

Mechanical Harvesting of Southern Highbush Blueberries and Postharvest Disease Relationships

- Part of comprehensive 4-year research/ extension project to take southern highbush production to next level
- Main themes:
 - 1) Overcome genetic, horticultural, and engineering barriers that stand in the way of mechanical harvesting for fresh market
 - 2) Improve overall fruit quality and microbial safety
 - 3) Address emerging systemic diseases that threaten the industry

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Mainland, C. M. et. al., 1975. The Effect of Mechanical Harvesting on Yield, Quality of Fruit and Bush Damage on Highbush Blueberry. J.A.S.H.S. 100:129-134

- Machine harvesting reduced yields of marketable fruit by 19 to 44%
- 10 to 30% softer than hand harvested fruit
- Machine harvested fruit developed 11 to 41% more decay after 7 d storage at 70°F
- Sorting increased rots of mechanically harvested fruit by an additional 5 to 10%



Questions to be addressed as part of mechanical harvest component

- Compare standard cultivars to the new crispy-flesh cultivars such as Sweetcrisp and Farthing:
- Do the plants survive and produce well?
- Do they mechanical-harvest well?
- Can they be manipulated with fruit abscission chemicals to improve harvest?
- How much delay in harvest occurs with machine-harvest?
- How much ground loss occurs?
- Does the fruit hold up well in storage? What are the impacts on microbial contaminants and postharvest disease?
- Do consumers like the crispy flesh fruit?
- Will switching to partial mechanical harvest improve profit margin?

Potential disease/ pathogen issues associated with machine-harvest

- Bush damage, especially at base of plant, due to harvester's catch pans
 - Entry points for stem blight and canker pathogens
- Fruit bruising due to direct contact with harvester's beater rods or as result of fruit falling in harvester
 - Increased susceptibility to postharvest decay
 - Potential attachment sites for microbial contaminants of food safety concern



Minimizing <u>crown injury</u> associated <u>diseases</u>

- Proper pruning, cultivar selection (narrow crown)
- Careful harvester operation
- More gentle catch pan designs (e.g. "centipede scales")



Quantifying <u>fruit bruising</u>: Blueberry harvest impact sensor

BIRD (Blueberry Impact Recording Device)





Changying Li

Pengcheng Yu

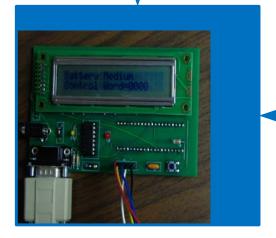


BIRD (Blueberry Impact Recording Device)

