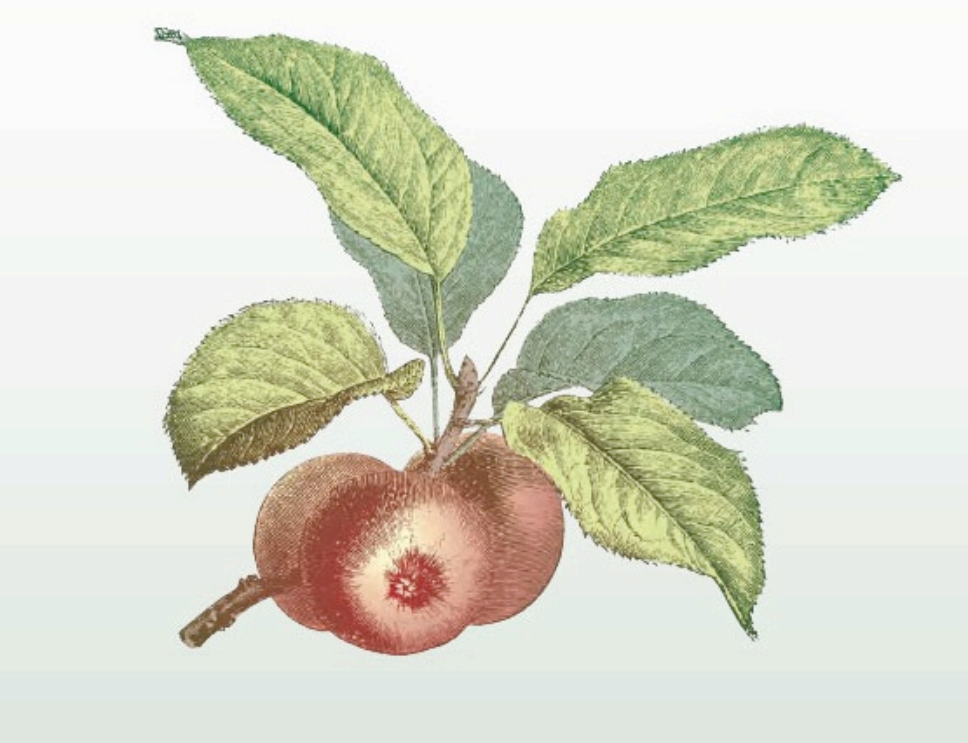
# What's the Future for Organic Apple Production in the Eastern US?



VirginiaTech
Invent the Future

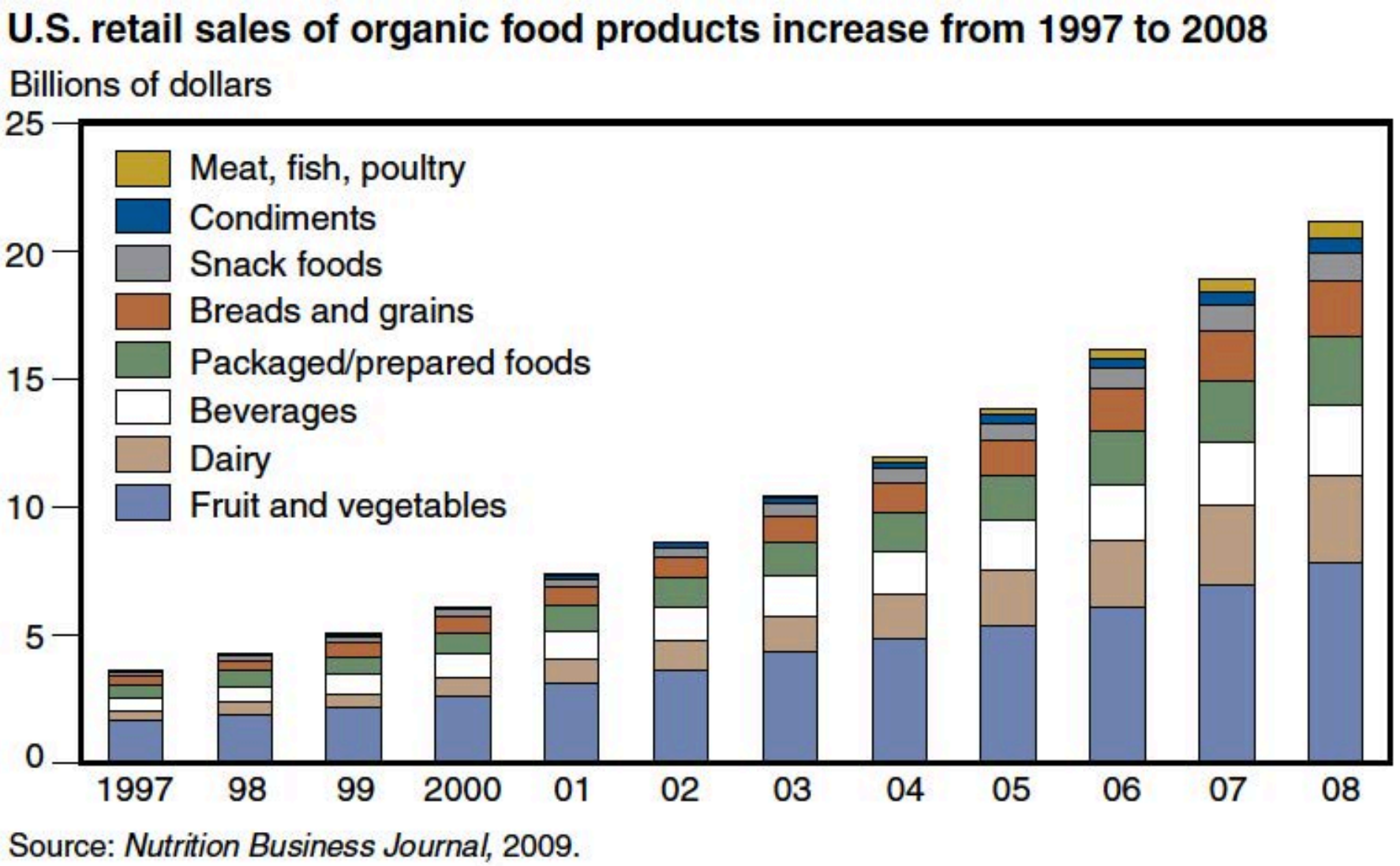
Gregory Peck, Ph.D.
greg.peck@vt.edu

# Organic agriculture


- Unified standards put in place in 2002 after more than two decades of efforts
- Prior to that there were regional standards enforced by state governments and private certifiers
- Large parts of the USDA standards were adopted from west coast certifiers (CCOF)
  - Of particular interest is the materials that are and are not allowed in production

✓ Naturally derived - accepted, unless prohibited

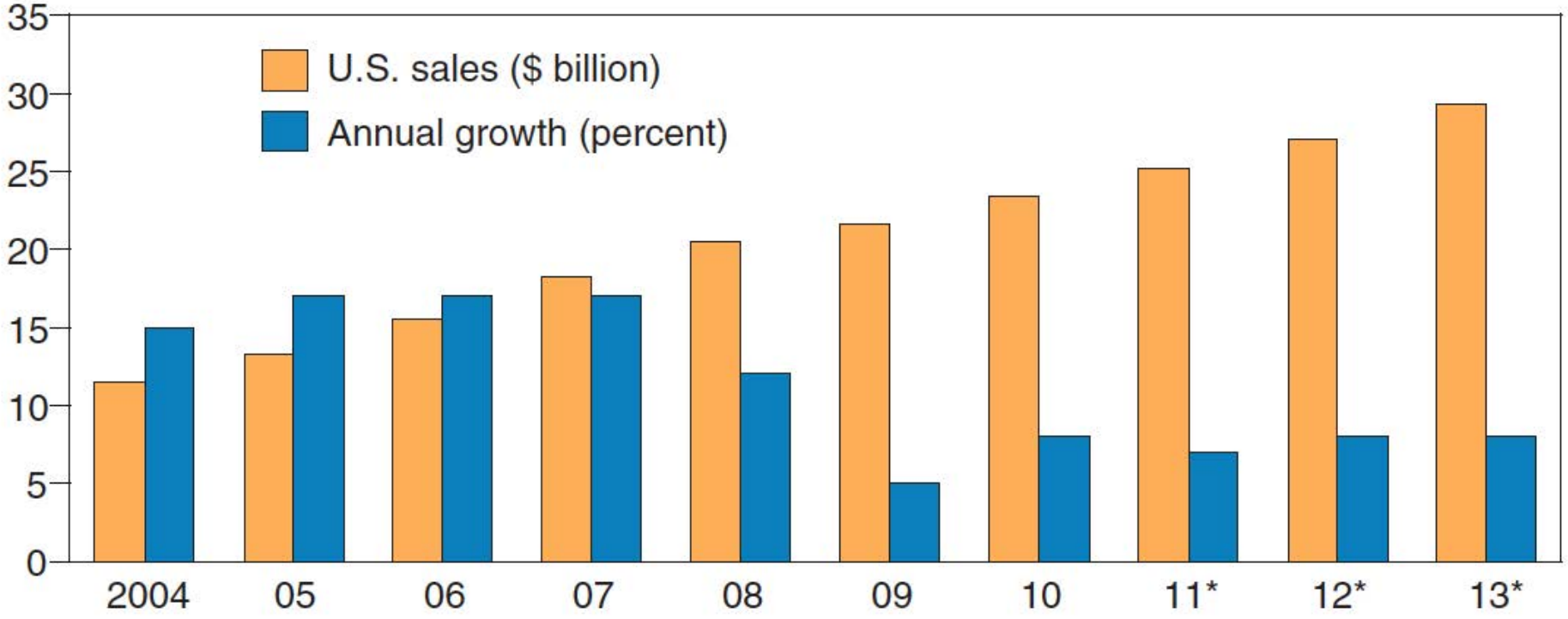
✕ Synthetically derived - prohibited, unless accepted




