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PERIMENT STATION

STATE FRUIT EX

# High Tunnel Raspberry Production in Grow Bags



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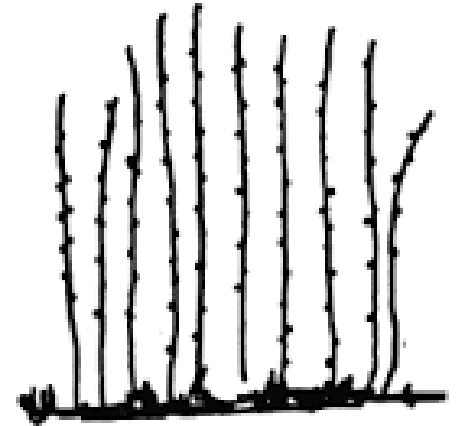
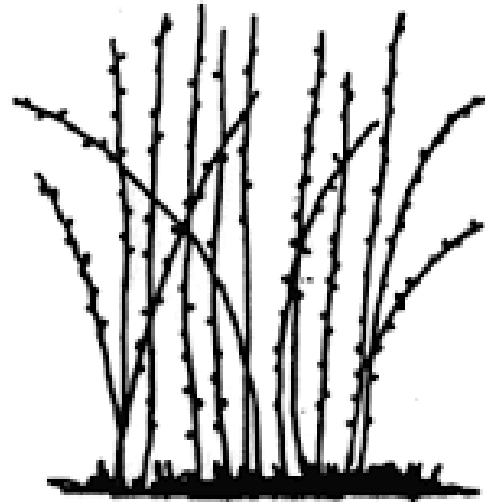
# This research is funded by The Specialty Crop Block Grant Program and the USDA



Special thanks to Shelia Long, Randy Stout, Jeremy Emery and our hourly employees for work on this project.

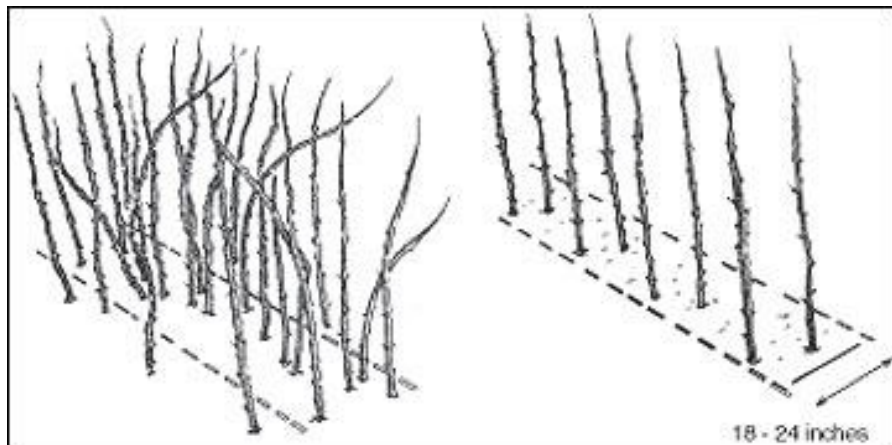
# Raspberries

- *Rubus idaeus*
- Red and yellow raspberries
- (Black raspberries)
- Perennial crowns with biennial canes
- Primocane bearers and floricanes bearers



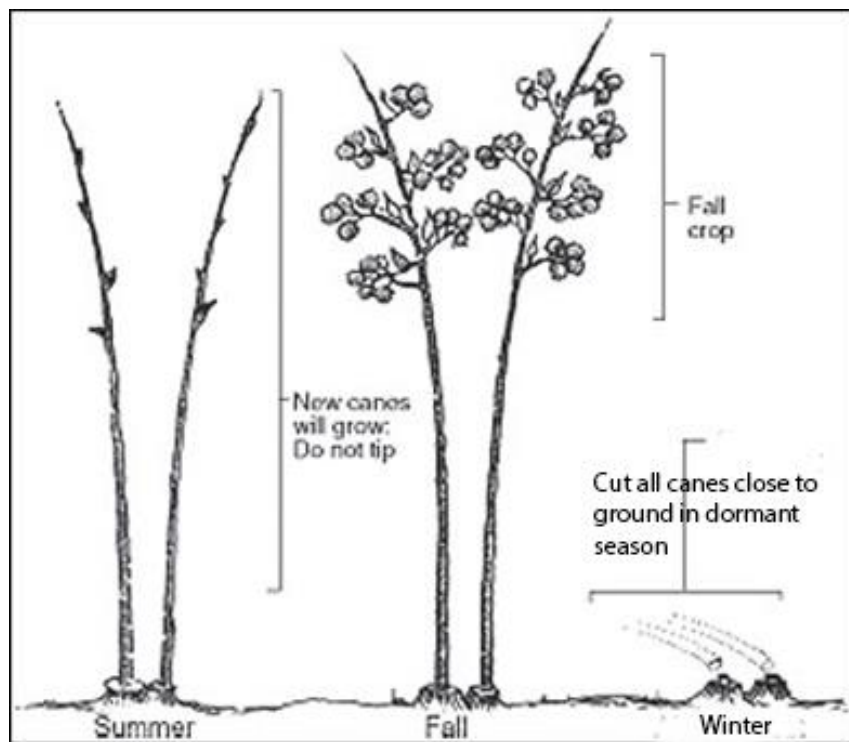
# Management of primocane and floricanes bearing raspberries

## Floricanes bearing



Canes do not bear fruit in the first season. The canes overwinter and produce fruit in the second season and then die. Fluctuating winter temperatures in Missouri may injure overwintering raspberry canes.

