Polyculture, Plastic, Pests & Profitability: An Alliteration of an Ecosystem

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http://ipm.osu.edu

IPM

Ohio Integrated Pest Management

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- HOME
- OHIOLINE
- ENTOMOLOGY
- EXTENSION ENTOMOLOGY
- HORTICULTURE & CROP SCIENCE
- PLANT PATHOLOGY
- OARDC
- VEGNET

latest updates

The Ohio State Integrated Pest Management (IPM) program is a comprehensive program that is designed to encourage collaboration and innovation among Ohio Agricultural Research and Development Center (OARDC) scientists and Ohio State Extension personnel to better address the pest management needs of the citizens of Ohio. Our goal is to reduce the environmental, economic and social risk associated with managing pests (insect, disease or weed). To accomplish this goal we work with OSU collaborators in 5 areas of emphasis to evaluate and disseminate new IPM information. These areas are Agronomic IPM, High Value Crop IPM, Conservation Partnerships, Pest Diagnostics, and School IPM. In addition this year we will enhance our collaboration with the Cleveland Botanical Garden Green Corp. Urban Youth Program.

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- Annual Reports
- Cornell Organic Guides
- Crop Profiles
- Elements of IPM
- Fruit
- IPM Internal Grant Program
- Lady Beetle Information
- Links
- Modular Ecological Design
- Newsletter
- People

The Project and P'in

- Polyculture – different commodities- J. Scheerens
- Plastics – high tunnels, landscape cloth – M. Kleinhenz
- Pests – arthropods, diseases, weeds – Ent., Plant Path
- Profitability – economics – Me, Checkbook Joe!
- Practical – Mod. Ecol. Design - J. Cardina
- Peaceful – calming aesthetics – J. Finer
- Prevention - Nature Bats Last!

Ecologically Based IPM

- General Principles
  - Select and grow a diversity of crops that have natural defenses against pests
  - Choose varieties with resistance or tolerance
  - Build the soil with organic matter

Integrated Pest Management
Builds on strengths of natural systems
(Ecomimicry)

- Three concepts
  - Ecosystem Stability
  - Biodiversity
  - Biological Control

Ecosystem Stability

- Ecosystems with more diversity
  - Are more stable
  - Greater resistance
    - Ability to avoid or withstand disturbances
  - Greater resilience
    - Ability to recover from stress

Ecosystem Stability

- Reduce tillage/cultivation - fewer weeds
- Reduce mowing - less disruption, increase beneficials
- Maintain “permanent” ground covers
- Add organic matter - substrate for good MO’s
- Use cover crops - inc. moisture retention
- Use crop rotation - breaks pest cycle
- Increase crop diversity - more difficult to find
- Create corridors - highways of habitat

Biodiversity
(sp. richness and eveness)

- Spatial diversity - across a landscape, within fields
- Genetic diversity - different varieties, different crops
- Temporal diversity - different crops at different stages of growth

What is Biological Control?

- The regulation of pest population densities below and economic injury level via a biological antagonist

Biological Control Potential?

- Many pest pop. are regulated below plant damaging levels by naturally occurring enemies (500 pests of apples in OH)
- There is extensive evidence for successful biocontrol
- Biocontrol is not a panacea; it will not work in some situations

Biological Control Impediments

- High cost of beneficials - raise plant/prey/predator, entomopathogens
- Availability & quality of biologicals
- Documenting success
  - Success rate (15-20%)
  - Usually best in Greenhouses, Islands, California (High tunnels?)
- Don't buy biocontrol insects for small outdoor plots

Enhancing Beneficials/Biocontrol

- Characteristics typical of fields with plenty of indigenous beneficials
  - Fields are small - a lot of edges, natural vegetation
  - Cropping systems are diverse
    - Include perennials and flowering plants
  - Crops are managed with minimal agrichemical inputs
  - Soils high in organic matter, biological activity during off season
    - Covered with mulch or vegetation

Fertility

- Slow release of nutrients the best,
  - any compost is good compost (yard waste, dairy barn, vermicompost)
- Pests seem to follow the Nitrogen (plant suckers i.e. mites & aphids) or follow High tunnels because of growth?
- Too much synthetic fertilizer cause nutritional imbalances

Modular Ecological Design

Goal - to determine optimal layout of an intensive fruit & vegetable polyculture system that mimics natural systems & can be used by the small periurban or urban farmer.