- Organic products accounted for 3.5% of US food sales in 2011
- Between 2004 and 2013, organic sales grew ~2.5 times
- Organic cropland accounts for ~0.7% of total US cropland

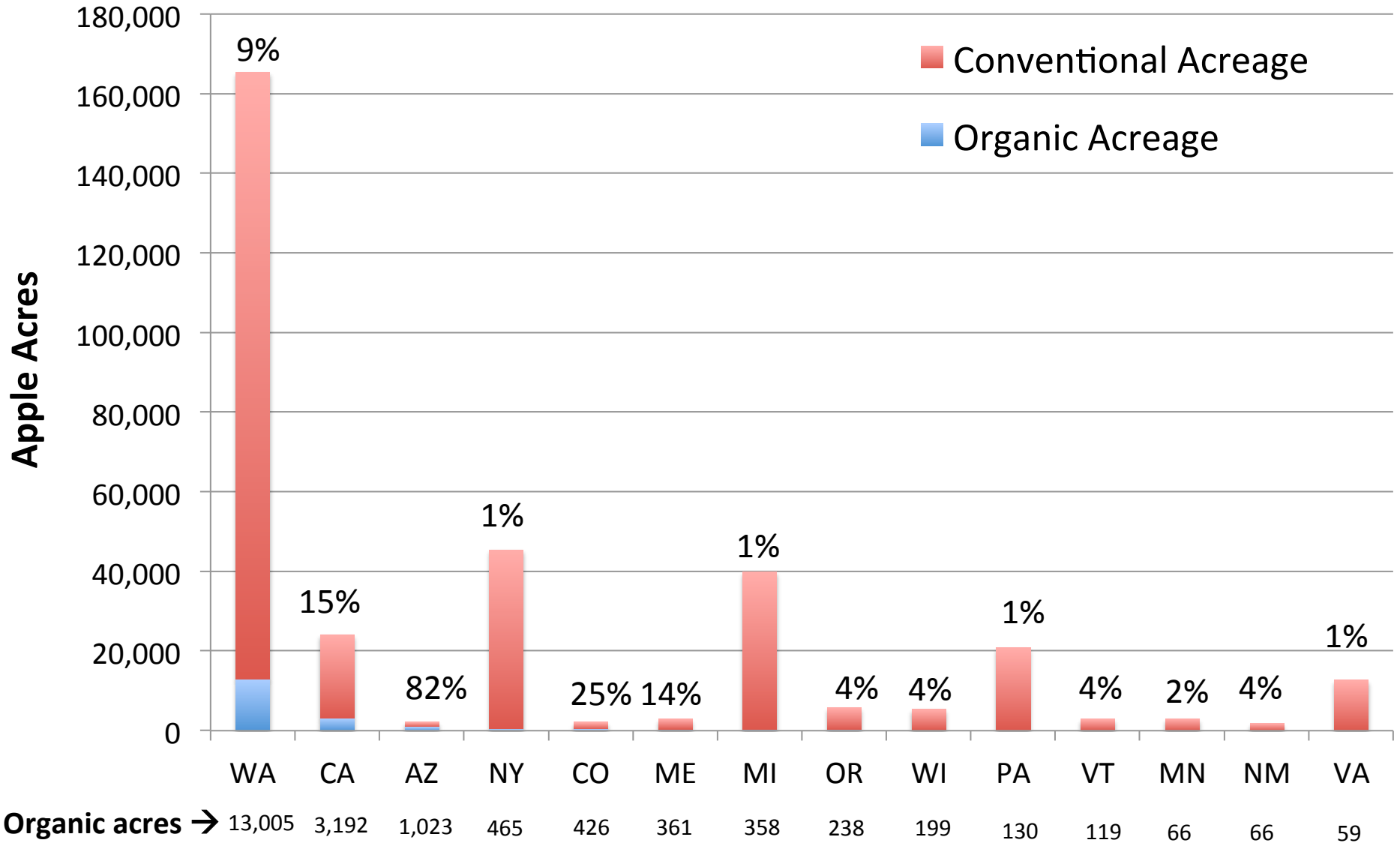
Greene and Ebel, 2012

## Organic food sales in the United States, 2004-2013



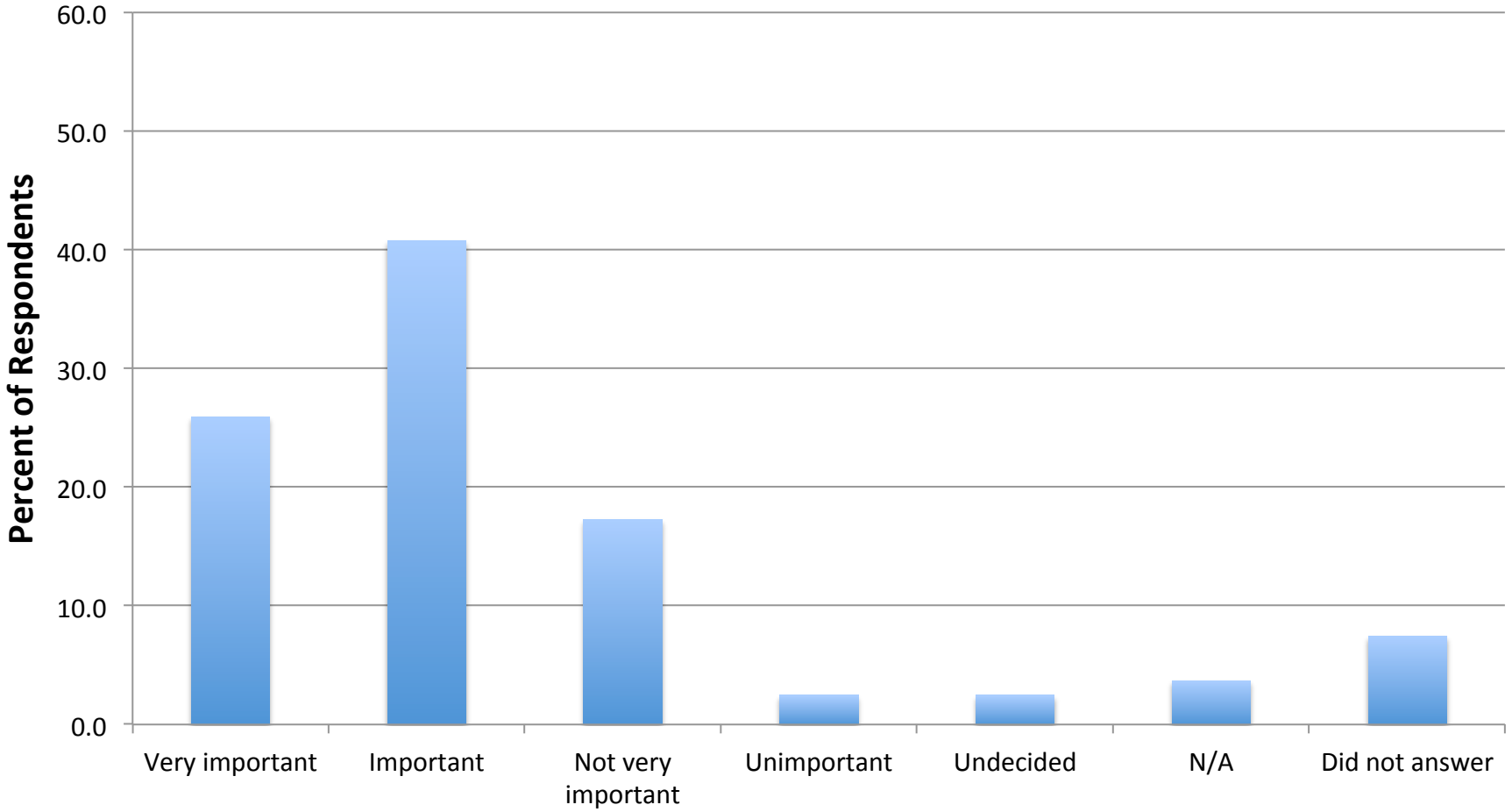

* 2011-13 estimates or projections. Source: *Nutrition Business Journal.*

"Data from The Perishables Group showed organic apple sales jumped 95% between 2006 and 2010." The Packer Nov. 5, 2011




Source: USDA-NASS 2007 Census of Agriculture

# Development of alternative orchard management approaches (e.g., organic, integrated fruit production (IFP), other "sustainable agriculture" systems)




81 respondents; 88% of which were growers.