## Primocane bearing



No overwintering canes, no problem with winter injury.

# Field grown floricanes bearing raspberries in Missouri

- Difficult to overwinter canes to become floricanes due to fluctuating winter temperature.
- Difficult to grow in heavy soils – need excellent internal water drainage
- Not a common crop in southern Missouri like Blackberries
- Prelude and Nova

# Field grown primocane bearing raspberries in Missouri

- Not a viable commercial crop in Missouri
- Most cultivars bear in August when heat is an issue
- Sunburn
- Diseases due to high humidity and rainfall
- Sensitive to heavy soils and wet soils
- Late bearing cultivars harvest period cut short by frost
- Hertitage, Caroline, Josephine

# Raspberries in High Tunnels!!



- Superior to field grown
- More reliable production
- Higher yields (even year 1 for primocane bearers)
- Larger berries
- Better quality – less disease
- Improved shelf life
- Extended growing season
- Protection from frost
- Protection from heat (shade cloth)

# Raspberry observational trial Mtn. Grove



- Caroline, Heritage and Josephine in ground in high tunnel and in an adjacent field planting.
- Harvested every other day
- Marketable yield and average berry weight data collected
- Cull fruit discarded and not weighed
- Weighed dormant cane prunings



**Table 1.** Three year annual average (2011 – 2013) weight of marketable yield, weighted average berry weight and weight of dormant canes for three primocane raspberry cultivars grown in a high tunnel (HT) and in the field (F) at Mountain Grove, MO

Cultivar/Location	Marketable Yield Lbs./30 feet	Average Berry Weight grams	Dormant Canes Lbs./30 feet
Caroline HT	30.9	2.8	22.5
Caroline F	13.9	2.3	12.8
Heritage HT	36.5	2.2	24.2
Heritage F	9.7	1.4	9.1
Josephine HT	<b>32.5</b>	<b>3.9</b>	<b>24.3</b>
Josephine F	5.8	2.8	6.9

**Table 2.** Marketable yield per cultivar/location for three primocane raspberry cultivars grown in a high tunnel (HT) and in the field (F) at Mountain Grove, MO

Cultivar/Location	2011 yield lbs/30' (establishment year)	2012 yield lbs/30'	2013 yield lbs/30' (significant loss of yield to SWD)*
Caroline HT	19	50	26
Caroline Field	27	7	8
Heritage HT	24	50	35
Heritage Field	21	2	7
Josephine HT	19	51	29
Josephine Field	13	4	2

\*Spotted Wine Drosophila discovered at Mountain Grove in 2013

@ \$5/pint (12 ounces) Josephine in the high tunnel in 2012 would realize \$1.42 gross revenue per square foot. Compare with tomatoes (slicers) at \$7.25; Cucumbers at \$2.50; Lettuce at \$8.05 and Green Peppers at \$3.20 (ISU Vegetable Production Budgets for a High Tunnel).

Problem is that the raspberries are perennial and planted in ground.

# Raspberry liqueur @ Missouri State



# Spotted Wing Drosophila

- Was discovered at our station in 2013
- Active after strawberries



# SWD Management

- Spray weekly at night
- Test berries for larvae (1c salt/gallon water) weekly



**Table 3.** Pesticides used on raspberries at the SFES

Insecticide	Class*	PHI Days	Max # of Applications Per season	Application interval	Probably SWD Efficacy
Delegate	5	1	6	4 days	Excellent
Mustang Maxx	3A	1	6	7 days	Excellent
Assail 30 SG	4A	1	5	7 days	Good
Danitol 2.4 EC	3A	3	3	14 days	Excellent
Malathion 5 EC	1B	1	3	7 days	Good

\*5 Spinosyns; 3A Pyrethroids and Pyrethrins; 4A Neonicotinoids and 1B Organophosphates

# A Fixed-Spray System for SWD Management in High Tunnel Raspberries

Arthur Agnello, Andrew Landers, and Greg Loeb

Department of Entomology, NYSAES, Cornell University, Geneva NY



Figure 6. 1/4-inch dropline inserted into spray supply line



Figure 7. Droplines along sides of rows from spray supply lines



Figure 8. Microsprinkler nozzle spraying

<http://www.hort.cornell.edu/grower/nybga/swd/pdfs/Management-SprayTechnology/Fixed%20Sprayline%20NY%20Fruit%20Quarterly.pdf>

# An observation

- In 2015, we discontinued pesticide application on September 28.
- No larvae were detected in October or November to early December in the high tunnel.
- Early or late HT production may avoid some SWD pressure.
  - Early floriscane producers – Prelude?
  - Late primocane producers – Crimson Giant?



