

# From Bush to Clamshell - How to Machine Harvest Blueberry for Fresh Market



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# Harvesting Fresh Market Blueberries is Increasingly Challenging

- Fresh-market blueberries are traditionally **harvested by hand**
- Industry is constrained by **high labor costs**, **low worker availability**, and **competition from other operations (COVID is a new challenge)**
- **Mechanization** is one solution to the labor challenge



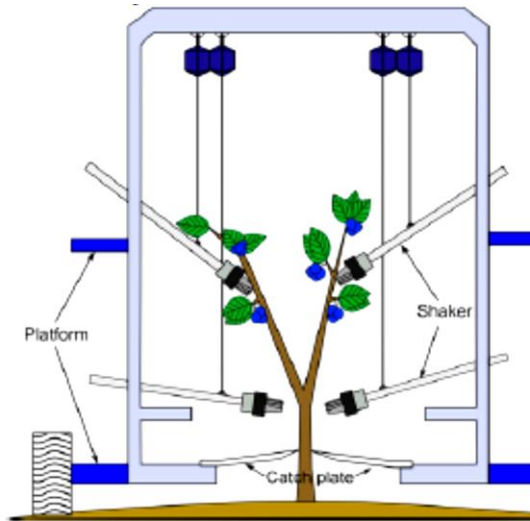
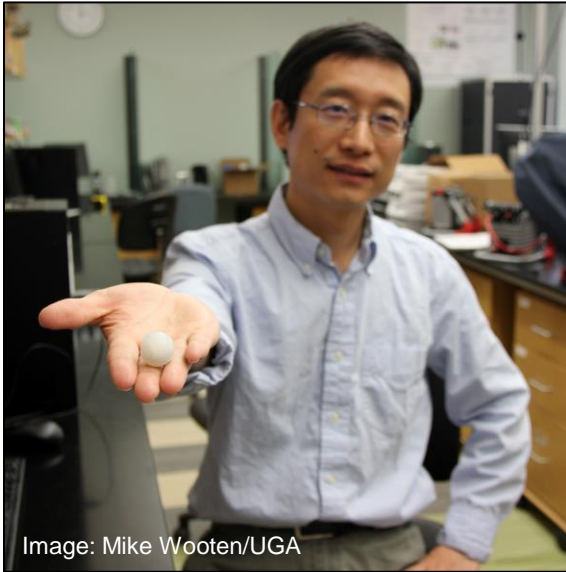
**Blueberry season is half over. Feds say growers must pay pickers 50% more**

BY WENDY CULVERWELL

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# Machine Harvest Research is a Response to this Industry Problem