# Integrated and Organic Production of 'Liberty' Apple: Two Agroecosystems for the Ground Up


HortScience 43(4):1111 (abstr.) (2008)

HortScience 44:1081: (abstr.). (2009)

HortScience 44(5):1382-1389 (2009)

HortScience 45(7):1038-1048 (2009)

Acta Hort. 873:57-66 (2010)

Applied Soil Ecology 48:18-30 (2011)

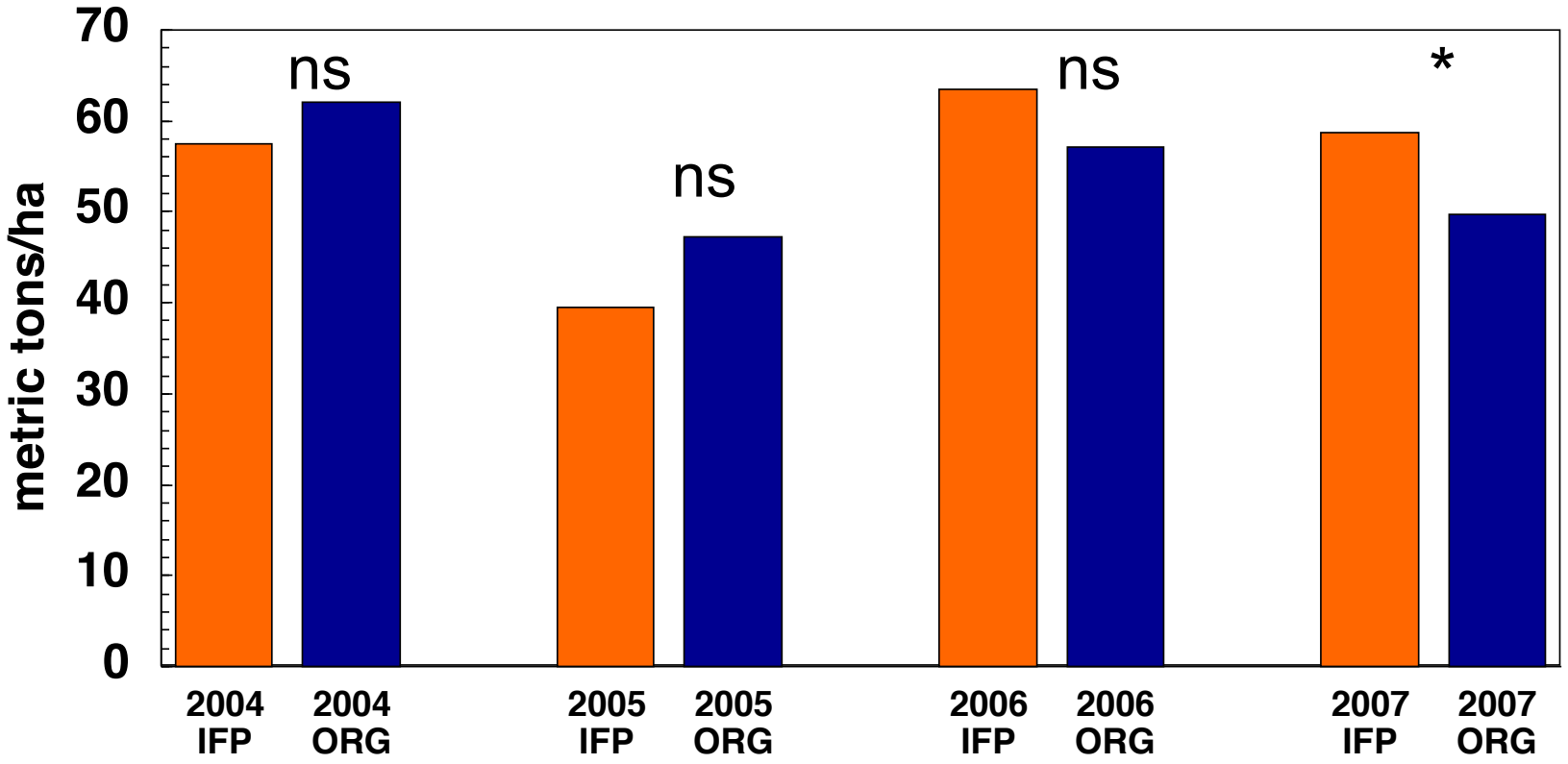
Cornell University
Department of Horticulture