# How to produce raspberries in a high tunnel sustainably?

- Minimize SWD damage?
  - Manage hedgerow density
  - Harvest daily
  - Rotate pesticides
- Pricing, market and cost of production
- New Research looking at moving plants in and out of the high tunnel to allow space for other crops to maximize profit per square foot.

# Research Project

- Initial Data  
April 2014 to December 2015
- 2 Years Additional Funding  
– Specialty Crop Block Grant
- 30 x 96 High Tunnel
- Mountain Grove, Missouri



# Goals



- Evaluate best cultivars for high tunnel production in grow bags
- Develop crop rotation cycle with vegetables and raspberries to maximize high tunnel space

# Joan J

- Great Britain
- Early Season
- Firm, Dark Red Fruit
- Vigorous and upright
- Spineless



# Himbo Top

- Switzerland
- Mid Season
- Large, bright red fruit
- Vigorous and upright



# Polka

- Poland
- Mid-Season
- Red, shiny fruit
- Good sucker production
- Susceptible to Potato Leaf Hopper
- Observed Leaf Symptom



# Josephine

- University of Maryland
- Late Season
- Large, dark red fruit
- Resistant to leaf hopper
- Baseline/Control



# Crimson Giant

- Cornell University
- Late Season
- Large, bright red fruit
- Cone shape
- Firm and flavorful
- Developed for November Market



Photo Credit: Dr. Courtney A. Weber,  
Cornell University



# Planted Early Season Vegetables



# Raspberry Planting



Bare Root



Plug

# Grow Bags

Smart Pot by High Caliper

- 5 Gallon (12 x 10.15")
- Aerates
- Air Prunes Roots
- Reduces tipping over
- Maximize Space



# Experimental Design

- Randomized Complete Block
  - 5 Treatments (Cultivars)
  - 4 Replications (Blocks)