Modular

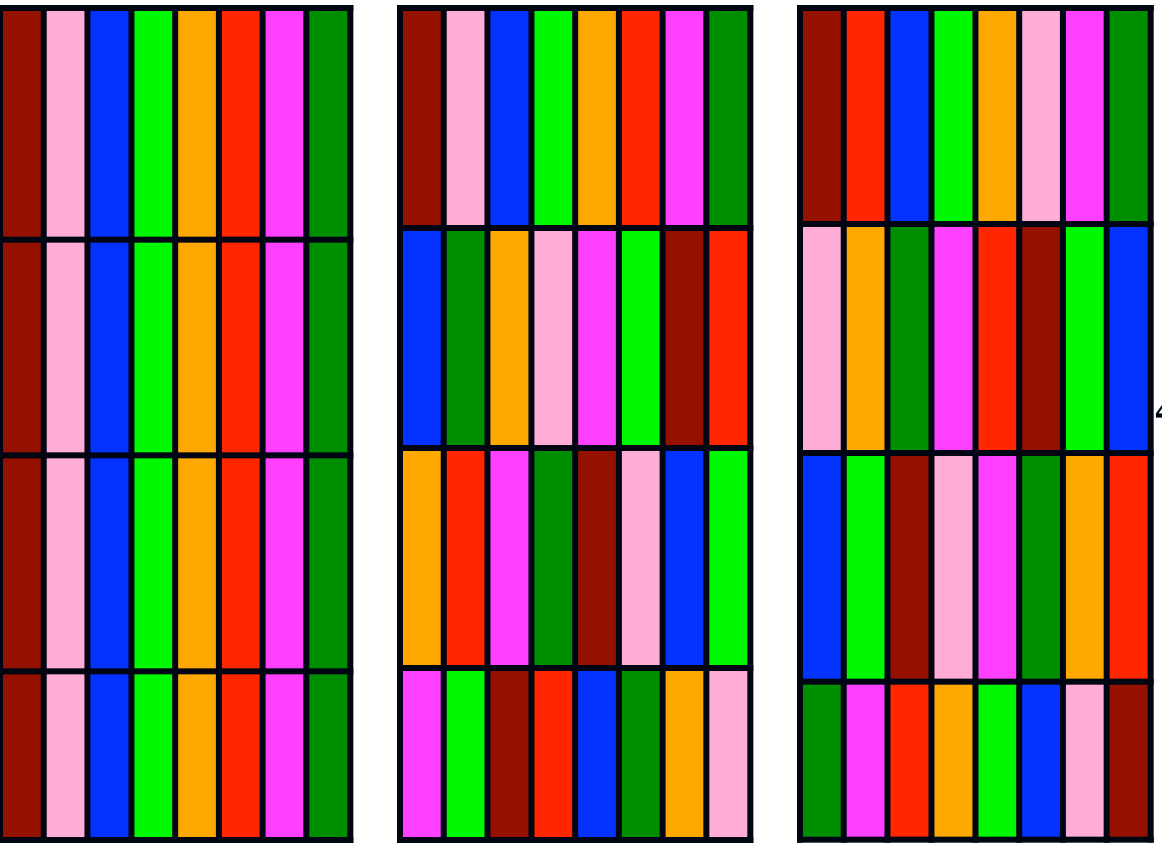
Pest density

Efficiency

Economics
-$10/ft of row
-$90 K/A

August 2005

Commodities and Treatments



Early, Mid, Late cultivars

4 trees/shrubs

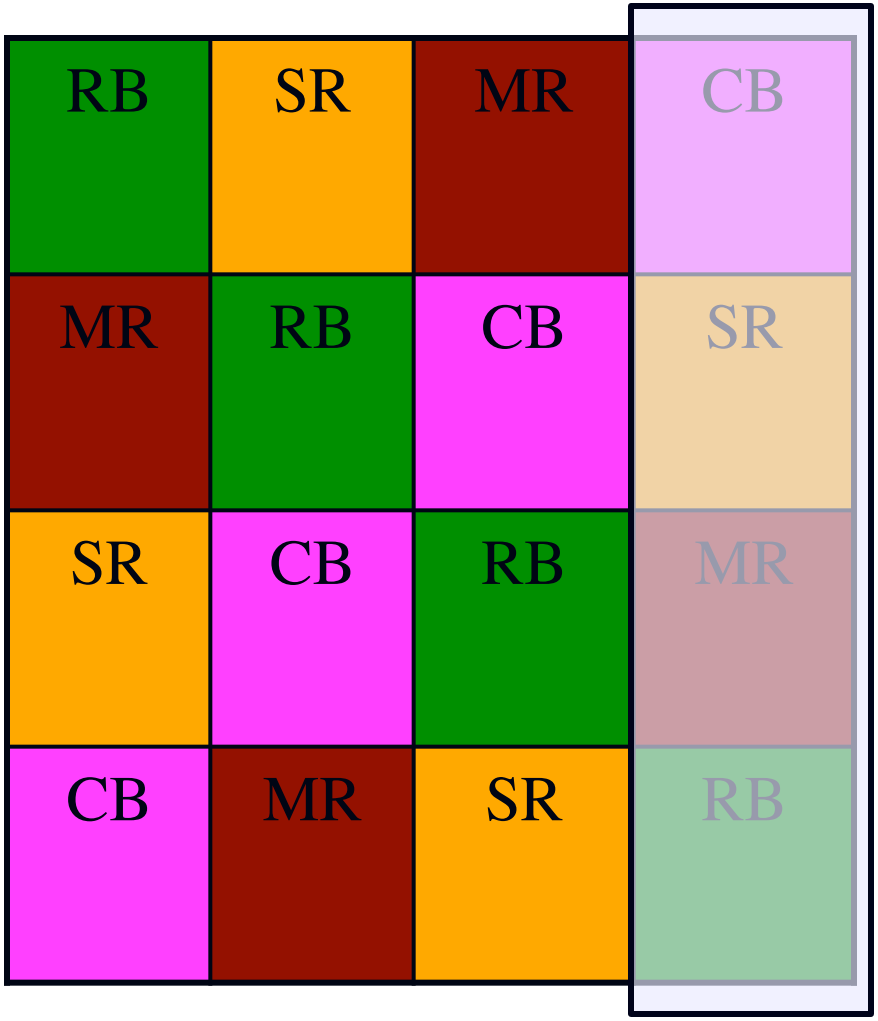
I. Apples(SwC)
II. Peaches
III. Blueberries
IV. Raspberries

4 herbaceous

Strawberries
Edamame soybeans
Tomatoes
Green beans

The fourth treatment (not shown) is a mixed row configuration on raised beds.

Layout of plots



RB = Raised Bed

SR = Solid Row

MR = Mixed Row

CB = Checker Board

Each plot - 44’ x 60’

Total Acres - 1.4 A

2007

Raised Beds

April 2005
($1.20/ft)