# Doctoral Research
# Cornell University–Ithaca, NY

IFP

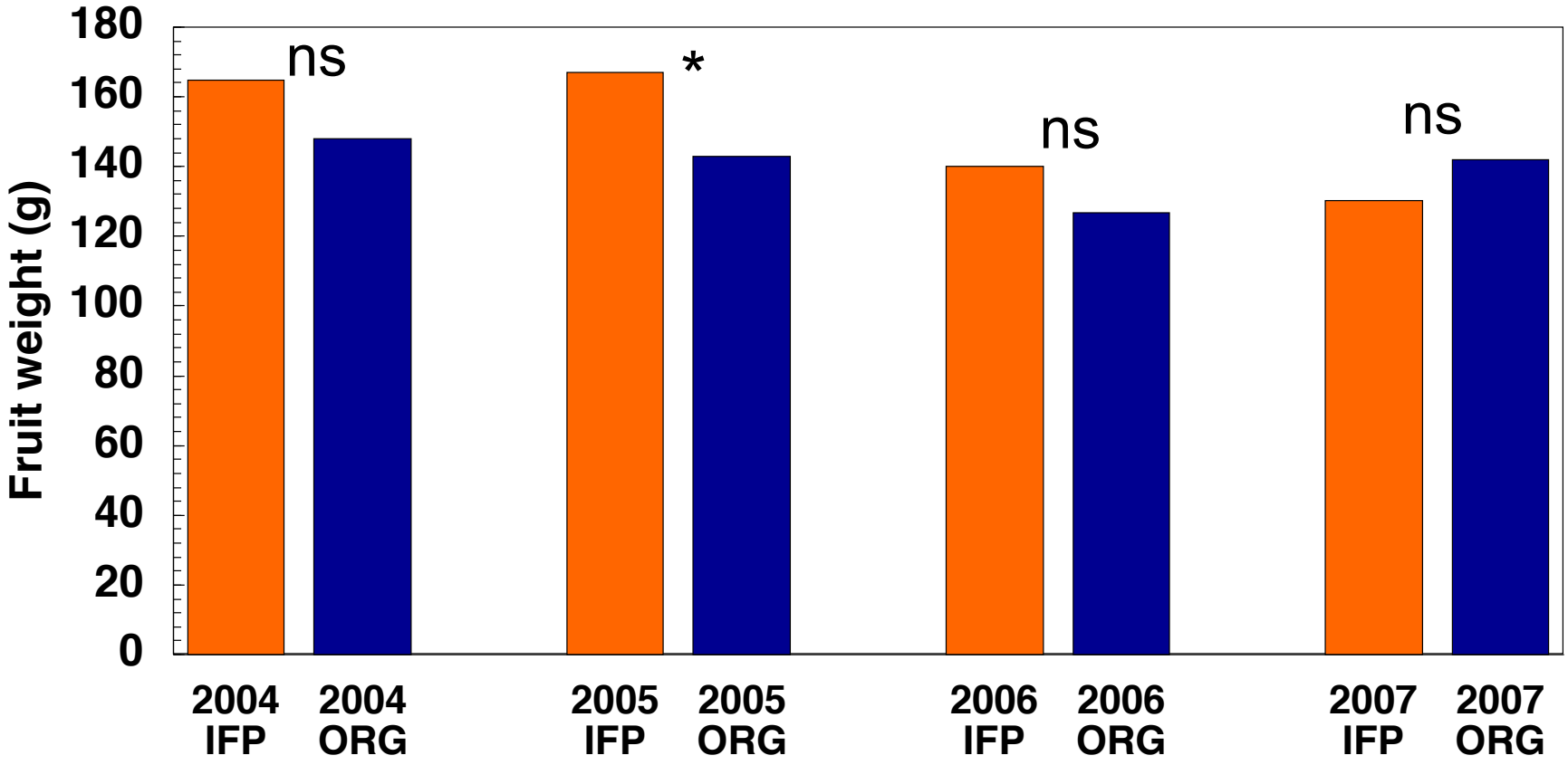
Organic

# Crop Yields - NY



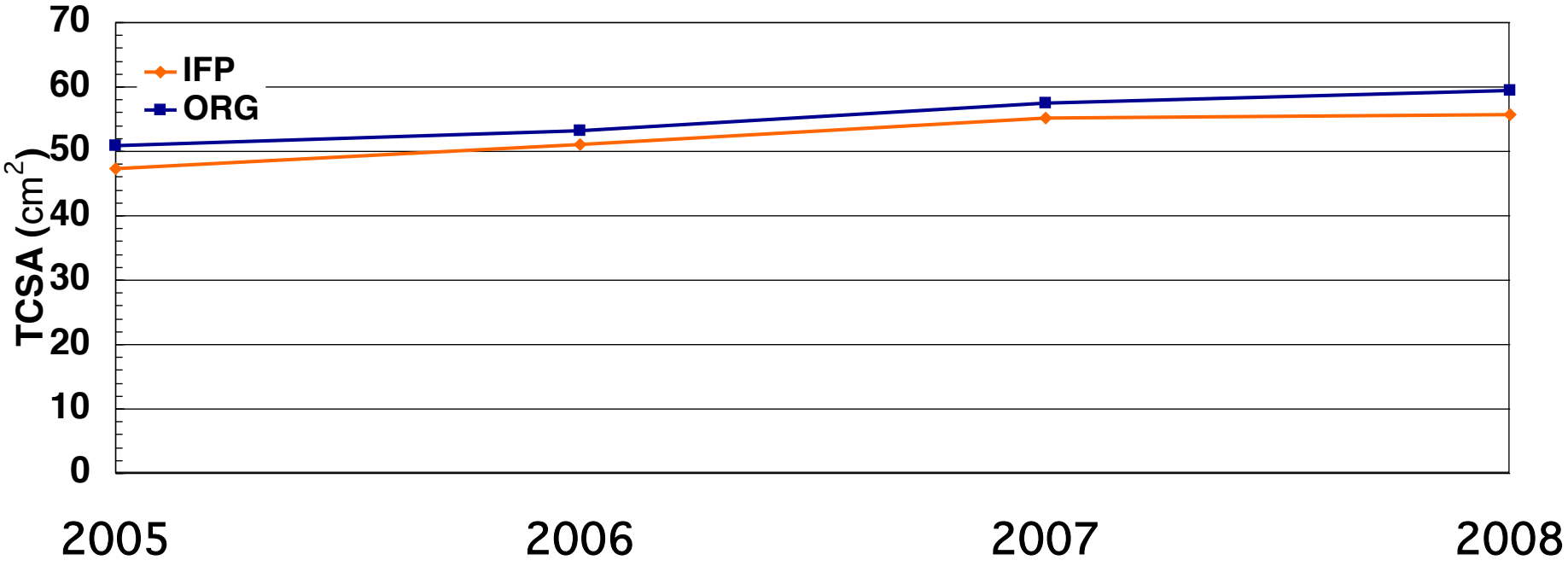

* $P < 0.05$

# Fruit Size - NY




* $P < 0.05$; Year*Treatment $P < .0001$

# Tree Size - NY




No difference between systems in TCSA, nor in the percent change between years.

* $P < 0.05$

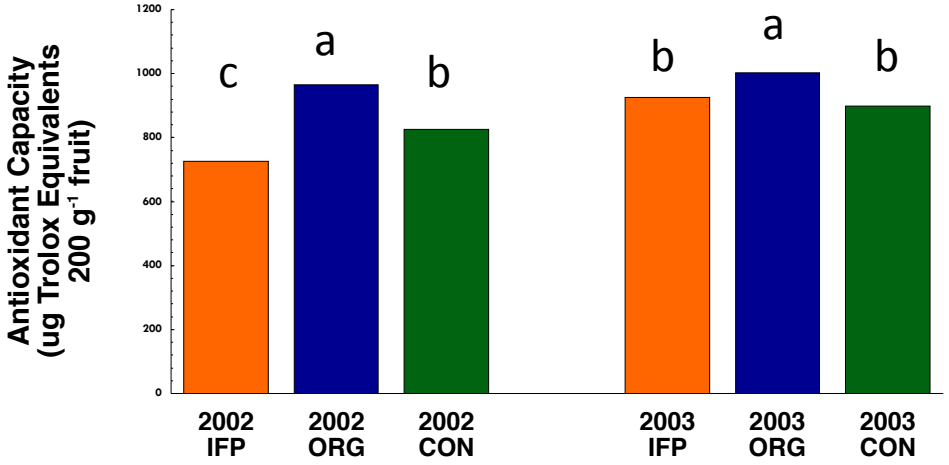
# Fruit quality - WA & NY

- WA -- Slight trend towards ORG fruit being firmer after storage
- NY -- Year-to-year variability, with no clear trend for greater fruit quality under either system
- No clear trends were found when comparing WA with NY