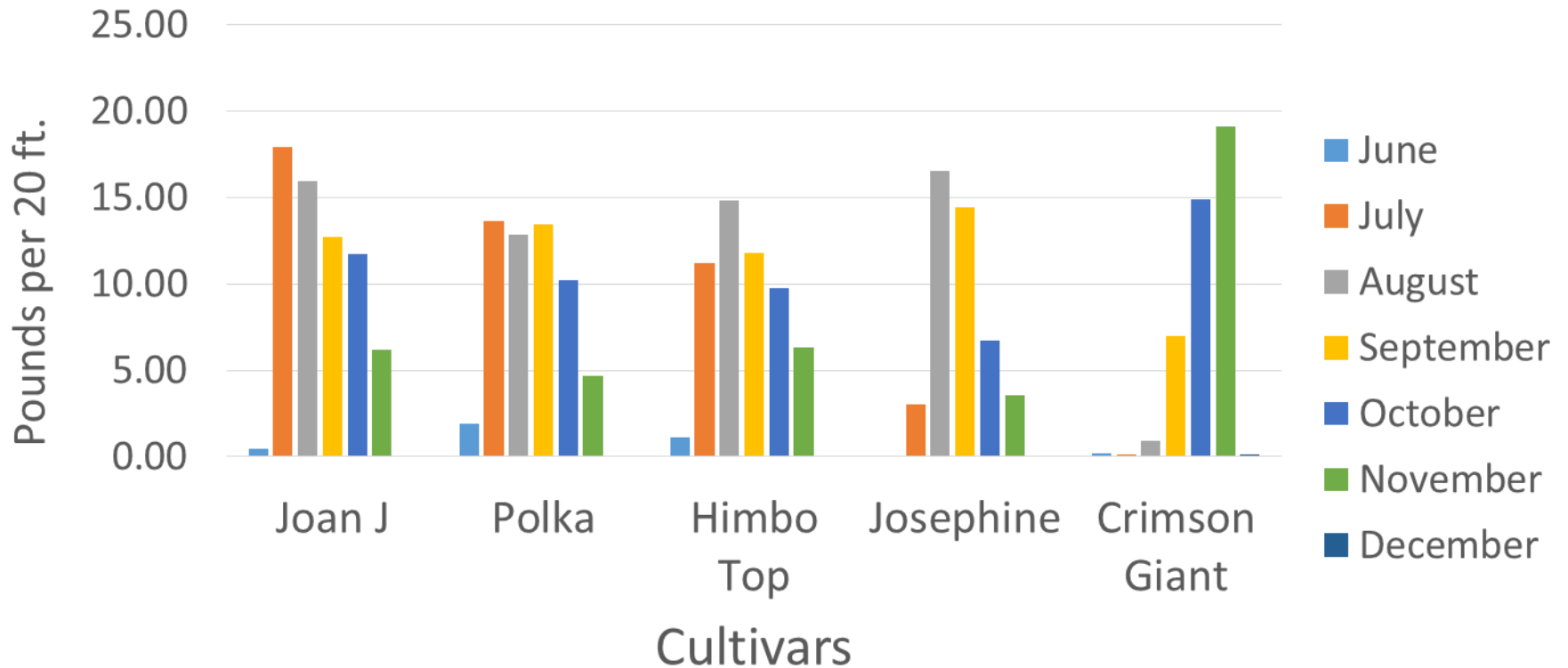
# Data Collected

- Marketable Fruit Weight
- 25 Berry Weight
- Weight of dormant canes