April 2005

Yard Waste Compost
May 2005

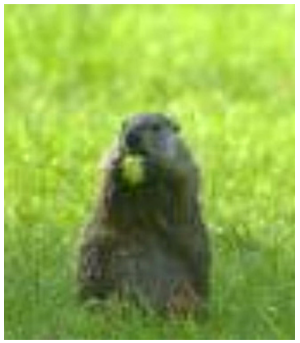
May 2005

May 2005

Tree and Bush Planting

May 2005

Groundhog, Rabbit, Deer Fence



June 2005

I garden therefore I fence

June 2005

June 2006 - Weeding Cost

2005 Weeding Costs - $1.35/ft

Labor hrs (760 hr) = $6,080

2006 Cost - $0.37/ft

Landscape Cloth = $1,250

Labor (214 hr) = $1,612

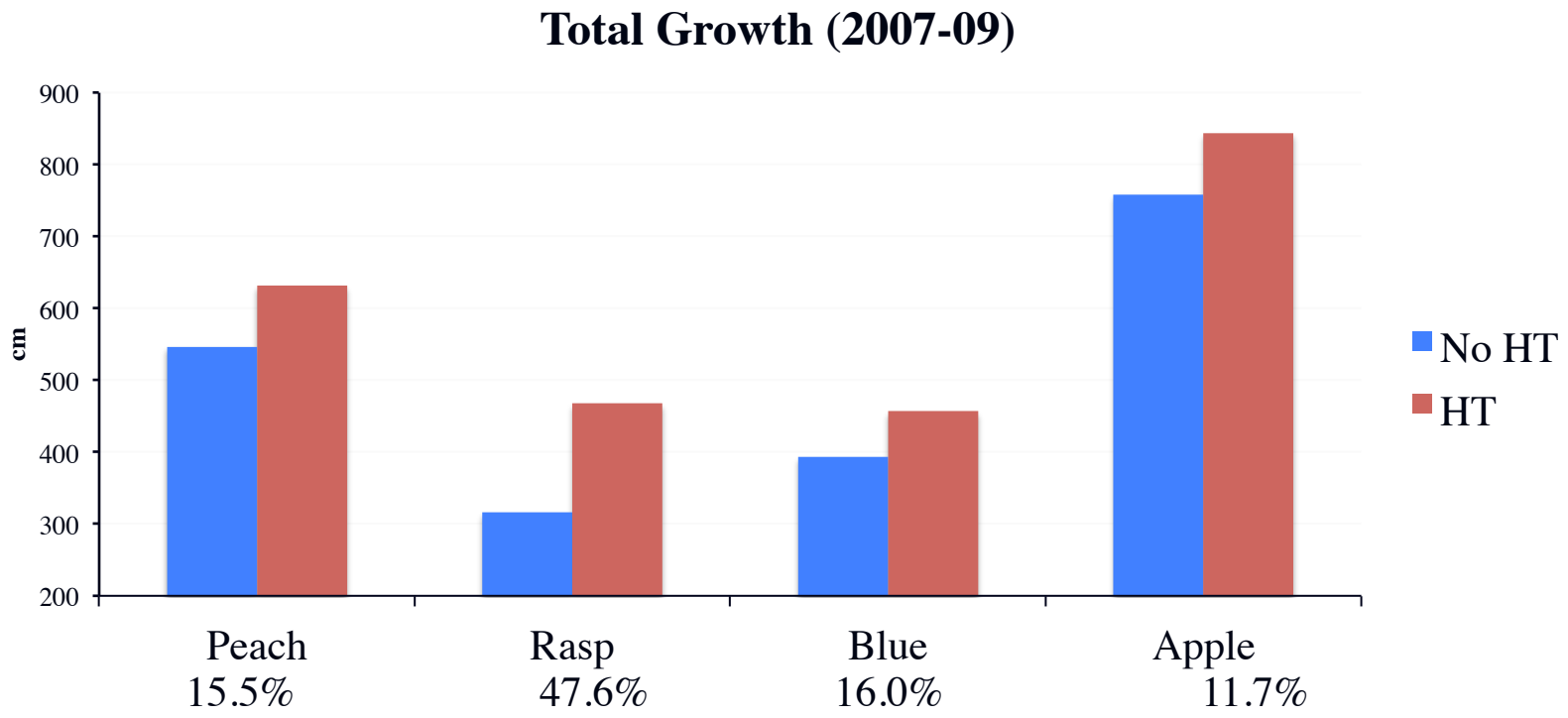
Total = $2,862

Haygrove High Tunnels

HT= $9.50/ft

Bees, High Tunnels & Pollination

High Tunnel Growth



High Tunnel Yield Differences (g/m)

Trt	Straw	S Rasp	F Rasp	Tom	Soy	Blue	SnP
NoHT	4673a	2276a	2086a	6806a	1147a	706a	269a
HT	3779b	1162b	3736b	8764b	1348b	951a	387a
%	-19%	96%	79%	23%	16%	-	-

Tunnels have a shading impact and reduce wind

Strawberries are primarily wind and gravity pollinated

Percent Marketing Yield (% clean)

HT	F. Rasp'08	S. Rasp'09	Tomato'07	Apple'08
Yes	74.2 a	74.6 a	81.7 a	27.0 a
No	57.1 b	65.1 b	64.4 b	3.0 b

Percent Marketing Yield
Tomato' 07

HT	Cracking	Zipper	Mech	Other
Yes	12.5 a	0.4 a	4.8 a	1.3 a
No	27.2 b	0.8 a	6.1 a	2.0 a