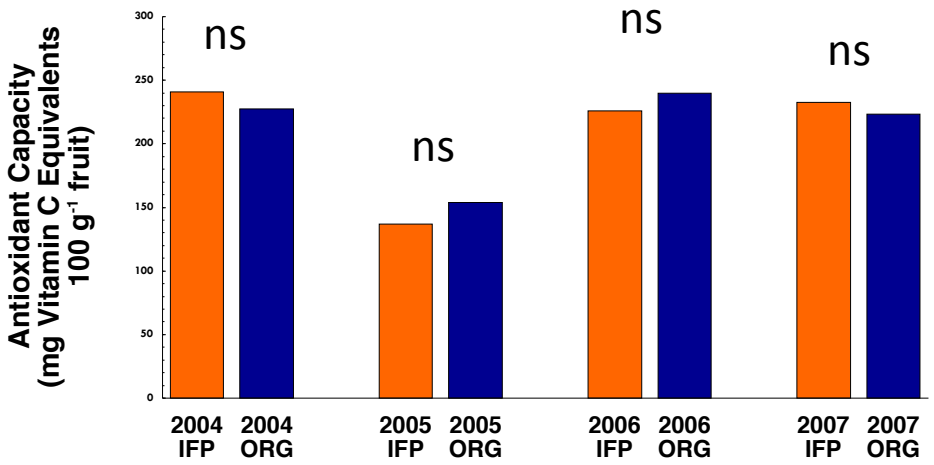

4
3
863
219

# Are organic apples more nutritious?

Antioxidant content was greater in organic fruit from WA, but not NY

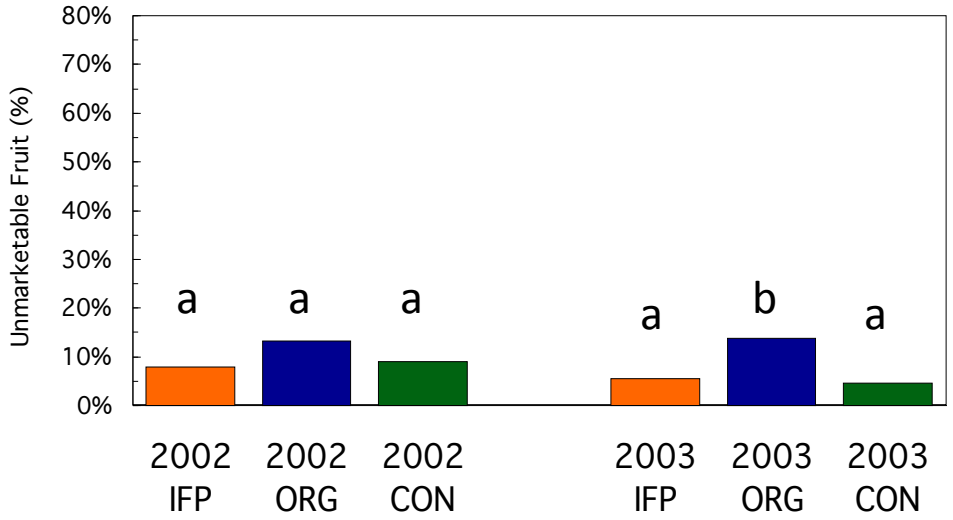



Washington

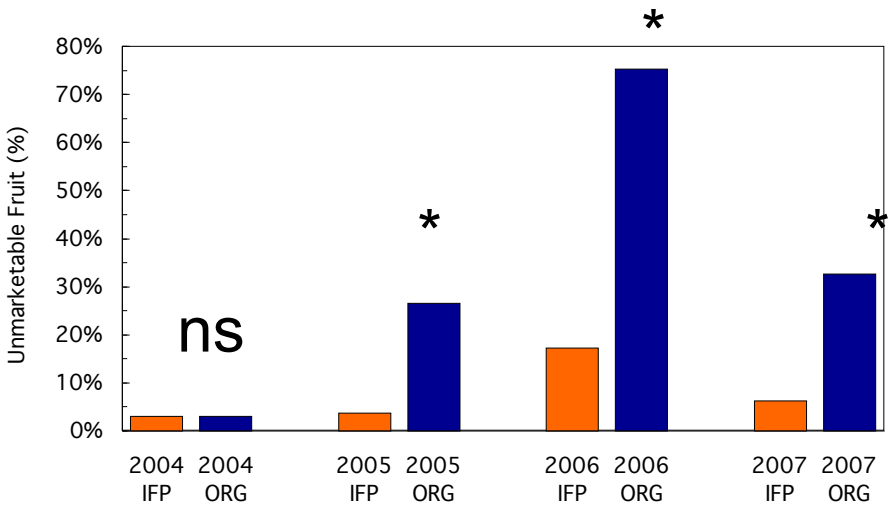



New York

# Fruit was unmarketable when there was insect damage or blemishes




Washington

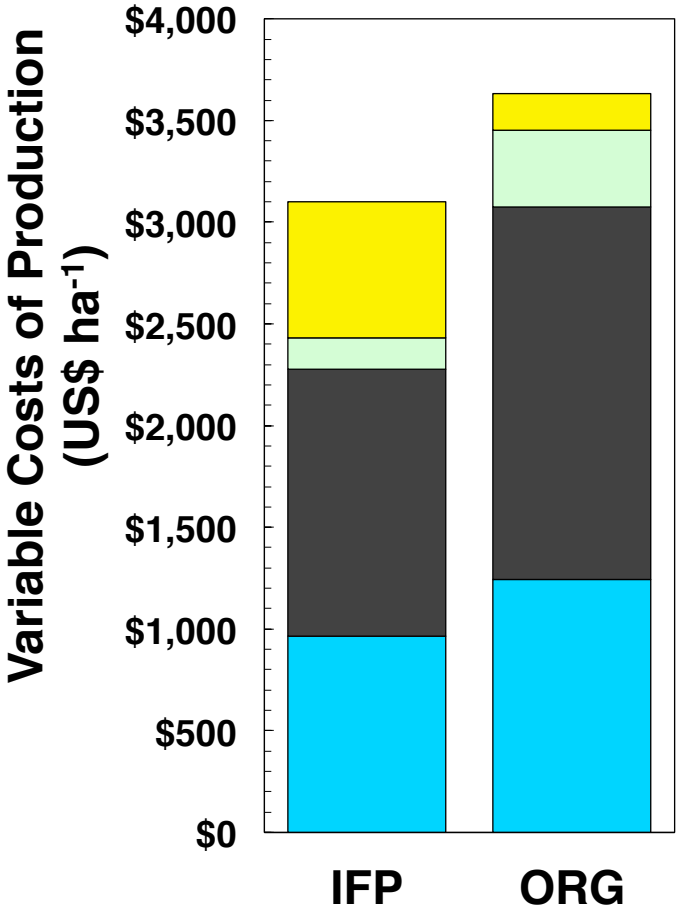



New York

Used USDA grading standards for determining marketability

* $P < 0.05$

# Variable Costs of Production (materials, labor, & machinery) Averaged per year (2004-2007)

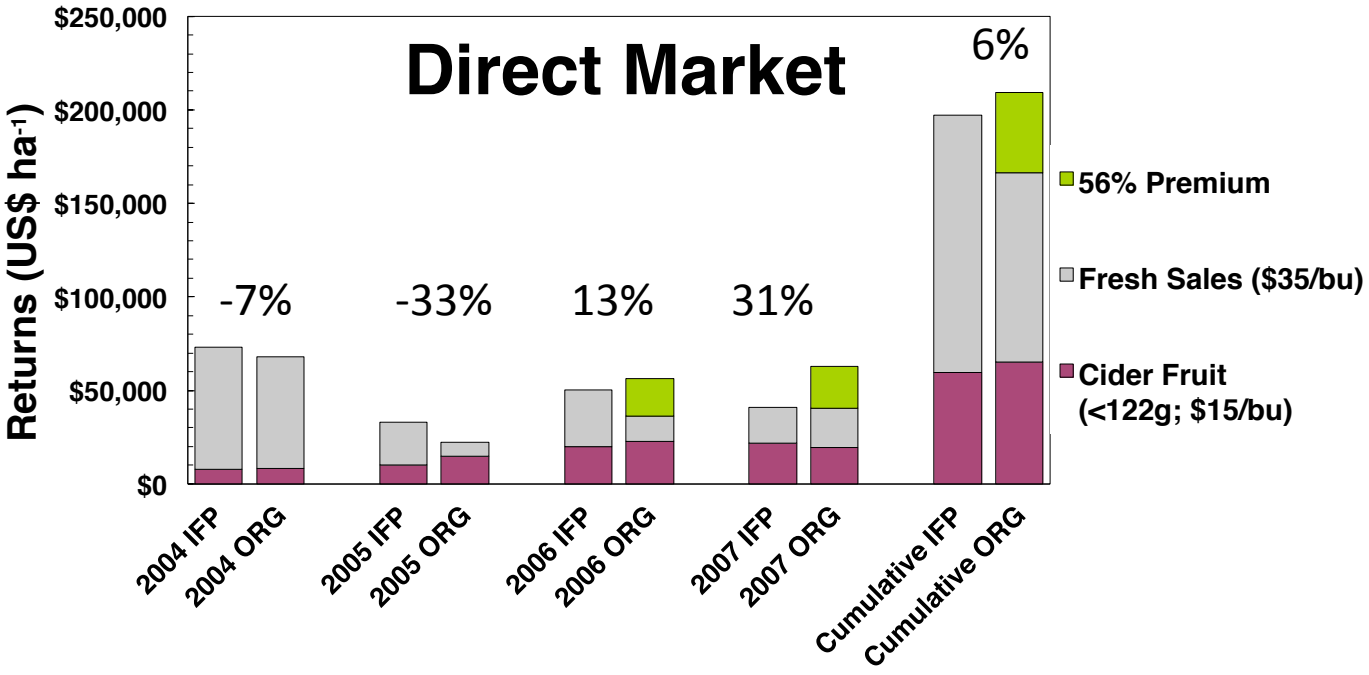


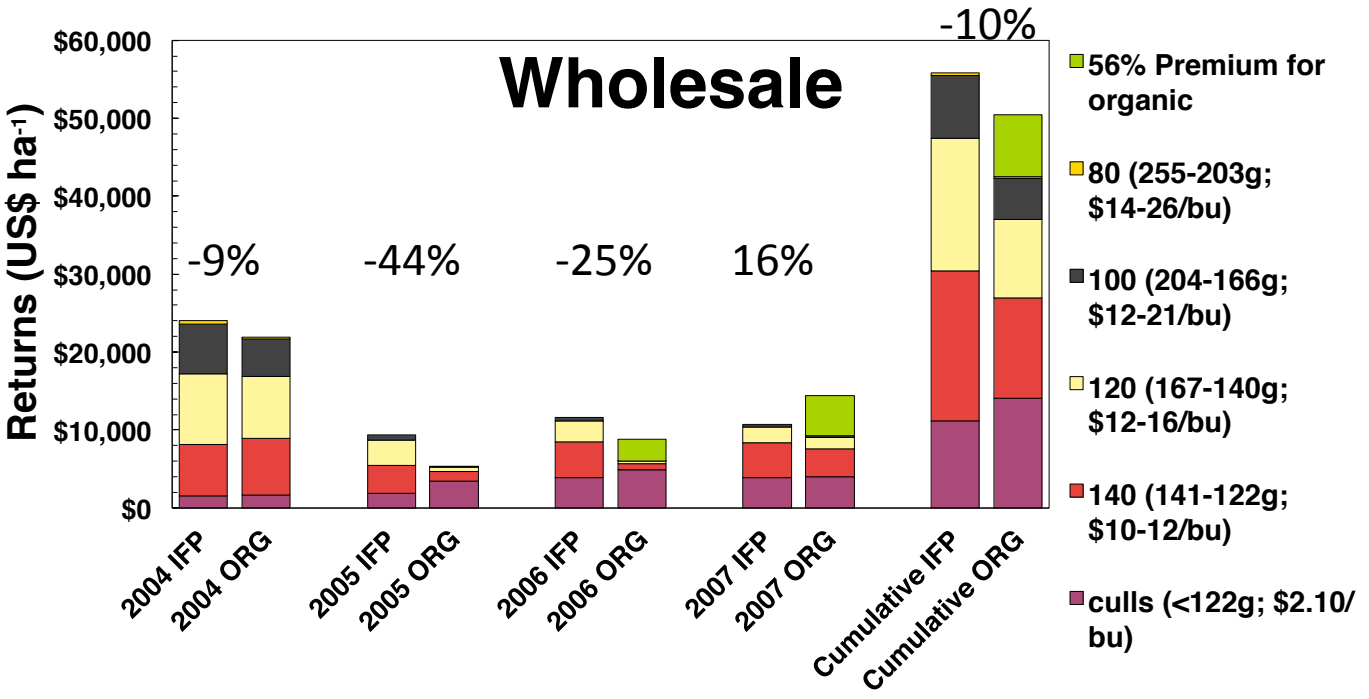

- Ground Cover/Weed Control - 366% less for ORG (33% less for ORG if using Herbicides alone)
- Fertilizers (Foliar & Ground) - 47% more for ORG
- Insect & Disease Control - 31% more for ORG
- Fruit Thinning - 22% more for ORG

**8% more for ORG overall,**

**17% more for ORG if no bark mulch in IFP**

# Gross Returns



# Economics - WA vs. NY

- In WA, organic apple production was as profitable as conventional...when there was at least a 35% price premium. IFP was not as profitable because there was no price premium. (Glover et al., 2002)

- In NY, a 56% organic price premium was used to equal the returns of IFP apples. Again, there was no IFP premium.

# A Grower's Guide to Organic Apples

NYS IPM Publication No. 223

Cornell University Cooperative Extension

IPM Integrated Pest Management

New York State Department of Agriculture & Markets

## Table of Contents:

- Organic certification & regulations
- Systems approaches
- Site selection
- Cultivar and rootstock selection
- Arthropod management
- Disease management
- Vertebrate management
- Allowable pesticides
- Crop load management
- Economics and marketing

## Available for free at:

**http://www.nysipm.cornell.edu/organic_guide/**

# A Grower's Guide to Organic Apples


## Primary Authors and Coordinating Editors

Gregory M. Peck*. Cornell University, Department of Horticulture, Ithaca.

Ian A. Merwin*. Cornell University, Department of Horticulture, Ithaca.

## Contributing Authors and Reviewers

Arthur Agnello*. Cornell University, Department of Entomology, NYSAES, Geneva.

*Insecticides; Common Apple Arthropod Pests*

Brian Caldwell*. Cornell University, Organic Cropping Systems Project, Ithaca; and farmer of organically managed orchards at Hemlock Grove Farms, West Danby.

*Site Selection and Orchard Design; Insecticides; Disease Control Materials*

Paul Curtis*. Cornell University, Department of Natural Resources, Ithaca.

*Wildlife Damage Management*

Ron Gardner, Sr. Cornell University, Pesticide Management Education Program, Ithaca.

*Pesticide Regulations; Pesticide Safety*

Michael Helms*. Cornell University, Pesticide Management Education Program, Ithaca.

