Issues in Organic Fruit Production

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Outline

• Defining sustainability
• Sustainability and fruit crops
• Organic fruit crop production
• Summary crop comments
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HOW IS SUSTAINABILITY DEFINED?
A Process Rather Than an End

“...four generally agreed upon goals that help define sustainable agriculture:

- Satisfy human food, feed, and fiber needs, and contribute to biofuel needs.
- Enhance environmental quality and the resource base.
- Sustain the economic viability of agriculture.
- Enhance the quality of life for farmers, farm workers, and society as a whole.”

Therefore,

- “Sustainability is best evaluated not as a particular end state, but rather as a process that moves farming systems along a trajectory toward greater sustainability on each of the four goals.”

NAS report 2010
Three Domains of Sustainability

- **Economic Sustainability**
  - Economically sound and profitable

- **Environmental Sustainability**
  - Environmentally sound, biologically interactive

- **Social, Community Sustainability**
  - Socially Responsible to people, families, and communities
SUSTAINABILITY AND FRUIT CROPS
Big Challenges to Sustainable Fruit Production

Crop adaptation
Crop reliability
Pesticide use
Energy use
Sustainable Advantages of Fruit Crops

Advantages of Fruit crops

– Permanent and perennial
– Good soil protection and cover in many cases
– Add leaf litter back to soil
– Good for soil conservation on sloped lands
– Some of the most advanced IPM and pest management tools available for crops
– Relate to local cultural heritage
Sustainability Issues for Fruit Crops

**Economic**
- Increasing resource and input production costs
- Declining wholesale value relative to production costs
- Increasing market product competition
- Increasing imported fruit

**Environmental**
- Small number of fruit breeding programs with public access
  - Lack of development of locally adapted cultivars
  - Few programs working on insect resistance
- Reliance on synthetic pesticides and fertilizers
- High energy requirement for production, harvest, transport and storage of products

**Social**
- High labor requirement but now wages
- Worker safety with significant equipment and chemical use
- Loss of local fruit farms, related businesses, and dissolution of communities with lost heritage

(see; Merwin and Pritts, 1993; and Granstein and Kupferman, 2008)
Challenges with Some Fruit Crops

**Fruit Crops Generally**

- Require more tractor-hrs/crop yield than most other crops
  - Mowing, cultivating, spraying, pruning, harvesting
- Require more pesticides/crop yield or per acre than most other crops
  - Insecticides, fungicides, bactericides, herbicides
  - Fruits, especially apple, have public attention for pesticide use although some pesticides such as herbicides are used much less in fruit crops than other crops
- Moderate amount of fertilizers but low nutrient uptake efficiency
- More hours human labor/crop yield than most other crops
  - Especially pruning, training, and hand harvest
- Have very high capital investments ($/acre), especially for tree fruit, grape, and strawberry production systems
- High grading standards for fruit and intense market competition (at wholesale)
  - Intense competition for the American diet as many fruits are regarded as “snack foods”
Fruit Systems moving towards Sustainability

- Integrated Fruit Production
  - Going beyond IPM

- Organic Fruit Production Systems

(see Granstein and Kupferman, 2008)
Planning for Sustainable Production

• Crop and Cultivar Selection
  – Select appropriate rootstocks for region and for sustainable production systems (tree fruits and grapes)
  – Crop must be adapted to the growing region
  – Crop and cultivar must match a market
  – Crop and cultivar should have multiple pest resistances

• Site and Soil

• Management affects pest problems
  – Crop susceptibility and resistances
  – Farmscape affects pest prevalence
System May Reduce Cost

% of Pesticide A.I.
Plant Environmental Response

Pn, Leaf Phenolic Content, Leaf Toughness

Outside
Distance from Outside of Canopy
Or Light Exposure (% full sun)

Inside

(adapted from Garcia and Rom, 1995)
Canopy Volume Affects Pest Management

• Increased plant density and decreased canopy volume
• Plants require less pesticide (ai) in many cases
• Plants develop better natural resistance
  – Poorer habitat for pests
  – Tougher leaves; higher phenolic content
• Orchard can be sprayed with alternate rows
Orchard Biodiversity

- Dealing with the Monoculture
  - Diversify crops (multiple fruit crops; add vegetables)
  - Diversify cultivars
    - Spreads both environmental and market risk
- Have managed vegetation belts; Farmscape
  - Pesticide and runoff catchments
  - Reservoir of beneficials
  - Trap crops
- Have diverse ground cover vegetation
  - Minimize use of herbicides and cultivation,
- Encourage mammal and bird predators
  - Raptor boxes, perch poles
Ground Cover and Vegetation Management

Best Practices for Ground Cover and Vegetation Mgmt
(Note: Young fruit plants are very sensitive to vegetative competition)

• Cultivation
  – Although seasonal clean cultivation is often used as an orchard practice, it is not sustainable
  – Limited, under crop/vine/tree cultivation may be useful