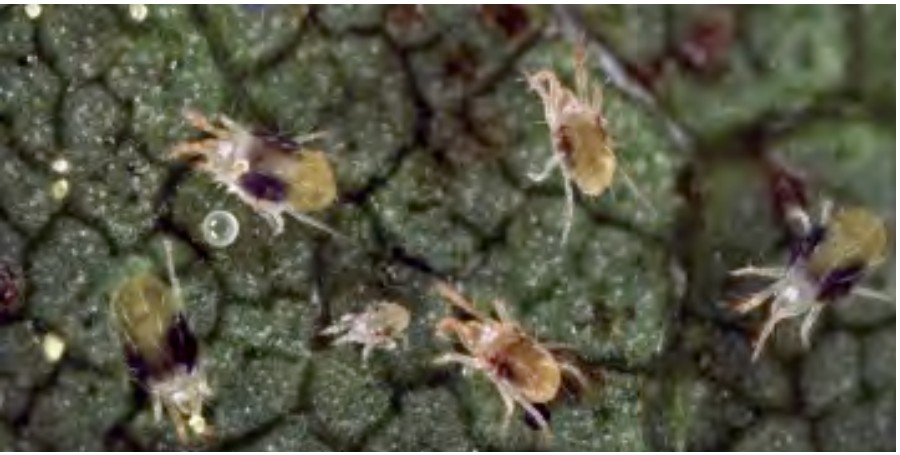
Percent Marketing Yield (% clean)

HT	Blue'09	Snap '06	Chick'09	Spin'09 (wt)
Yes	88.2 a	96.7 a	68.7 a	82.2 a
No	90.9 a	98.7 a	77.5 a	95.1 a

Apple Pests – Wooly Apple Aphid

HT	% WAA
Yes	41.7 a
No	1.4 b

Apple Pests – Two Spotted Spider Mite



HT	% ERM
Yes	20.8 a
No	0.0 b

Japanese Beetle

(July-Aug)

Year	No. JB
2005	15,000
2006	60,000
2007	283,000
2008	441,000
2009	162,000
2010	7,200

Trt	
High Tunnel	(3 - 4%)
No HT	(96 - 97%)

Japanese Beetle Raspberry (JB/5ft/date)

Trt	2006	2007
MR	10.4 a	35.0 b
CB	11.7 ab	29.8 c
RB	13.3 bc	43.6 a
SR	15.3 c	37.8 b

Cultivar	2006	2007
Royalty	3.1 a	15.5 a
Carol	12.0 b	36.4 b
Prelude	22.9 c	57.7 c

Royalty

Prelude

Japanese Beetle Blueberry (JB/5ft/date)

Trt	2007
MR	10.0 a
CB	9.9 a
RB	11.1 a
SR	13.6 a

Cultivar	2007
Duke	14.7 a
Bluecrop	13.9 a
Elliot	4.9 b

Arthropod Collections 2005-08

Sweep net samples

Jun, Jul, Aug, Sep, Oct

	Total	Beneficial	Pest	Incidentals
Families	139	53	37	51
Indiv ’05	25,258	16%	54%	30%
‘06	16,202	21%	50%	29%
‘07	24,118	21%	51%	28%
’08	23,493	20%	45%	32%

Shannon's Diversity Index

Crop	H' 05	H' 06	H' 07	H' 08
Strawberry	1.69 d	2.22 a	2.52 a	1.46 a
Peach	2.24 a	1.91 b	2.70 a	1.51 a
Raspberry	1.829 c	1.59 c	1.86 c	1.11 b
Blueberry	1.64 d	1.46 c	1.99 c	0.72 c
Apple	-	1.17 d	2.01 c	0.65 c
Soybean	2.07 b	1.01 de	2.30 b	-
Potato	-	1.08 d	-	-
Tomato	1.61 d	0.84 e	1.44 d	-
Corn/Cuke	2.18 ab	-	-	1.13 b
Green bean	1.89 c	-	-	-

Is increasing biodiversity good?

Can Intercropping increase biodiversity?

Treatments:

1) Peaches alone
2) Peach intercropped w/ straw.
3) Strawberries alone
4) Straw. Intercropped w/ peach

Intercropping Biodiversity

Beneficials/Natural Enemies

Treatment	Biodiversity (H')
Peach	0.77 a
Peach inter. w/ straw	0.81 a
Straw	0.52 a
Straw inter. w/ peach	0.62 a

Intercropping Biodiversity

Pest Insects

Treatment	Biodiversity (H')
Peach	0.79 bc
Peach inter. w/ straw	1.13 a
Straw	0.53 c
Straw inter. w/ peach	0.87 a

Is increasing biodiversity good when you increase the biodiversity of pest insects?