# Summary of Machine Harvest Research in the PNW



**Oxbo 7440 with Orbirotor<sup>®</sup>  
picking heads**



**Soft-Catch Material  
(elastomeric polymer)**



**Graduate Student,  
Yixin Cai**

# Objectives – 2019 and 2020

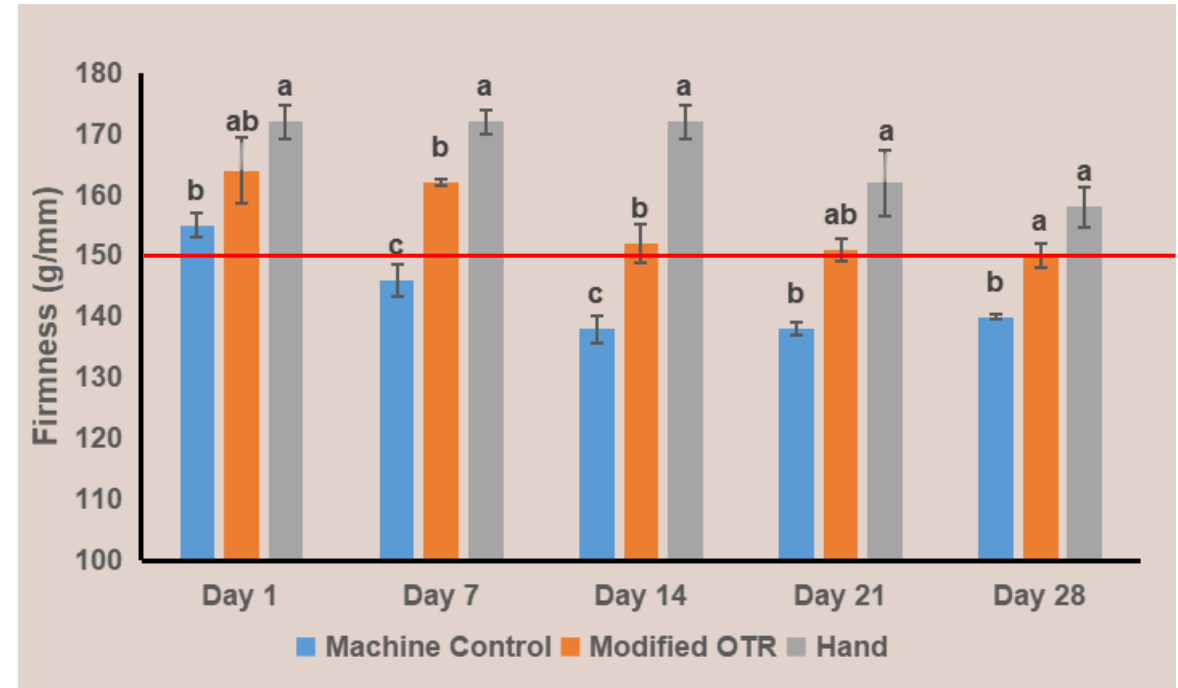
1. Evaluate **harvest efficiency** and resultant **fruit quality** in northern highbush blueberry using a **modified over-the-row (OTR) harvester prototype** compared to **hand harvest** and a **traditional OTR harvester**
2. Determine **optimal blueberry harvest intervals** for important cultivars to maximize fruit quality and harvest efficiency

# Objective 1 – Machine Harvest Comparison

	2nd harvest 'Duke'		
	Packout	Color	Soft
<b>Machine control</b>	<b>88.9 b</b>	<b>4.7</b>	<b>4.4 a</b>
<b>Modified OTR</b>	<b>90.9 a</b>	<b>4.3</b>	<b>3.4 b</b>
<b>Hand harvest</b>	<b>91.1 a</b>	<b>3.9</b>	<b>2.5 c</b>
<b>P-value</b>	<b>0.015</b>	<b>NS (0.44)</b>	<b>&lt;0.0001</b>