• Use targeted herbicides
  – Minimize/eliminate soil-active residual herbicides
  – Targeted contact herbicides in conjunction with other practices (e.g. mowing, cultivation)

• Allow some non-competitive vegetation
  – Either temporally, spatially, or genetically
Alternatives for Ground Cover Management

• Mulches
  - Organic mulches:
    • Sawdust, Wood chips: Blueberries, blackberries, tree fruits, grapes
    • Straw mulch: all fruits
    • Plastic and geotextile mulch: strawberries, grapes, tree fruits
• Cultivation: grapes, tree fruits
• Flaming; very energy consuming
Between Row Vegetation

• Cover Crops
  – Fruit crops do not compete well directly with cover crops
  – However, cover crops can be grown between fruit rows to provide various services to the farm system and ecosystem

• Plant vegetation that provides benefits
  – Mechanical support of equipment
  – Habitat for beneficials; predators and parasites
  – Helps dry soils during wet periods

• Avoid vegetation that may host pests
  – Alternate hosts for insect pests and disease
  – Habitat and food stuffs for mice
  – Does not compete with fruit crop for water or nutrients
  – Does not spread into the crop row

*There is no evidence that legumes that fix N in the drive row provide N to the crop plants*
Nutrition Management

Best Practices to Nutrient Management

• Develop healthy soil
  - Is a challenge in a perennial crop sensitive to competitive vegetation
• Maintain soil pH
• Apply nutrients based upon soil and foliar analyses
• Apply nutrients at a time when they will be absorbed by the plant
• Multiple applications may be more efficient than single application
• Apply nutrients to the crop with banding or target applications
  - But, be sure to provide nutrients to drive-row cover crops
• Apply foliar nutrients as needed (more efficient)
• Use of organic nutrients is somewhat untested
Reducing Energy Use

The majority of fruit production energy use is in chemicals and application, tractor operations, storage and transport

• Resistant Cultivars require less sprays
• Small, high density and diversified orchards reduce less chemical inputs
• Alternative ground covers reduce mowing, herbicides
• Develop multiple operation equipment
  – Try to do multiple operations with one orchard tractor pass
• Develop a market strategy that includes regional sales
• Capture your local market ("build a wall around the state..")
• Farm Energy Sources for Buildings and Storage facilities
  – Wind turbines, solar panels
  – Belowground storage
Vertebrate Pests

- Significant Vertebrate pests of fruit crops
  - Birds
  - Deer
  - Mice
- Best controls are
  - Exclusion; fencing and netting
  - Scare tactics; visual and sound
    - Include dogs in the management plan
  - Predatory birds - include habitat or perches for raptors (hawks, owls, etc.)
Trends

• Organic tree fruit consumption – significantly up!
  – News reports stimulate: “It pays to purchase..”
  – Report on costs and profitability of organic tree fruit production stimulating industry in west
    • ~15-20% of WA apple crop now organic
ORGANIC FRUIT CROP PRODUCTION
Challenges for Organic Fruit Production

• Crop Adaptability
• Weed Control
• Pest Management
• Crop Nutrition
• Annual Cropping
• Maintaining product quality
Organic Fruit Production – Still Developing

• Limited research, on organic production systems
• Reports in other regions have indicated significant reductions in yield, especially pack-out, declining production over time, etc., due to problems with competitive vegetation, sufficient nutrient supply and adequate pest management
• MORE WORK IS NEEDED
Relative Ease of Adapting to Organics

- Natives
- Blueberries
- Blackberries
- Strawberries
- Apples
- Peaches
- Grapes
Organic Fruit

- Pawpaw
- Persimmon
- Elderberry
Organic Fruit

• Blueberries – a real opportunity
  – Many locally adapted types and cultivars
  – Strong local consumer demand
  – Few insect pests and diseases – spotted wing drosophila
  – Very sensitive to weeds; require high OM and well drained soils; very drought sensitive
  – Birds are a problem

• Blackberries – good opportunity
  – Adapted to the region
  – Strong local seasonal markets
  – Few insect and disease pest
    • Cane borers are the big challenge for organics
    • Japanese beetles are a problem
    • Spotted wing drosophila
  – Not competitive with many grasses
Organic Fruit

- Spotted wing drosophila
  - Pest of blueberry, strawberry, blackberry, raspberry
  - Monitor populations with traps
  - Spray to manage
Organic Fruit

• Annual Plasticulture Strawberries
  – Locally adapted
  – Frost protection is essential
    • Floating row covers or low tunnels
  – Strong seasonal demand
  – High value crop
  – Sanitation and crop rotation critical
  – Diseases can be managed by cultivar selection, cultural practices, and with organic fungicides
Apples
- Several insects and disease pests
  - Plum curculio has risen as a primary pest with unreliable organic controls
- Other primary insect pests controlled with mating disruption and targeted biological and parasitic sprays
- Secondary pests controlled by introduction of predaceous insects and parasites
- Trees are sensitive to competitive vegetation
- Organic nutrition at appropriate times is difficult
Organic Fruit