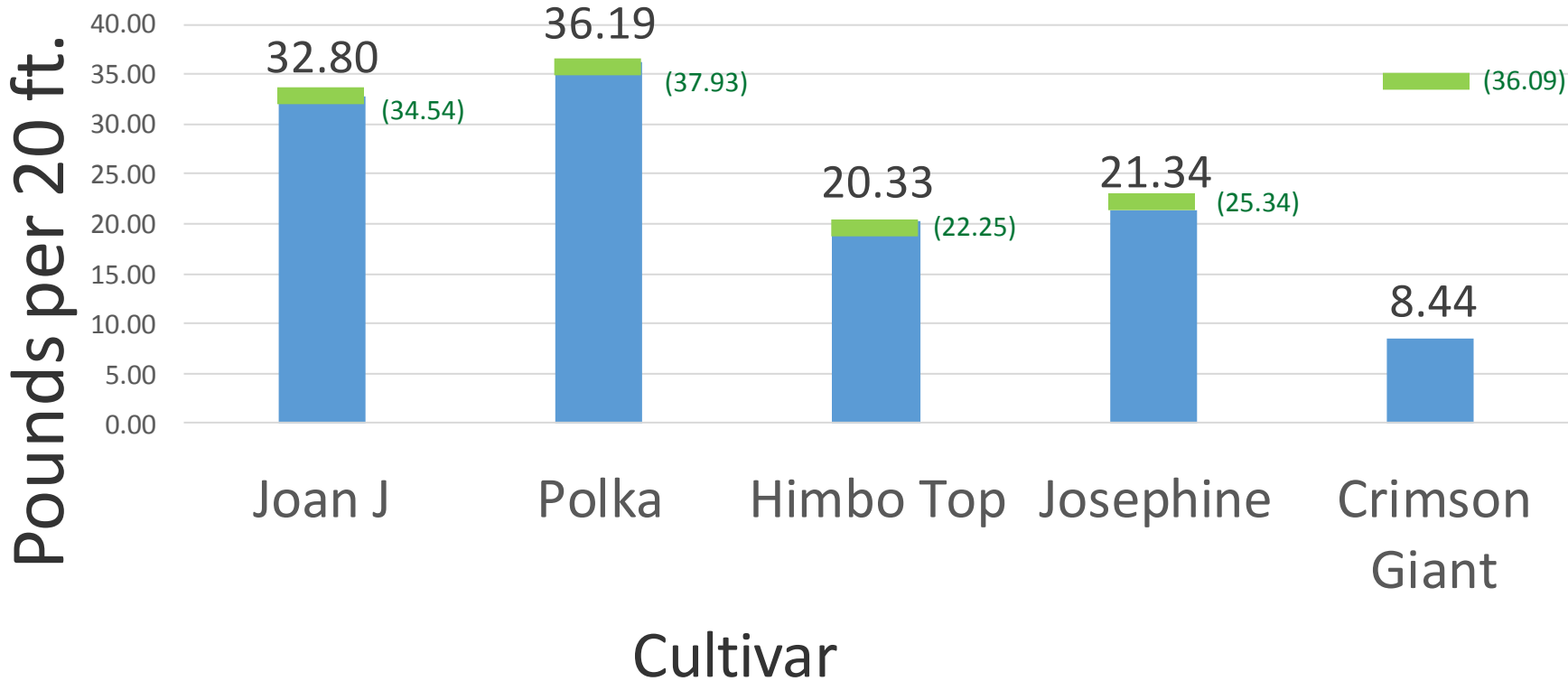




## 2015 Raspberry Yield by Month (lbs. per 20 ft.)



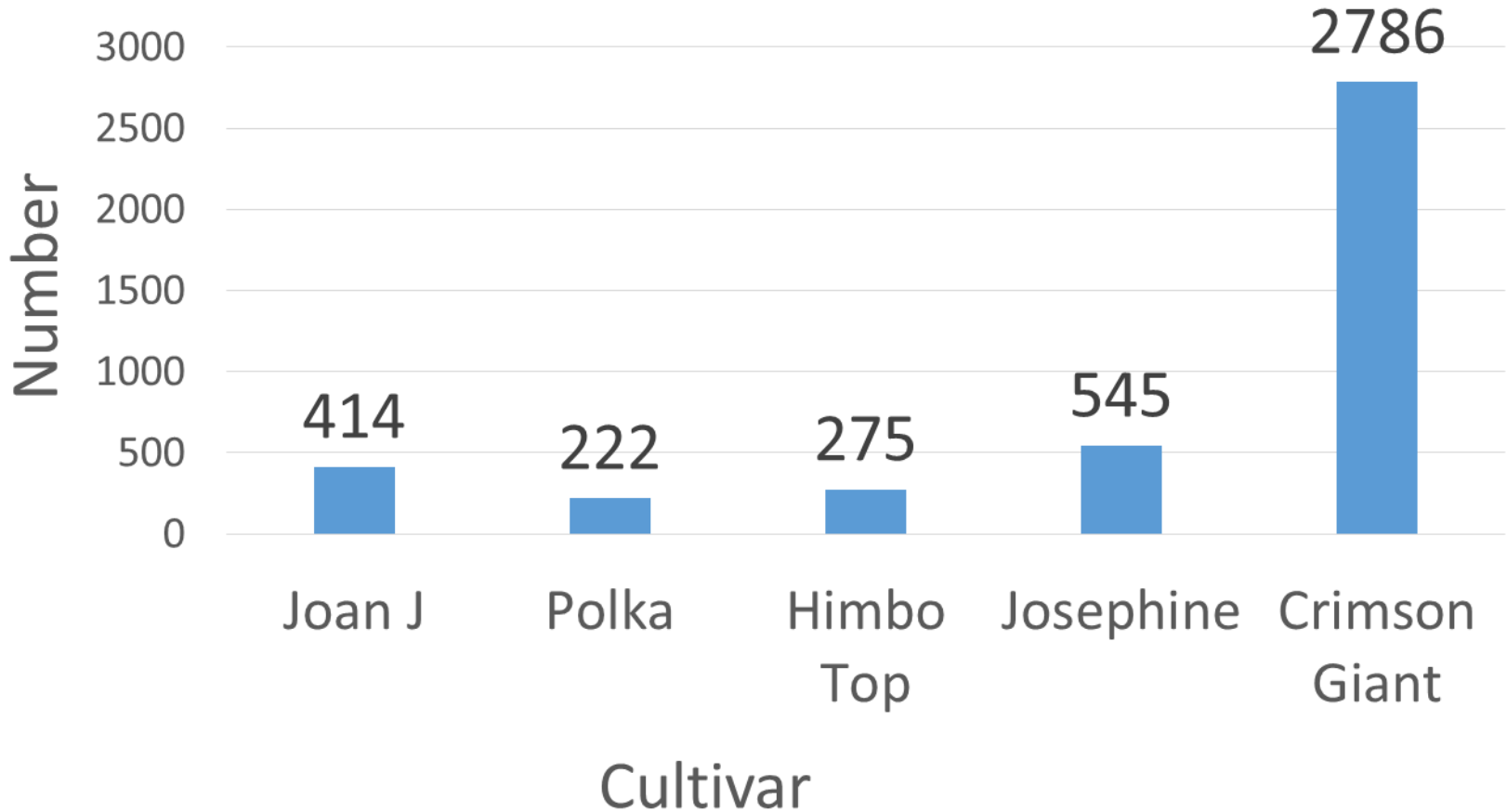