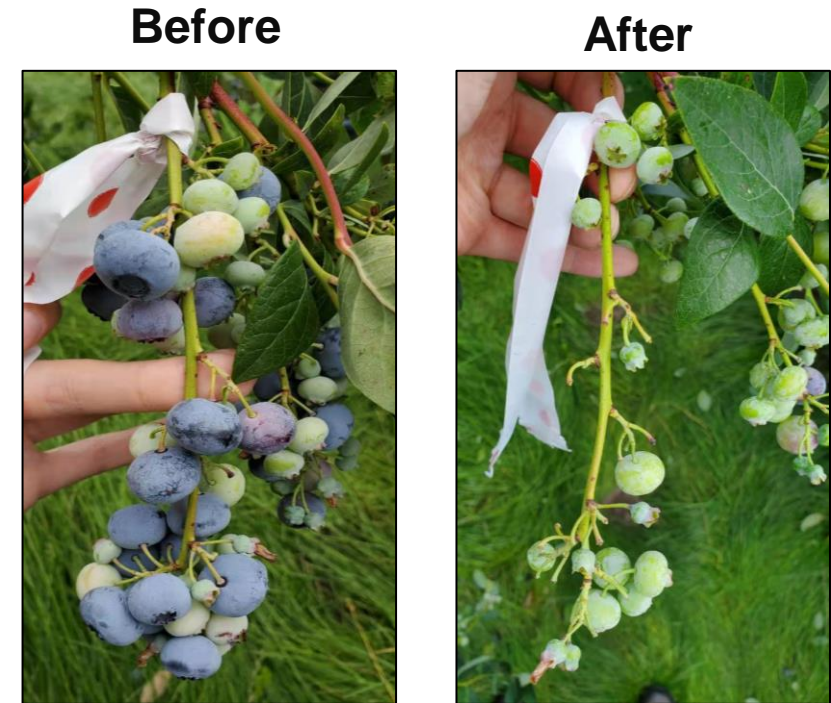
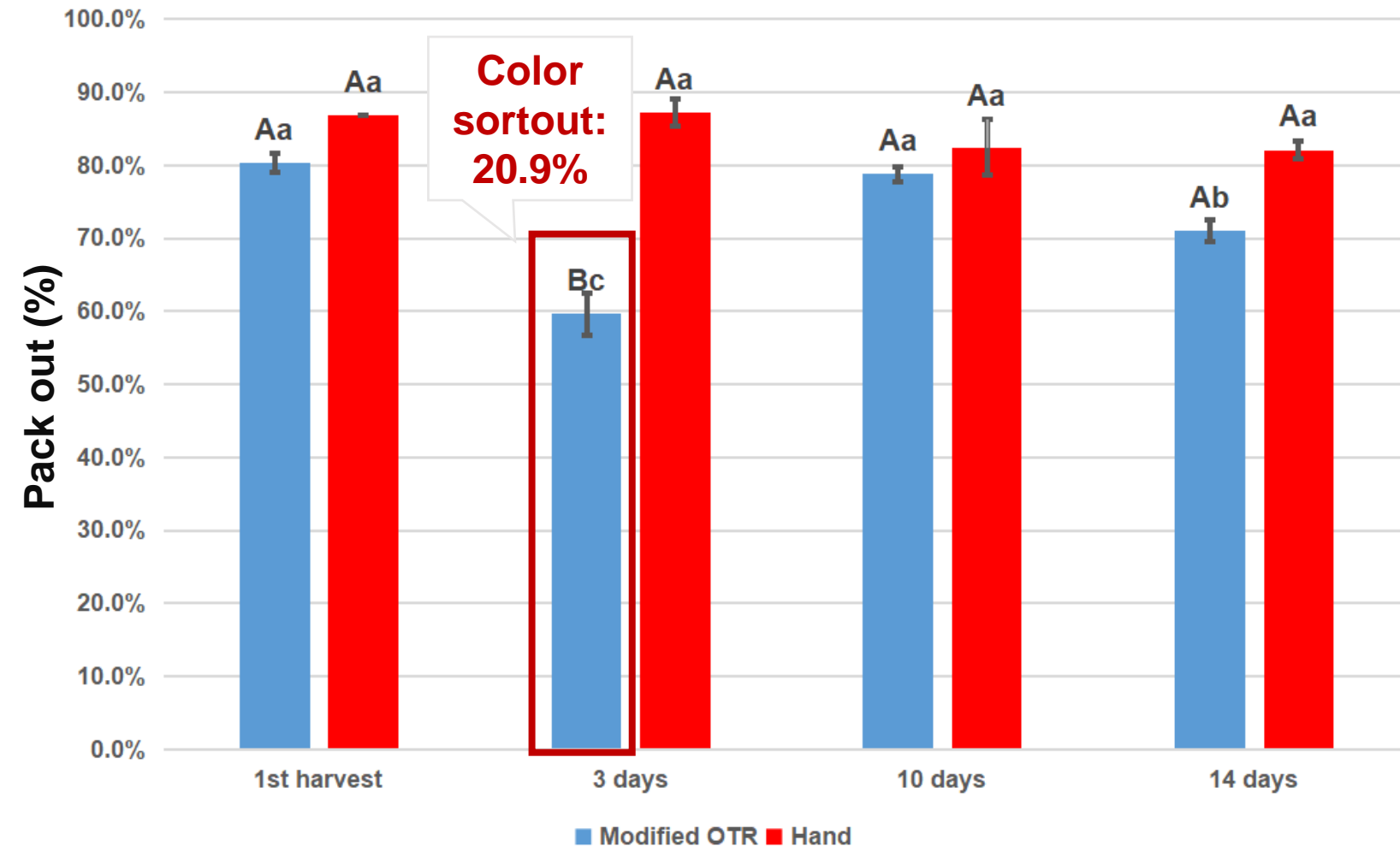
<sup>Z</sup> Means followed by same lower-case letter within a column are not statistically different at  $\alpha=0.05$ ; data were analyzed using one-way ANOVA by R.