Harvest


STRAWBERRIES
STRAWBERRIES
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STRAWBERRIES


BERRIES
BERRIES

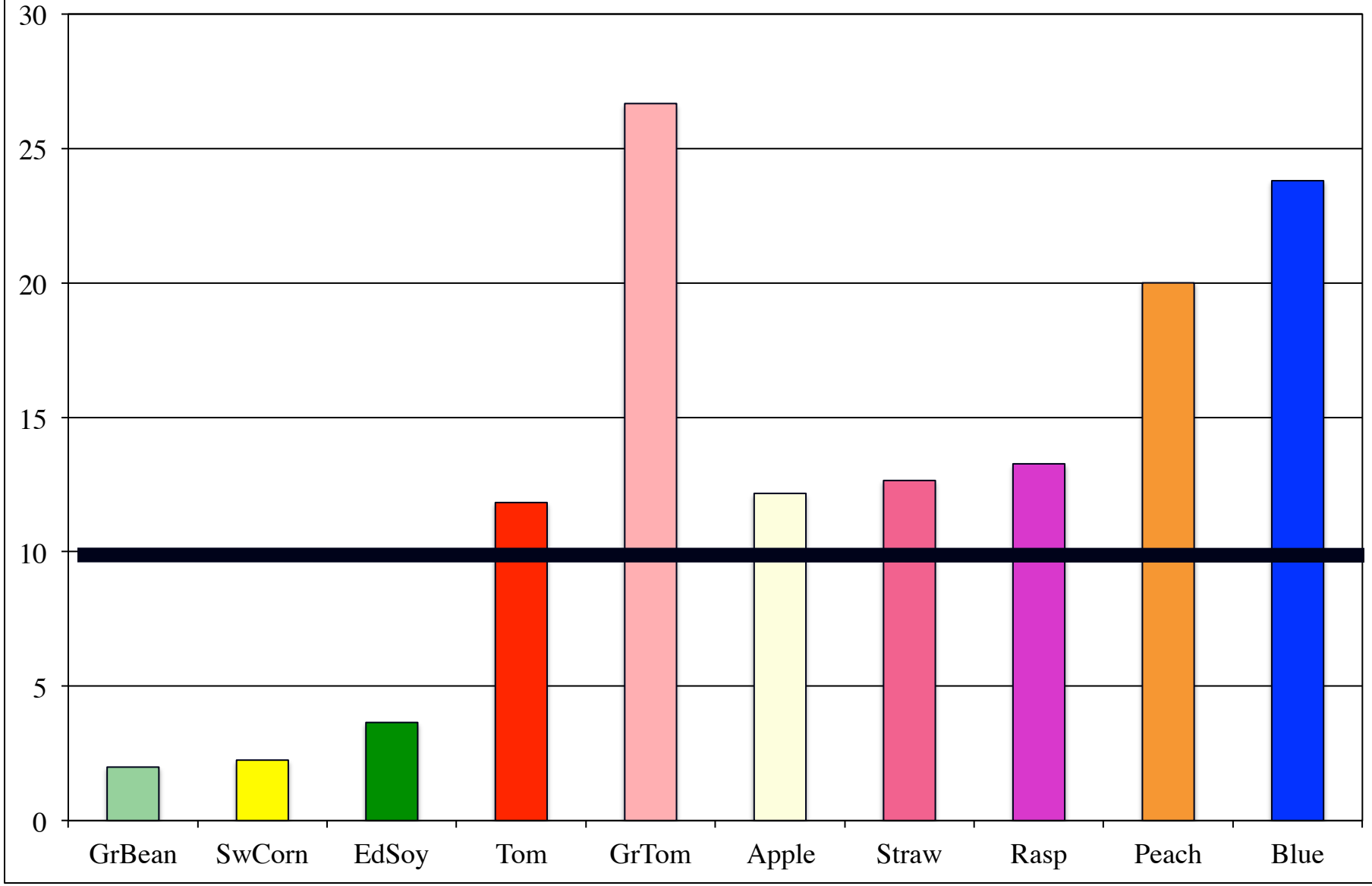
Harvest Evaluations 2006

Trt	Soy	S.Rasp	Straw	Tom	Potato
SR	32	381	1407	2338	486
CB	59	279	1310	2083	300
MR	47	289	1314	2420	275
RB	56	505	1619	3086	475
% inc	19	75	23	28	73

