cornell.edu/hort/fq/spring02/spring02.pdf, http://www.organic.cornell.edu/research/tsfsumms/2005/apples.pdf, http://www.nysaes.cornell.edu/hort/fq/spring03/NYFQ%20Spring03.pdf, http://www.nysaes.cornell.edu/ent/scaffolds/2008/080324.html.

In 2000, we conducted efficacy studies to determine the impact of the then newly registered insecticide Surround WP on the insect complex of four commercial apple varieties grown on M-26 rootstock. We applied Surround WP using a handgun at the high-labeled rate of 50 pounds per acre, on a 10–14-day interval in a season-long program beginning at early petal fall. In retrospect, Surround would have demonstrated far greater efficacy had it been applied in 2–3 applications prior to bloom in the high-pressure experimental orchards we have in the mid-Hudson Valley. This method gave us reasonable control of the primary insect pests compared with a
conventional program of Calypso 2F at 1.0 oz/100 gal at pink, Guthion 50W at 8.0 oz/100 gal at PF applied until the end of season, and Provado 1.6F at 2.0 oz/100 gal at 3rd cover.

In harvest evaluations of damage to ‘Ginger Gold’, the Surround treatment had 45% clean fruit compared with the commercial standard of 89%. Plum curculio damaged 25.9% of the fruit compared with 1.9% and 42.3% in the commercial standard and untreated treatments, respectively. In regards to the complex of internal and external feeding Lepidoptera larvae, we observed higher levels of fruit damage in the Surround treatment (14.1%), compared with 5.2% and 72.9% in the commercial standard and untreated treatments, respectively. Surround did as well as the commercial standard for European apple sawfly and apple maggot control.

To better understand the combined effects of managing diseases and insects using organic control measures, we conducted a trial in 2006, making applications to five single-tree replicates for each of 28 different cultivars arranged in a randomized block design. Only 15 of the 28 cultivars were used for data collection. A commercial standard was compared with a program based on organic fungicides plus Surround WP applied using airblast applications on a 7–10-day interval in three treatment blocks. The Surround was included beginning with two pre-bloom applications at tight cluster, in order to layer kaolin on the trees prior to the establishment of European apple sawfly, tarnished plant bug, and plum curculio. In addition, spinosad was applied once during early summer and again in August to help with control of internal lepidopteran pests and apple maggot, with a Bt application for the obliquebanded leafroller in mid-June.

In evaluations of the organic plots, we observed smaller fruit size than in the standard and unsprayed plots when king fruits and lateral fruits were measured on 26 May. This size differential was attributable to the liquid lime sulfur thinning sprays applied in mid-May.

In pre-June drop fruit evaluations, we found that the organic program was equivalent to the standard program for controlling damage by European apple sawfly (EAS) and tarnished plant bug (TPB) on king fruit, and provided better control than the standard program on lateral fruit. Control of PC, EAS, and TPB in our standard program might have been better if an insecticide had been applied at pink. The proportion of fruit showing no insect damage was still quite high in the organic blocks on 26 May, but this dropped considerably due to later damage from PC. We attributed the high incidence of plum curculio damage at harvest to very heavy pressure (94% damage in the unsprayed control plots), a delayed peak in PC activity in the 2006 season, and the loss of insecticide residues from heavy rains on 2 June.

Evaluations of fruit at harvest showed that the organic program was more effective than the standard program for protecting fruit from EAS and TPB, less effective against external lep damage, and statistically comparable for controlling internal leps and apple maggot. The full report of this study can be found on-line at: http://www.nysipm.cornell.edu/grantspgm/projects/proj06/fruit/rosenberger2.pdf.

Use of Surround WP in a season-long program has been observed to fall short in controlling San Jose scale (Fig. 1) while adding to costs related to contending with clay residues on the fruit after harvest. San Jose scale management can be remedied with the use of a single well-applied 2–3% dormant oil application during the pre-bloom period. Clay residues can be removed using food grade fruit and vegetable cleaners such as acid or alkaline cleaners in dip tanks, flumes and sprayers over the washer brushes. An additional concern related to the use of Surround is that the clay barrier does not actually kill plum curculio, which continues to be present within the orchard throughout the season, and may remain at relatively high numbers to cause later damage as residues wane.

In summary, pesticides plus application costs totaled $650/A for the standard program as compared with $1,173/A for the organic program. Total yield per acre (including fruit damaged by pests) was 209, 409, and 861 bushels per acre for the unsprayed, organic, and standard treatments, respectively. Pest control costs per bushel were $2.98 for fruit from the organic block compared with $0.76 for the standard. Results from this trial show that
pest-free apples can be produced organically in New York, but organic producers will likely need at least a 400% sales premium compared with standard growers, due to the high costs and reduced yields associated with organic pest control.

Further research may lead to cost reductions and improved productivity for organic systems, but farmers currently considering a switch to organic apple production should verify that their prospective buyers will be willing to pay a significant premium for organic fruit.

Fig. 1. San Jose scale on McIntosh grown using a Surround program.

Reference