# 2014 Raspberry Total Yield



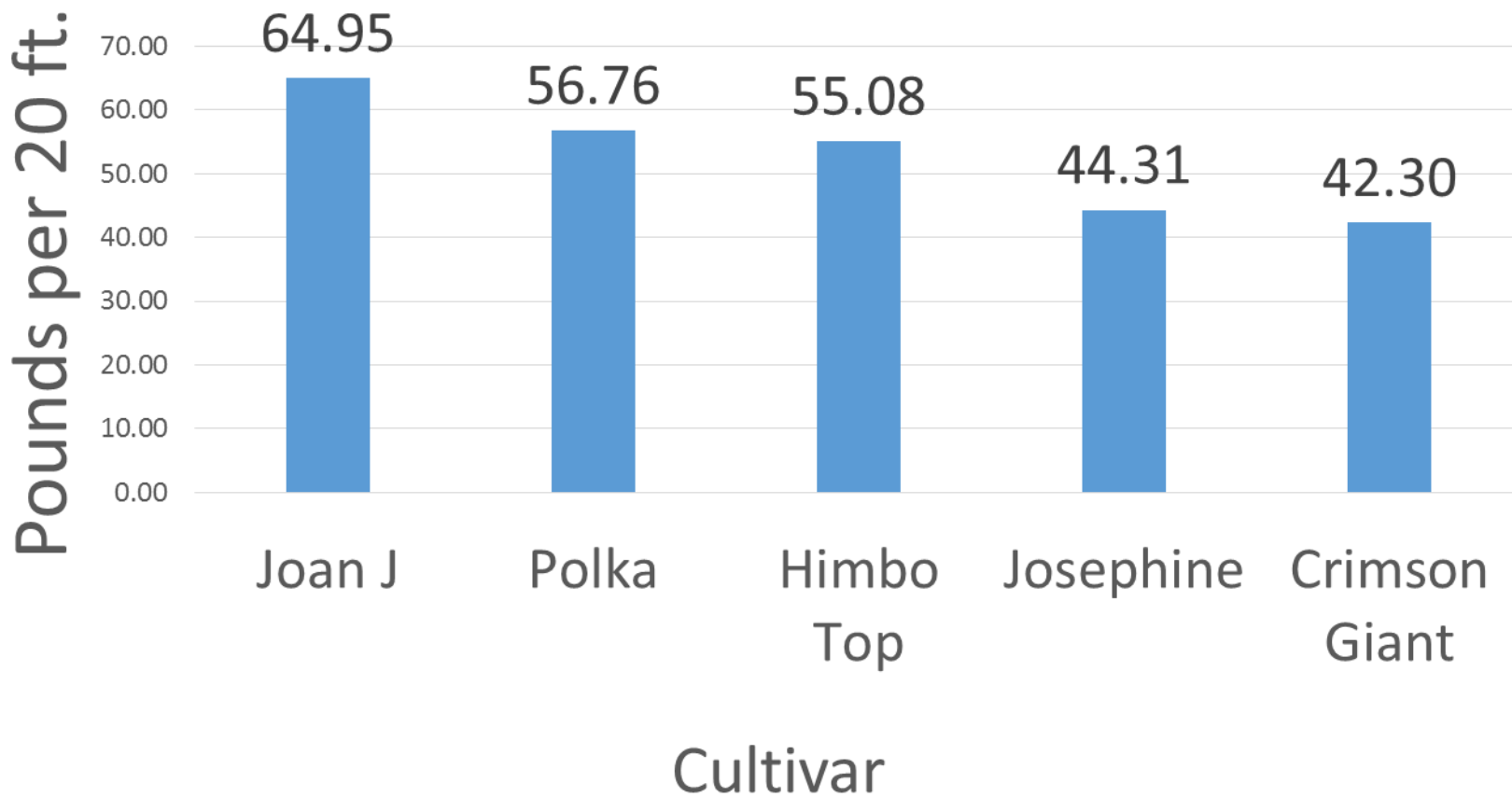
Yield estimation based on unharvested  
Green berries on October 31, 2014