• Peaches
  – Most insect pests can be controlled culturally, with mating disruption and trapping, and targeted biological, botanical, biorational sprays
  – BROWN ROT – the limitation
    • No satisfactory organic controls or technology at this time

• Grapes
  – Most insect pests can be controlled culturally, with mating disruption and trapping, and targeted biological, botanical, biorational sprays
  – Phylloxera root louse is a problem
    • Controlled with rootstocks
  – BLACK ROT – the limitation
    • No satisfactory organic controls or technology at this time
Organic Fruit

- Brown rot
Organic Fruit

- Black rot
Observations

Slow response with organic mulches and organic, natural fertilizer sources

– Young trees and vines are very sensitive to vegetation competition

– However, can maintain tree nutrient status, cropping and quality with organic nutrient sources
  • Some “tweaking” needed

– Increased soil biological activity, significant increase in soil OM, pH maintenance

– Increased water infiltration, retention
Pest Management

Best Practices for Organic Fruit Pest Mgmt

• Select multiple resistant cultivars
  – Generally available disease resistance but not insect resistance
• Strong cultural prevention program required
  – Sanitation, exclusion
• Implement IPM program
  – Scouting, monitoring, trapping
  – Employment of models to predict insect and disease outbreaks
  – Treat PRIOR to outbreak; prevent problems rather than correct problems
  – Use mating disruption, trapping, predators and parasites for insect control; supplement with targeted biorational, biological and botanical insecticides
  – Use cultural controls to reduce potential for disease
  – Maintain a proactive fungistat and bacteristatic spray program in advance of anticipated disease problems
Annual Cropping

• Annual cropping and avoiding biennial bearing is a significant issue in tree fruits, grapes, and blueberries
  
  *Flowers are formed the year prior to bloom and are influenced by crop health, crop load and environment that year*
  
  – Must have strong, consistent annual pruning
  
  – Must practice crop load management
    • Few reliable growth regulators; must rely on hand labor

• The goal is to optimize crop load, thereby maximizing crop size and quality, and return bloom
  
  – Over cropped plants may have high yield of small, poor quality fruit; become biennial
Opportunities

• Tremendous local and regional markets for fresh fruit
  – Must still meet quality/grade standards to be acceptable

• Potential for local labeled fruit, eco-labeled fruit, and organically produced/labeled fruit
Natives

• Limited experience with commercial production
• Pest complex is not well understood
• Limited number of cultivars
• Marketing challenges
Grapes

• Sustainability metrics being adapted faster than many other specialty crops because of wine production and retail pressures
  – Moving beyond IPM in vineyards
• Requires annual pruning; high labor requirement for pruning
• Mechanization and pesticides may drive LCA (life cycle assessment = true costs) upward
• Difficult to produce organically in MO because of insect pests and particularly black rot of clusters
Blueberries

• Wide range of adapted species, hybrids, and cultivars for the region
  – Cultivars can be used to spread harvest and extend season

• Special care needed for soil management, weed control, and irrigation

• Few insect and disease pests; most can be managed

• Highly adaptable to sustainable production and readily adaptable to organic production

• Proper nutrition, pruning, irrigation are biggest management issues
Blackberries

- Widely adapted; strong local/regional market that is expanding
- Select disease resistant cultivars
- Readily adapted to sustainable and organic production
  - Limitations: weed control
  - Cane borers (can be difficult in organic planting)
Strawberries

- Now grown as an annual crop in plasticulture
  - Planted in Sept/Oct; overwintered; harvest in spring (March – May) until daily temps consistently exceed about 90°F
  - Require plastic mulch
  - Generally require a row cover or organic straw mulch in the winter for winter and frost protection
  - High nutritional requirements
  - Require strong crop rotation schedule; probably a 3-5 year rotation on the same ground in the absence of soil fumigation or pasteurization
  - Some disease problems need to be controlled; apply fungistatic sprays for organics
  - Few insect pests; can use row covers to protect from insects
  - Readily adaptable to high tunnel and greenhouse production systems
Summary

- Sustainable fruit production is possible and improving with new technologies
- Crop and cultivar selection for specific areas, markets, and uses is critical
- Must have a good start; site, soil, prep
- Must follow strong IPM program
- Organic fruit production in the can be done, but is challenging due to environment, pests, weeds, and cropping regularity
  - Technology is still developing
- Strong local market potential for high quality fresh fruit products as well as processed products
Resources

- **Cornell University**
  - [http://nysipm.cornell.edu/fruits/default.asp](http://nysipm.cornell.edu/fruits/default.asp)

- **ATTRA**
  - [https://attra.ncat.org/horticultural.html#Fruits](https://attra.ncat.org/horticultural.html#Fruits)

Any Questions?

That’s Life

“Organic doesn’t have that ‘pesticidy’ aftertaste.”

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