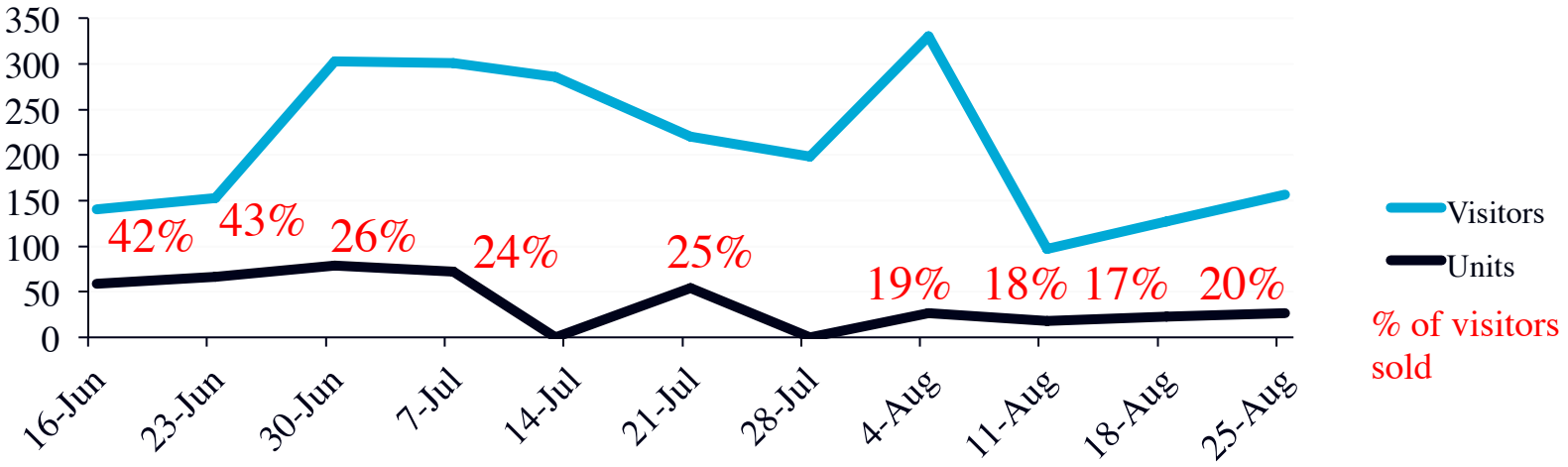
Harvest Evaluations 2009

Trt	Straw	S.Rasp	F.Ras	ChickP	Blue	Spin
SR	300	396	370	30	4684	67
CB	431	677	313	68	4604	84
MR	324	567	612	39	3752	104
RB	642	606	490	132	4672	125
% inc	98	7	20	238	26	20

Crop Dollars per Foot of Row



OARDC Farmer's Market 2009



Total Season	$2,208
Profit	$1,460
Per Mkt. Day	$20/hr

Best day 7/1/09 - 78 units for $318

Fresh Fork Market – 90 units=$360

BioControl Study = $2000

What I've Learned

- High Tunnels – Love 'em and Hate 'em

Love 'em	**Hate 'em**
Season Extension (earliness)	Putting up and taking down plastic
Less JB's, Less Diseases (leaf & fruit rots)	More mites, aphids, thrips, PM, OFM, more Leps?
Can work in rain or cold	Venting in summer
Increase yield and quality	Picking fruit and veg. in November (market?)

What I've Learned

- SR – Easiest to pick
- CB – Most confusing (me and pests)
- MR – Best aesthetic and overall winner
- RB – Most productive

- Nature Bats Last
  - Polyculture systems do reduce pest levels but not enough that you can go without some sort of pest management intervention

What I've Learned

- Nature Bats Last
  - Biggest problems are polyphagous insects such as OFM, JB, PC (lack good biocontrol agents) and voles
- Farmers' Markets are not for me (I question time & money especially in cities in Ag. area)
- I feel I can make money from fruit (except peaches, lack of consistent crop) but vegetables harder (depends on market)
- $10/ft still possible with right consistent crop mix and type of market (sell retail to neighbors)

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Parking Lot Project

Questions?