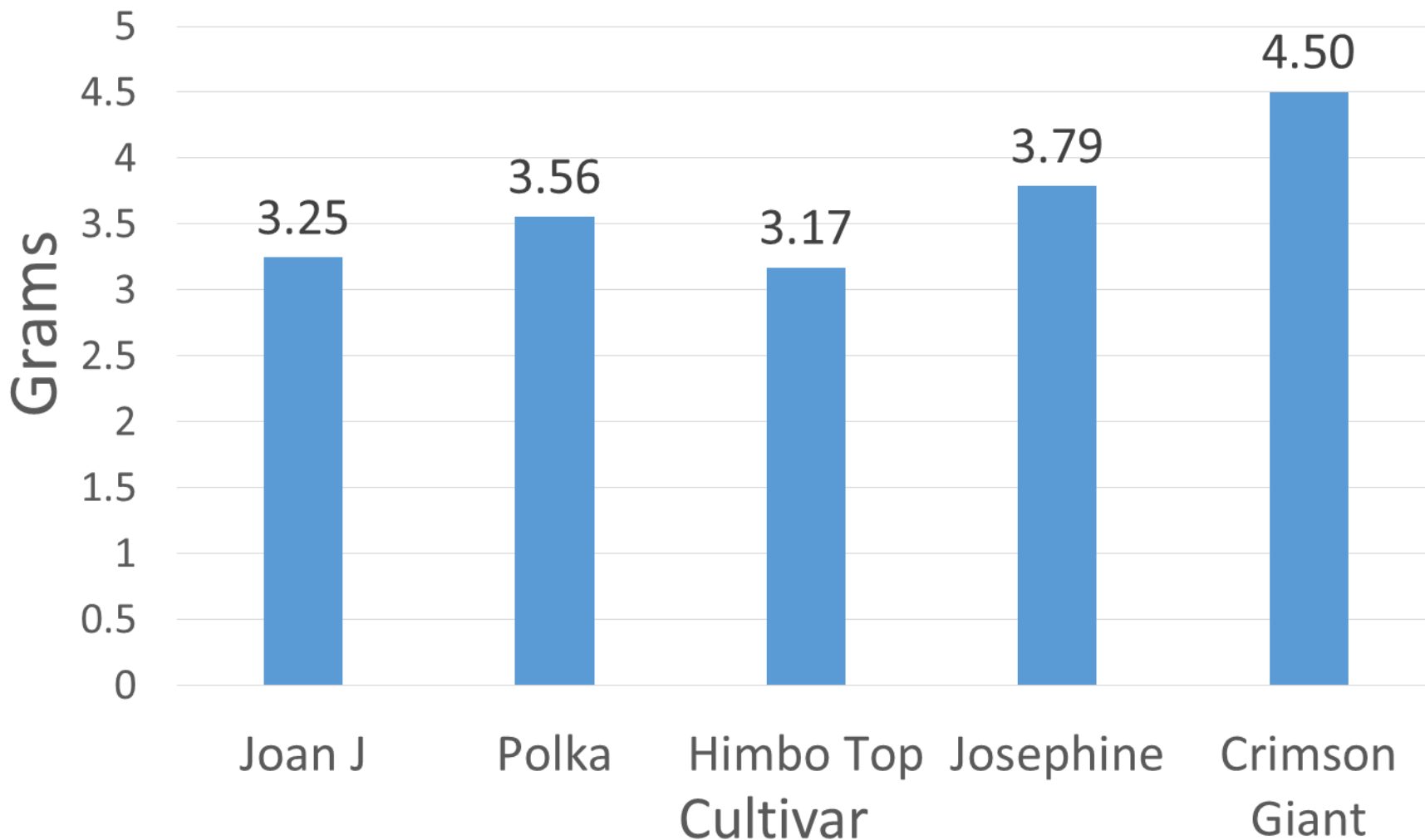
## 2014 Number of Unharvested Berries



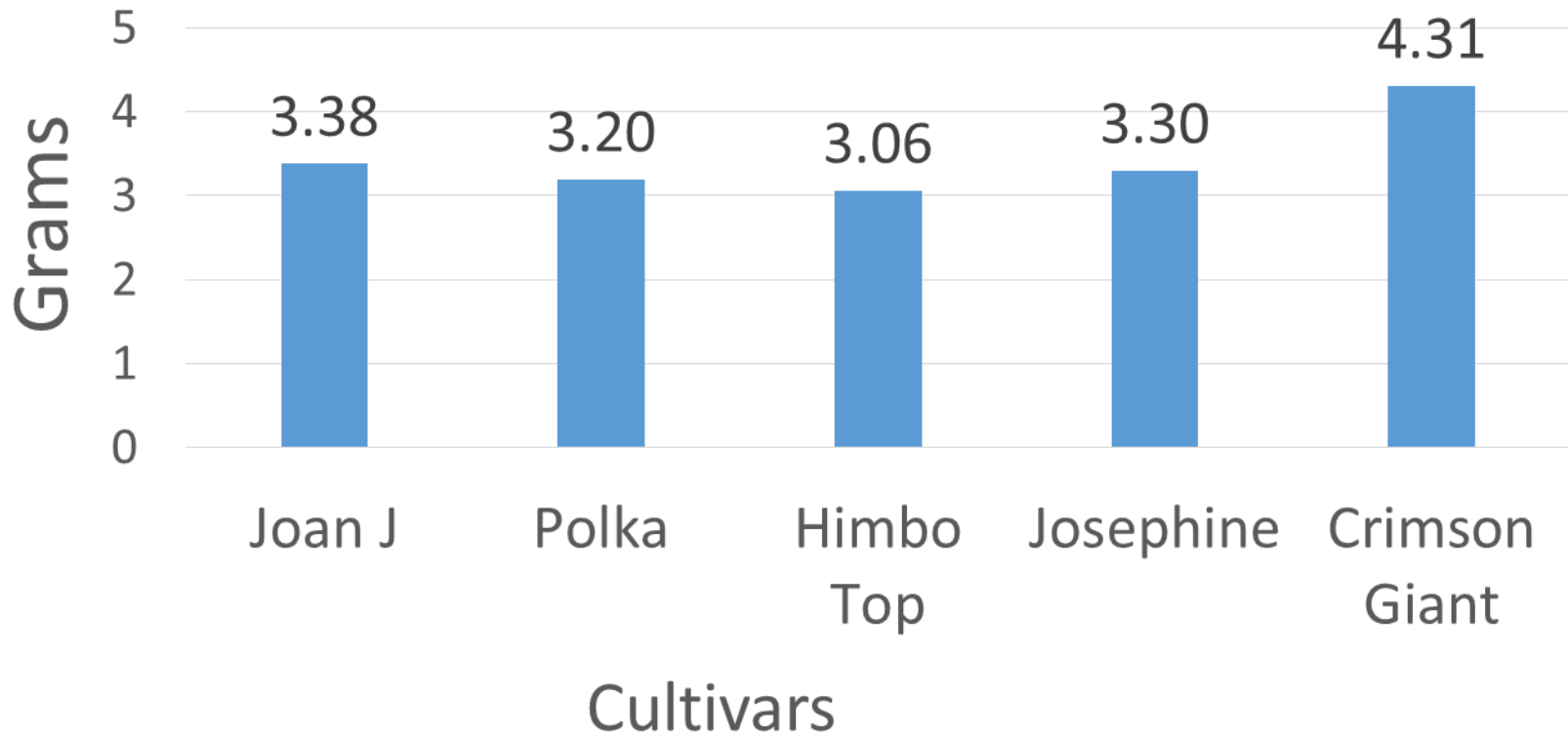
## 2015 Raspberry Total Yield



## 2014 Average Berry Weight



## 2015 Average Berry Weight



# Future Plans

- Continue Evaluation of Lettuce/Raspberry Rotation
- Monitor SWD Pressure
- Add a Demonstration Trial of Prelude
  - To observe early Floricane Berry Production
- Compile a Cost Analysis