*Pesticide Regulations; Pesticide Safety*

David Rosenberger*. Cornell University, Department of Plant Pathology, NYSAES, Hudson Valley Laboratory.

*Site Selection and Orchard Design; Disease Control Materials; Key Apple Diseases; Harvest and Postharvest Handling*

Elizabeth Thomas (New York State IPM Program, Geneva)

Christopher Watkins. Cornell University, Department of Horticulture, Ithaca.

*Harvest and Postharvest Handling*

**Pesticide Information and Regulatory Compliance*

Listing of 50 disease-resistant cultivars.

Information gathered from: resulting publications from:

- NE-183 trials
- PRI and Cornell-Geneva breeding program publications,
- The authors' personal experiences with the cultivars.



**Florina (Querina®)**: Fruit 50% red on yellow ground color, firm, small to medium size, sweet flavor. Whitish-yellow flesh, very crisp, low acid. Moderately resistant to fire blight. Deserves further evaluation.

**Galarina** (Gala × Florina): Developed in France. The medium size fruit matures one to two weeks after Gala. Skin color is 65-100% orange-red over greenish-yellow with flesh that is yellowish-white. The stem end of fruit is prone to russeting. Flavor is aromatic and slightly tart. Trees are moderately vigorous. A Gala-like apple that is resistant to apple scab and can be stored for longer periods.

**GoldRush** (formerly Co-op 38; Golden Delicious × Co-op 17): Medium-sized yellow-bronze apple maturing after Rome and three to four weeks after Delicious. Late maturity may limit its northern adaptability, but it hangs very well and ripens adequately after a few frosts. Fruit are ovate and regular, greenish-yellow at harvest turning to deep yellow in storage, sometimes with a fine net-like russet. Skin is non-waxy, tender, thin to medium in thickness with conspicuous russeted lenticels. Flesh is pale yellow, medium coarse-grained, firm, very crisp with a complex, spicy flavor; high in both sugar and acid levels; slow to brown when sliced. Develops a red blush on sun-exposed cheek. Eating quality is good at harvest and superb after a period of two months in storage. Stores at least seven months in refrigeration. High humidity during storage is recommended because non-waxy fruit surface makes it susceptible to shriveling. Must be thinned aggressively to achieve satisfactory size. Trees are slightly upright, with low vigor, limited branching, semi-spur bearing habit, and slight biennial tendency. Moderately resistant to powdery mildew and fire blight; susceptible to cedar apple rust. Suggested for both homeowner and commercial growers. Recommended for cider and juice as well.

**Jonafree** (formerly Co-op 22; PRI 855-102 × NJ 31): This mid-season red apple ripens with Jonathon and Delicious. Fruit color well and trees are annually productive. Flavor similar to Jonathan but less acid. Fruit are 75-95% medium red; medium-grained, light yellow to cream colored, firm, crisp and slightly breaking flesh, slightly tough until fully ripe; moderately acid, mild flavor, and juicy. Skin is thick, tough, and waxy. May be more acceptable in areas where Jonathan is a preferred cultivar. Off-flavors develop after two to three months of storage. Usually requires two

juicy. Flavor sub-acid to mild. Maintains firmness and crisp texture in refrigerated storage for over six months. Flavor becomes bland after nine months in storage and will develop off flavors after one year. Heavy and annual crops. Tree moderately vigorous, spreading, sturdy wood, heavy semi-spur type, with very little blind wood. Desirable growth and bearing habit. Leaves are moderately susceptible to rust, but fruit are resistant; field resistance to fire blight. Grown in France under organic production and licensed as an exclusive to Benoit ESCANDE (www.juliet.eu).

**Liberty** (PRI 54-12 × Macoun): Mid-season, somewhat striped, dark red apple maturing with Empire. Trees are consistently productive (equal to Empire) with good winter hardiness. Flesh is yellowish, moderately acid, juicy, crisp, aromatic and fine textured. Flavor and quality are excellent when picked at the right time, but harvest window is narrow. Requires multiple pickings for best quality. Fruit soften rapidly, develop off-flavors, and drop if left too long on tree. After hot growing seasons, fruit are very acid at the optimum harvest date but eating quality improves after several weeks of storage. Requires aggressive thinning to maintain adequate fruit size. Loses quality after several months in regular cold storage, but keeps longer if picked pre-climacteric and held in low-oxygen cold storage. Recommended scab-resistant cultivar for McIntosh growing regions for both homeowner and commercial production. Recommended for hard cider and juice.

**Macfree** (McIntosh × PRI 48-177): Mid-season red over greenish-yellow background apple. Fruit coloring is a problem in southern areas, just as with McIntosh. Flesh is juicy, white with a slight green tinge. Firm, moderately coarse, pleasant, moderately acid. Fruit size is medium to small. Biennial tendency. Susceptible to mildew and cedar apple rust.

**McShay** (McIntosh × PRI 612-4): Fruit mature in early September. The fruit are attractive with a green undercolor and a dark red blush covering 70% of the surface. The skin has a light bloom and polishes to a bright shine equivalent to that of McIntosh. Fruit lenticels are white and moderately conspicuous. No russeting has been observed. The skin is thin and the flesh is fine-textured, moderately firm, juicy, and light green with a good balance of sugars and acids. The fruit retains its flavor and texture for two to three months in refrigerated storage, then softens in a manner similar to McIntosh. Trees are vigorous, with an upright growth habit and a tendency to develop spurs. McShay produces good annual crops. Susceptible to powdery

**Table 4.1. Apple rootstocks.**

| Rootstock | Percent of Standard Tree Size[1] | Yield Efficiency[2] | Yield Precocity | Need for Support? | Fire Blight Resistance | Collar and Root Rot Resistance | Replant Disease Resistance | Cold Damage Tolerance | Comments |
|---|---|---|---|---|---|---|---|---|---|
| P.22 | < 30 | High | High | Required | Susceptible | Resistant | Unknown | High | Suckers profusely |
| M.27 | < 30 | Medium | High | Required | Susceptible | Variable | Low | Fair | Limited availability |
| G.65 | < 30 | Very | High | Required | Moderate | Moderate | Low | Fair | Limited availability |
| Bud.146 | < 30 | High | High | Required | Susceptible | Unknown | Unknown | High | Limited availability |
| Bud.491 | < 30 | High | Low | Required | Susceptible | Susceptible | Unknown | High | Limited availability |
| P.16 | < 30 | High | High | Required | Susceptible | Resistant | Unknown | High | Extensively planted in Eastern Europe |
| MARK | < 30 | Low | Low | Required | Susceptible | Moderate | Susceptible | Fair | Not recommended. Trees fail due to massive burr knots |
| M.9 | < 30 | High | High | Required | Susceptible | Moderate | Susceptible | Fair | Most common full-dwarf rootstock |
| Bud.9 | < 30 | Very | High | Required | Resistant | Moderate | Susceptible | High | Increasing popularity among US growers |
| P.2 | 30-55 | Very | High | Required | Susceptible | Unknown | Unknown | High | Limited availability |
| G.16 | 30-40 | High | High | Required | Resistant | Resistant | Susceptible | High | Virus sensitive |
| O.3 | 30-40 | High | High | Recommended | Susceptible | Resistant | Moderate | High | Virus sensitive |
| G.11 | 30-40 | High | High | Required | Resistant | Resistant | Moderate | Good | Limited availability |
| G.41 | 30-40 | High | High | Required | Resistant | Resistant | Resistant | Good | Limited availability |
| M.26 | 40-50 | High | High | Recommended | Susceptible | Moderately susceptible | Low | Good | Does not tolerate droughty or poorly drained soils |
| G.30 | 50-60 | High | High | Required | Resistant | Resistant | Moderate | Good | Weak graft unions |
| M.7 | 55-65 | Fair | Low | Not required | Resistant | Moderate | Moderate | Poor | Can be overly vigorous on fertile soils; Useful for low-vigor cultivars; Suckers |
| CG.6210 | 55-65 | High | High | Recommended | Resistant | Resistant | Resistant | Good | Limited availability |
| MM.106 | 65-85 | Good | Medium | Not required | Susceptible | Susceptible | Moderate | Poor | Requires well-drained soils and long, mild growing season |
| Bud.490 | 65-85 | Low | Low | Not required | Susceptible | Susceptible | Moderate | Good | Vigorous! |
| MM.111 | 65-85 | Low | Low | Not required | Susceptible | Susceptible | Moderate | Good | Drought resistant; extensive rooting; Vigorous! |
| Bud.118 | 65-85 | Low | Low | Not required | Resistant | Susceptible | Moderate | Good | |
| P.18 | 65-85 | Fair | Low | Not required | Resistant | Resistant | Moderate | Good | Does well in poorly drained soils |
| Seedling/ Standard | 100 | Poor | Poor | Not required | Variable | Variable | Variable | Variable | Seedling trees highly variable due to genetic differences in seeds |

[1] Based upon a standard seedling rootstock being equal to 100%. Ultimate tree size will depend upon scion variety, height of bud union above the soil line, and environmental factors such as soil fertility and water supply.

[2] Yield efficiency is ratio of expected fruit production (lbs) to tree size (trunk cross-sectional area)

Comprehensive table of organically acceptable fertilizer inputs.