**Firmness  $\geq 150$  g/mm  
acceptable for shipping 'Duke'**



**Overall Findings: Modified OTR resulted in an intermediate fruit quality between conventional OTR machine harvesting and hand harvesting without efficiency and selectivity losses**

# Objective 2 – Harvest Interval



- 'Liberty'
- Interval effect on day 3
- 10 day is optimal harvest interval

Different UPPERCASE letter: significant difference between **harvest interval**  
Different lowercase letter: significant difference between **harvest type**

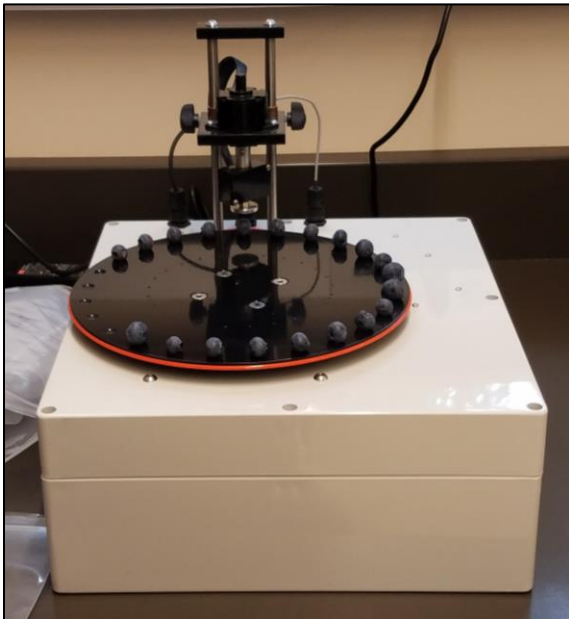
# Many Factors Influence the Final Product



# Start off with a Good Cultivar



- **Firmness, texture, and resistance to bruising**
- Exposed clusters
- Narrow crown and upright habit
- Concentrated ripening
- Consider **timing of production**
- **Good storability**
- Adaptability
- Machine harvest for fresh is a **breeding target**



# Field Conditions – Pest and Disease Management



Manage **pests** (including birds) and **diseases**



# Field Conditions – Weed Management



- **Weeds** can complicate machine harvest and **increase ground loss**
- Consider **mowing** before harvest if alleyway weeds are tall

# Field Conditions – Pruning and Training



Minimize  
ground  
loss and  
plant  
damage



- **Prune for machine harvest** → **narrow crown** to ensure good fit of catcher plates
- **Trellising** and **raised beds** can also help

# Field Conditions – Timing



Photo: Faith Critzer



Bloom  
important for  
quality and  
shelf life

- **Balancing act**
- Consider **hand pick at first blue** or first harvest
- Pick fruit when **dry** and after dew has evaporated
- First pick usually done at <50-60% blue for high quality and prices
- **Overly mature** fruit is softer and drops easily
- Pick **early in the morning** and avoid heat
- **Interval selection**

# Field Conditions – Harvester Operation



- Have a **trained operator and crew**
- **Center machine** and **adjust height** to minimize ground loss and damage
- **Beater speed** and **amplitude**
- **Ground speed**
- Head gap

# Impact of Harvester Settings

## First-Pick 'Draper' in northwest Washington

*Harvested July 24, 2018*

Treatment (head speed; ground speed)	Pack out (%)	Firmness (g/mm)				Percent bruising (24 hours)
		Week 0	Week 1	Week 2	Week 3	
Trt. 1 (315 rpm; 0.3 mph)	92	156.2 b <sup>z</sup>	154.7 b	148.5 b	133.8	6.4 bc
Trt. 2 (600 rpm; 0.5 mph)	92	157.7 b	157.8 b	152.1 b	128.7	7.6 ab
Trt. 3 (550 rpm; 0.4 mph)	93	153.2 b	142.9 c	150.9 b	129.8	8.4 a
Hand	- <sup>y</sup>	179.7 a	180.8 a	166.6 a	136.2	1.7 d
<i>P</i> -value	-	<0.0001	<0.0001	0.004	NS	<0.0001

<sup>z</sup>Means with the same letter within a column are not different due to treatment at  $\alpha = 0.05$ .