# University of Arkansas Interactive Budget

- Developed by Center for Agriculture and Rural Sustainability
- Apple, Blackberry, Blueberry, Raspberry, Strawberry
- <http://cars.uark.edu/ourwork/Specialty-Crop-Production-and-Marketing/Raspberry%20Budget%20Version%202.0.xlsm>

### Our Work

[Water Quality & Quantity Management](#)

[Economic Contribution of Agriculture](#)

[Specialty Crop Production & Management](#)

[High Tunnel Production](#)  
[Organic Certification](#)

[Walmart Vendor Agreement](#)

[National Strawberry Sustainability Initiative](#)

[AR Market Maker](#)

[Interactive Budgets for Fruit Crops](#)

[Life Cycle Assessment](#)

[Sustainability Metrics](#)

[Risk Management](#)

[Research Experience for Undergraduates \(REU\)](#)

[Waste Management](#)

## Interactive Budgets for Fruit Crops

Interactive budgets can help producers in estimating the costs of production and in conducting what-if analyses around costs, revenues and production levels.



[Apple Budget User Guides](#)



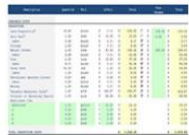
[Interactive Apple Budget](#)



[Strawberry Budget User Guides](#)



[Interactive Strawberry Budget](#)



[Blackberry and Raspberry Budget User Guides](#)



[Interactive Blackberry Budget](#)



[Interactive Raspberry Budget](#)

**Floriscane-Spring/Summer Production High Tunnel**



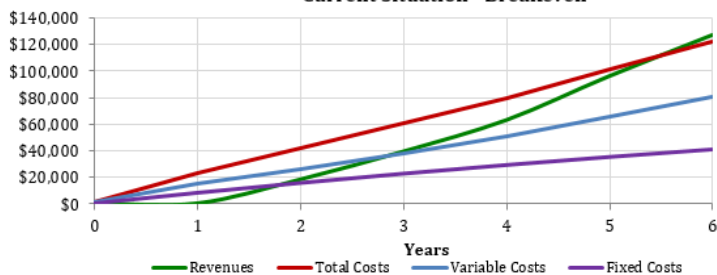
<b>Gross Revenues</b>	<b>Total Costs</b>	<b>Net Revenues</b>
\$127,193	\$121,793	\$5,400

<b>Fixed Costs</b>
\$41,309

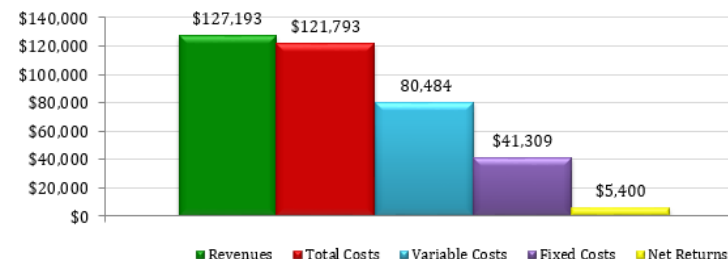
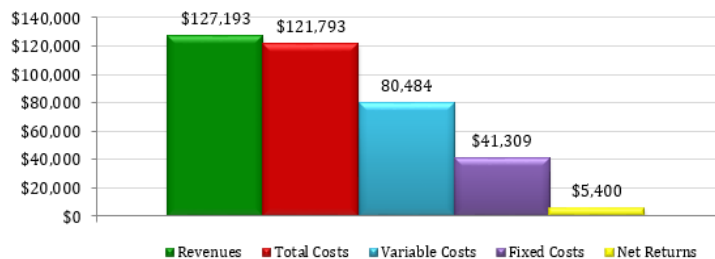
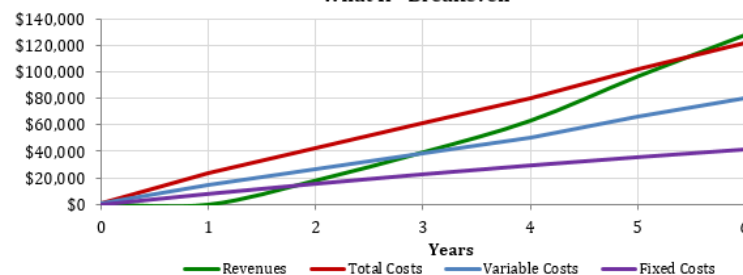
<b>Variable Costs</b>
\$80,484



**Current Situation - Breakeven**



**What If - Breakeven**



Breakeven Analysis	
<b>Quality 1 Price (\$/lb)</b>	<b>Quality 2 Price (\$/lb)</b>
\$3.56	\$0.71
<b>Quality 1 Yield (lbs/ac)</b>	<b>Quality 2 Yield (lbs/ac)</b>
22,436	9,613

Breakeven Summary
<i>The enterprise will breakeven after:</i>
6 years
\$121,793

What If Analysis	
<b>Quality 1 (\$/lb)</b>	<b>Quality 2 (\$/lb)</b>
\$3.56	\$0.71
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22,436	9,613

What If Analysis
<i>The enterprise will breakeven after:</i>
6 years
\$121,793



# Raspberries Overwintered



# Questions?