**TABLE 5.4. Organic fertilizers and soil amendments. Read product label for application rates. Check with your certifier about the acceptability of specific products and name brands.**

| Material | Nutrient content<br>Percent by weight of N-P-K or other minerals as noted. Diamond between N-P-K concentrations denotes different product formulations. | Comments |
|---|---|---|
| Alfalfa meal or pellets | 2.5-1-1 ♦ 5-1-2 | Slow release nitrogen source; also a moderate source of calcium |
| Azomite (powder or pellets; also called "rock dust") | 0-0-2.5; plus magnesium, 5% calcium, and 67 other trace minerals | Mined aluminosilicate from an ancient marine deposit in Utah; name is derived from the phrase: "A to Z of Minerals Including Trace Elements" |
| Bat guano | 0-7-0 ♦ 3-10-1 ♦ 8-4-1 ♦ 10-3-1 | Rates vary depending upon guano source; quick release nitrogen and phosphorus; highly soluble |
| Blood meal | 12-0-0 ♦ 13-0-0 ♦ 13-1-0 | Readily available nitrogen source; by-product of meat rendering |
| Bone meal | 2-11-0; 22% calcium ♦ 3-15-0; 24% calcium ♦ 3-22-0; 30% lime I 5-10-0 | Readily available phosphorus source; also a calcium source; can increase soil pH |
| Canola meal | 5.5-0-0 ♦ 6-2-1 | Slow release nitrogen source; recovered from canola oil pressing |
| Corn gluten meal | 10-0-1 | Some pre-emergent herbicidal activity |
| Cottonseed meal | 6-2-1 | Slow release N-P-K; somewhat acidic |
| Epsom salts | 9.9% magnesium; 12.2% sulfur | Magnesium sulfate |
| Feather meal | 13-0-0 | Slow release nitrogen; hydrolyzed ground feathers |
| Fertibor | 15% boron | Natural, mined, and purified boron; slow release; can be phytotoxic if over-applied |
| Fish bone meal | 3-16-0; 14% calcium | Can be used as bone meal |
| Fish emulsion | 3-1-1 ♦ 4-2-1 ♦ 5-1-1 | Liquid fish protein that has been enzymatically digested and then stabilized with phosphoric or sulfuric acid; concentrations vary depending upon source and manufacturer |
| Fish meal | 10-4-0 ♦ 10-6-2 | Slow release |
| Fish oil | | Spreader sticker; purported UV stabilization |
| Fish powder | 11-0.25-1 ♦ 12-1-1 | Enzymatically hydrolyzed fish protein; usually applied to foliage or through irrigation systems |
| Glacial rock dust | Ca, Fe, Mg, K, plus trace elements and micronutrients | Mined material from Canadian moraines; readily available; purportedly can increase phosphorus availability and improve cation exchange capacity |

## 6. Groundcover and Weed Management

Managing orchard understory vegetation is important for weed suppression, attracting and sustaining beneficial arthropods that prey upon foliar and fruit pests, and protecting the soil surface beneath trees from erosion, weathering and organic matter loss. However, planted groundcovers and weeds in the tree row can also compete excessively with trees for water or nutrients, and provide habitat for voles (*Microtus sp.*) and other rodents. Weed management is often cited as one of the main challenges in organic production.

Under NOP regulation §205.206(c), weed problems may be controlled through:

(1) Mulching with fully biodegradable materials
(2) Mowing
(3) Livestock grazing
(4) Hand weeding and mechanical cultivation
(5) Flame, heat, or electrical means; or
(6) Plastic or other synthetic mulches—provided that they are removed from the field at the end of the growing or harvest season.

When weeds are allowed to grow in the tree row they can stunt tree growth, especially during orchard establishment, as well as reduce yields and fruit size. The optimal area for weed management around trees is determined by soil type, tree age, and irrigation availability. In dwarf and semi-dwarf plantings, weeds should be controlled from the tree trunks out to 2 to 4 feet in all directions. Smaller weed-free areas may be sufficient in orchards with irrigation or very fertile soils. In Northeast orchards the most critical months for weed competition with fruit trees are May, June and July; during autumn and the winter months tree requirements for soil nutrients are reduced. Therefore, groundcovers and weeds during nine months of the year have minimal competitive effects on fruit trees, and can provide beneficial protection for soil quality.

The drive-lane (the area between the tree-rows) is usually planted with a turfgrass, although it is possible to plant different species in that area. In most orchards there is an endemic seed bank of clovers (*Trifolium* spp.), plantain (*Plantago* sp.), dandelions (*Taraxacum officinale*), and other herbaceous broadleaf plants that will naturally establish within a mowed grass lane. Drive-lane vegetation improves traction for orchard equipment, reduces soil rutting and compaction, minimizes dust and mud, and can provide biodiversity for the

Orchard groundcover management is an active area of research and there are no generic recommendations that are appropriate for all sites. Most organic apple growers integrate mulch, compost, or dormant-season cover crops in combination with mechanical cultivation in the tree-rows during the growing season. Below is a description of some of the more common groundcover management methods used in organic orchards.

### Cover Crops

Integrating cover crops under apple trees offers important benefits. However, it is difficult to find the right balance between beneficial cover-crop impacts and the negative effects of cover crops as "weeds" that compete with trees for water and nutrients, and may provide ideal vole and rodent habitat. The ideal cover crop should be low growing, non-competitive with trees, and non-invasive. Both perennial and annual cover crop species have been tested in orchard situations, as have legumes, other broadleaf plants, and grasses. Research has shown that it is difficult to keep tree-row cover crops at a high plant density and weed free.

The best choices for perennial groundcover within tree rows and drive lanes of orchards where mowing will be the primary weed management practice, or livestock will be pastured, are probably cool season fine-leaf fescues such as hard fescue (*Festuca duriuscula*), sheep fescue (*F. ovina*), or red fescue (*F. rubra*). These grasses hold up well under machinery and foot traffic, and tend to cease growth during hot weather in mid-summer when water and nutrients are most limiting for fruit trees. The fine-leaf fescues are also low in stature, and do not provide as much protective cover for meadow voles as other more vigorous cover crops and grasses.

### Biomass Mulch

Mulch has many positive attributes that make it an attractive option for organic operations. It can stabilize and protect the soil surface, increase organic matter content in the soil, act as a slow release fertilizer, conserve soil moisture, moderate soil temperature, and stimulate biological activity in the topsoil.

A layer of wood chips, bark, straw, or other organic material applied to a depth of three to six inches can help suppress many weeds by blocking sunlight from hitting the soil surface, thus preventing seed germination and slowing weed growth. When applied onto a weed-free soil, a thick layer of mulch may effectively control weeds for one to two years. When mulch is applied onto a weedy soil, weed suppression will not be as effective. Eventually some weeds (particularly deep

## 11. INSECTICIDES

Organic pest control is based upon cultural, physical, and biological practices, combined with the use of NOP allowed pesticides as specified on the National List. Growers are encouraged to manage habitat to enhance natural enemies of pests and to safeguard and release biological control agents whenever feasible.

However, apples and other tree-fruits in the cool humid Northeast face arthropod and disease pressures that are much greater than most other crops, or than apple orchards in the arid Northwest. In a NY apple orchard the dynamic equilibrium between biocontrol agents and pest populations does not provide sufficient natural control of pests that infest the fruit (known as **direct** fruit pests). Surveys of abandoned orchards in the Northeast show that—in addition to fungal and bacterial disease damage to foliage and fruit—more than 95% of the apples in these orchards are severely damaged by pests such as plum curculio (*Conotrachelus nenuphar*), tarnished plant bug (*Lygus lineolaris*), apple maggot (*Rhagoletis pomonella*), codling moth (*Cydia pomonella*), oriental fruit moth (*Grapholita molesta*), and leafrollers (Tortricidae). When they are not disrupted by broad-spectrum pesticides, natural biological controls such as predatory wasps, syrphid flies, coccinellid beetles, and insectivorous birds can usually provide adequate control of insects and mites that infest the leaves and shoots of fruit trees (known as the **indirect** foliar pest complex). In a commercial setting these beneficial predators rarely provide suppression of direct fruit pests adequate enough to produce marketable fruit. For these reasons, pesticide applications are almost always necessary in Northeast organic apple orchards.

Pesticides must be currently registered with the New York State Department of Environmental Conservation (DEC) to be

**SPINOSAD** (Entrust® Naturalyte® Insect Control, GF-120® NF Naturalyte® Fruit Fly Bait)
Spinosad is a naturally derived insecticide composed of spinosyns in alpha and delta stereoisomer forms, produced by aerobic fermentation of the actinomycete species, *Saccharopolyspora spinosa*. This rare bacterium was originally found in soil samples collected outside a Caribbean rum distillery. Spinosad acts as both a contact and stomach poison by over-activating the insect's nervous system and causing loss of coordination. Insects die of exhaustion within one to two days. Without a penetrating adjuvant, there is minimal movement of spinosad into the leaf surface. Depending upon light conditions and rain, spinosad residues will last from 2 to 14 days. The use of a UV protecting adjuvant will extend its effective period.