<sup>y</sup>Data not available.

# Oxbo 8040 Machine Harvested 'Draper'



# After Harvest – Cool Fast and Handle with Care!



- **Cool fruit quickly** to remove field heat
- **Cover to reduce UV radiation** (reflective covers?)
- Don't allow fruit to sit out in the heat
- Consider **refrigerated trucks** and **forced-air cooling**

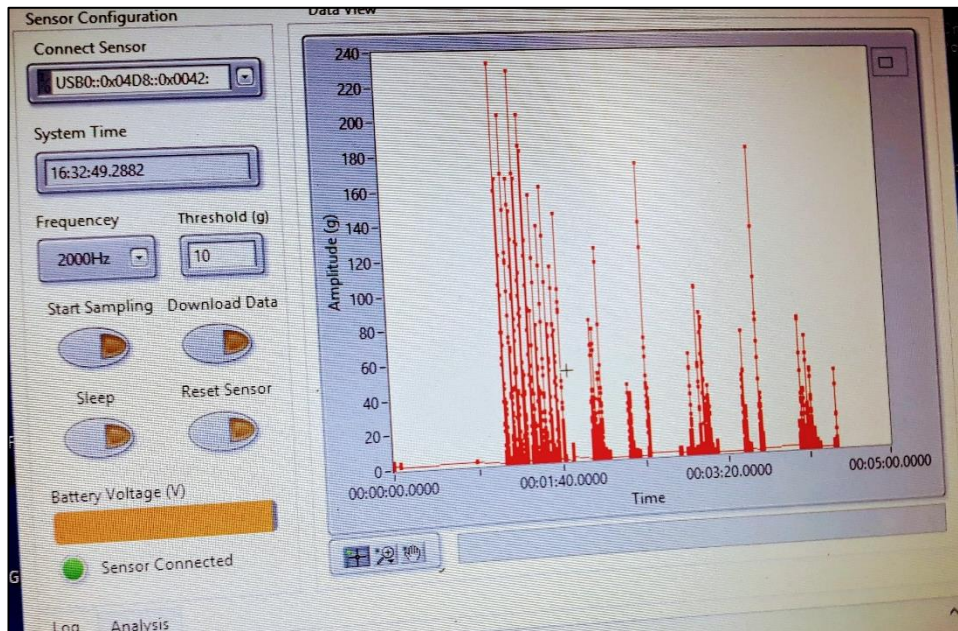


# Harvest – Container Size and Compression



- Use **shallow flats** to **minimize compression**
- Minimize **number of drops**, **drop height**, and **rolling**

# Packing Shed – Need Good Sorters and (again) Minimize Drops



- **Good operators important**
- **Sorting technology**
- Number of sorters
- **Drop height**
- **Padding and sanitation**
- Configure sorters **to cultivar and market**
- **May need to cull more fruit in machine harvest situations to obtain high quality**

# Practice Good Food Safety from Field to Packing House!



- Softer and/or padded surfaces are more likely to **form biofilms**
- Biofilms form within *hours*
- **Water alone** is not as effective as **chlorine**, **peracetic acid (PAA)**, and **Alphet D2 (62.5% ethanol / 7.5% isopropanol)** sanitizers
- **Sanitize regularly!**

# Storage

- Goal is to reduce decay, physiological breakdown, physical abuse, and dehydration
- Maintain **cool temperatures** (32-34°F/0-1 °C) and **high relative humidity** (>95%)
- **Controlled or modified atmosphere** (10-12% CO<sub>2</sub> and 1-2% O<sub>2</sub>)
- UV light, ozone and fumigation with SO<sub>2</sub> may reduce decay



# Many Factors Influence the Final Product

Machine harvesting **high quality fresh fruit is possible**, but **requires good harvester practices from field to clamshell**





# Thank You ~ Any Questions?

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