Spinosad is a fast-acting, somewhat broad-spectrum material that has greatest activity against insects in the Lepidoptera (caterpillars), Coleoptera (beetles), Thysanoptera (thrips), and

**EUROPEAN APPLE SAWFLY** ***(Hoplocampa testudinea)***

***IPM strategy:*** Prior to bloom, monitor adults with non-UV reflective white sticky boards that mimic blossom color.

***Biological:*** As this is a non-native species, few natural enemies exist in Northeastern orchards.

***Cultural:*** Remove infested or dropped fruit. Trap out with white sticky boards.

***Pesticidal:*** Kaolin clay; pyrethrum; spinosad (there are no OMRI approved spinosad products currently labeled for European apple sawfly). Many insecticides used for European apple sawfly will also adversely affect honeybees, which are closely related to sawflies.

**TABLE 17.1. Some direct production related costs for managing a 'Liberty' apple orchard.**

| Costs | $/acre/yr |
|---|---|
| *Machinery Operation* | |
| Tractor + Airblast sprayer | 93 |
| Tractor + Wonder Weeder (three cultivations per year) | 13 |
| Applying chicken manure compost (once every three years) | 24 |
| Total machinery costs | 130 |
| *Materials* | |
| Dormant spray (copper and Stylet oil) | 47 |
| Insecticides | 233 |
| Kaolin clay | 143 |
| Pheromone mating disruption ties (for codling moth and oriental fruit moth) | 181 |
| Fungicides | 17 |
| Adjuvants | 11 |
| Thinning chemicals (liquid lime sulfur and Crocker's fish oil) | 150 |
| Foliar fertilizers | 75 |
| K-Mag (Sul-Po-Mag) | 94 |
| Chicken manure compost (applied once every three years) | 16 |
| Total material costs | 967 |
| *Labor* | |
| Tractor airblast spraying | 102 |
| Chicken manure application (applied once every three years) | 22 |
| Cultivation | 17 |
| Hand hoeing | 72 |
| Hanging pheromone ties | 24 |
| Hand thinning | 347 |
| Harvesting | 1,222 |
| Total labor costs | 1,806 |
| ***Grand Total*** | 2,903 |

| Barrier | Issue |
| --- | --- |
| Crop-load management | • Lime sulfur/oil is phytotoxic<br>• Hand thinning is costly<br>• Small fruit size |
| Weed/ground-cover management | • No effective herbicides for grasses or perennials<br>• Reliance on cultivation<br>• Nutrient competition with trees |
| Scab | • Marketability of disease-resistant cultivars<br>• Vf gene is losing effectiveness<br>• Reliance on sulfur and liquid lime sulfur |
| Fire blight | • Possible de-listing of antibiotics by the NOSB |
| Invasive pests | • Brown marmorated stink bug! |
| Markets | • Hard to compete with regions with more favorable climate (WA)<br>• Low acceptance for blemished fruit (SB/FS; Russet; superficial insect damage, etc.) |
| Costs | • Greater labor costs from thinning and weeding<br>• Organic materials tend to be more expensive and need to be applied more often |

# What will it take to grow organic apples in the Northeast?
## A system developed from the ground up

An efficient orchard design with trees that allow good spray penetration and are small enough to allow for greater hand work

Disease resistant rootstock with high nitrogen use efficiency

Disease resistant cultivars and careful management of the Vf gene

Cropload management with lime sulfur and oil and/or mechanical thinners

Mechanical weed control

Disease control based on lime sulfur, sulfur, copper, streptomycin, and to a lessor extent (but possibly more in the future) on biocontrols

Arthropod management based on pheromone mating disruptions, kaolin clay, Bt, granulosis virus, and spinosad – and to a lessor extent pyrethrums and neem oil

Appropriate expectations from growers and buyers—somewhat lower yields, russet, greater disease and insect damage

High premiums!

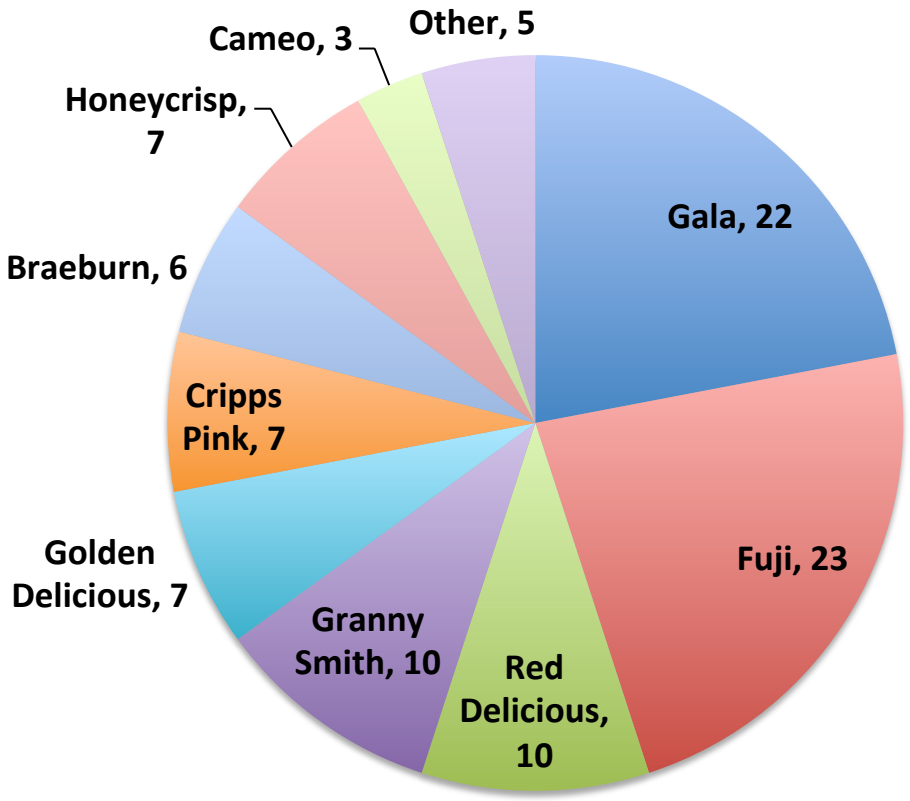
# Surround (kaolin clay)

# Mechanical cultivation


# The Voen Orchard Covering System


# What varieties to grow

- Washington State – mainstream cultivars




- East Coast--Disease Resistant Cultivars
  - Liberty
  - GoldRush
  - Enterprise
  - Pristine
  - Crimson Crisp
  - Galarina?
  - Florina (Querina®)?
  - Modi?
  - Honeycrisp?

Kirby and Granatstein, 2012

# Marketing Challenges for East Coast Growers

Poor quality fruit being sold as organic

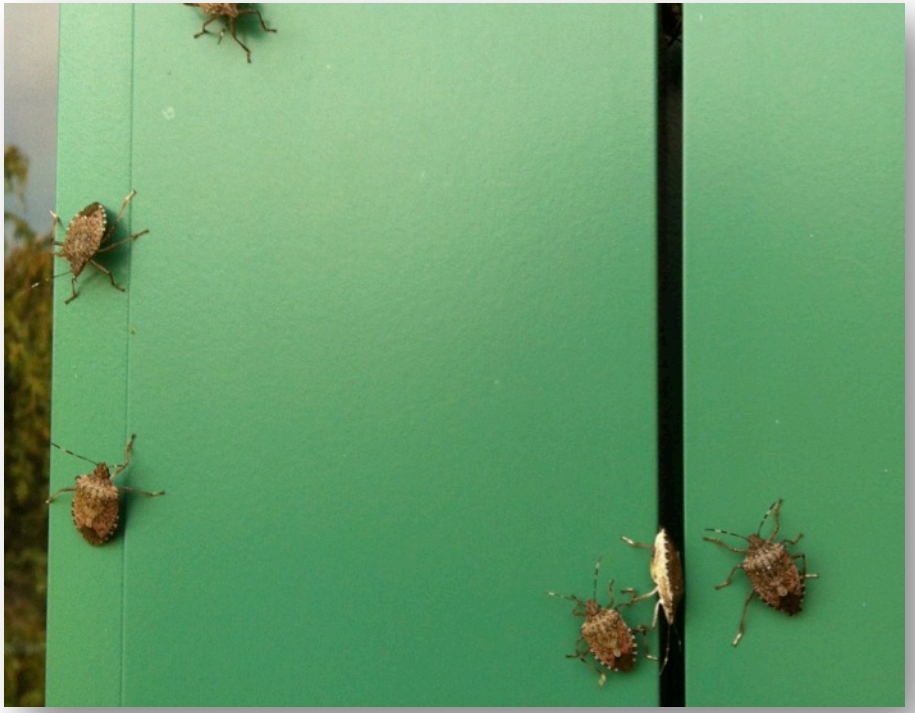

Imported fruit


Unknown cultivars


Equal pricing, but not equal costs of prodution

# Pest control is not going to get easier...

Brown Marmorated Stink Bug



# Partial List of Land-Grant Universities in the East Conducting Organic Apple Research

| Institution | Project | Status |
|---|---|---|
| UVM | OrganicA | Established |
| Cornell | High-density plantings in Geneva and Hudson River Valley | Under establishment |
| Cornell | Demonstration plot with 'Liberty'<br>Several studies on organic pest and disease control | Established |
| PSU | "PROFIT" (Pennsylvania Regional Organic Fruit Industry Transition) | Established plots in Biglerville and Rock Springs |
| MSU | Plots in Clarksville Research Center | Established |
| Univ of Arkansas | Various trials with ground-covers and crop load management | Established |
| Univ of Maine | Plots to study weed control in organic orchards | Established |


March 12, 2007

# Where to go from here?

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