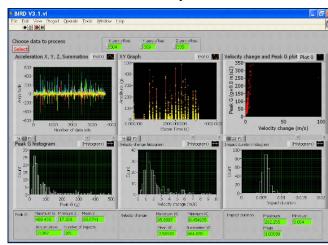
BIRD sensor node



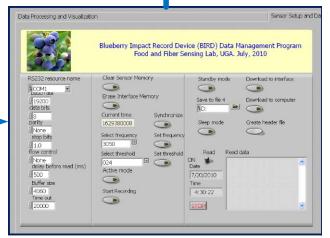
Downloading/recharging interface



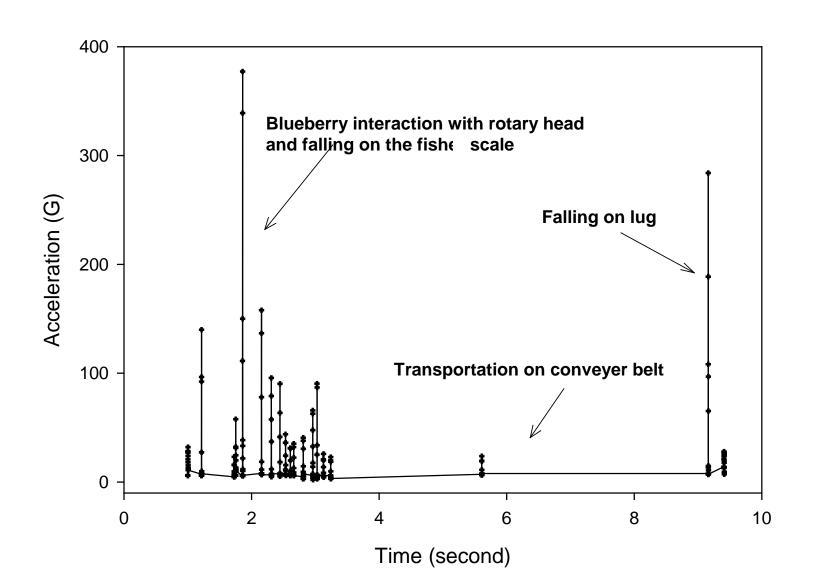
PC-BIRD software: data analysis



PC-BIRD software: data acquisition



BIRD (Blueberry Impact Recording Device) during mechanical harvest with Korvan 8000



Fruit firmness and machine-harvesting

- Berry firmness is key
- Conventional SHB cultivars such as Star, Emerald, Scintilla, Primadonna
 - Lower firmness than rabbiteyes
- Novel crisp-textured SHB cultivars
 - New focus of UF, NC, and UGA breeding programs
 - Firmer berries than conventional cultivars
 - E.g. Sweetcrisp, Farthing, Suzieblue



Lucky Mehra

Machine-harvesting of crispy SHB cultivars may be feasible with reduced bruising and postharvest decay

Crispy berries, machine-harvest, and postharvest disease development

- Compare conventional and crisp-textured SHB genotypes after hand- or mechanical-harvest in relation to:
 - microbial contamination on fruit at harvest
 - 2. subsequent postharvest decay development

Identify fungal organisms associated with postharvest decay



Cultivars and harvesting (Waldo, FL)

- "Conventional" type
 - Star, Scintilla (2009/2010)
 - FL 01-248, Primadonna (2009)

- "Crispy" type
 - Sweetcrisp, Farthing (2009/2010)
 - o FL 98-325 (2009)



OR



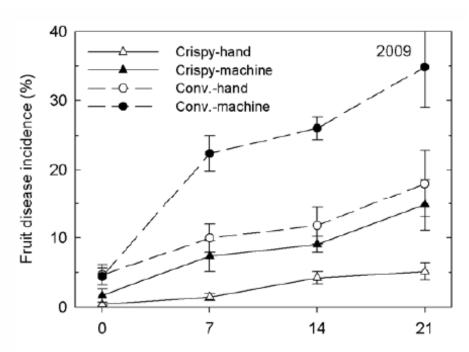
4 replicate row sections





Cold storage for 0, 7, 14, and 21 days, room temp for 4 days

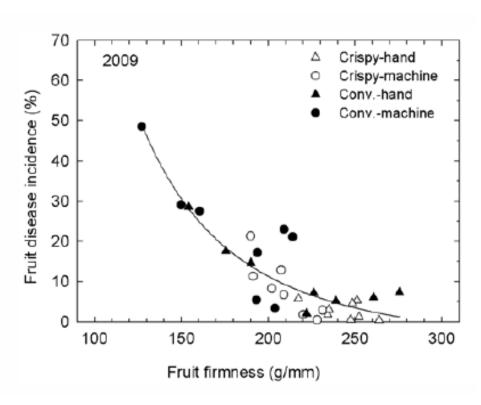
Natural disease development in cold storage



Days in cold storage (+4 days at room temperature)

Source	2009				2010			
	ndf	ddf	F	Р	ndf	ddf	F	Р
Flesh type (F)	1	6	62.75	0.0002	1	6	274.5	<0.0001
Harvest (H)	1	6	139.53	< 0.0001	1	6	157.8	<0.0001
F×H	1	6	2.55	0.162	1	6	18.4	0.005
Time (T) ^b	3	164	53.30	< 0.0001	2	120	10.4	< 0.0001
$T \times F$	3	164	1.53	0.209	2	120	2.83	0.063
$T \times H$	3	164	4.08	0.008	2	120	0.270	0.761
T×F×H	3	164	0.610	0.609	2	120	0.030	0.967

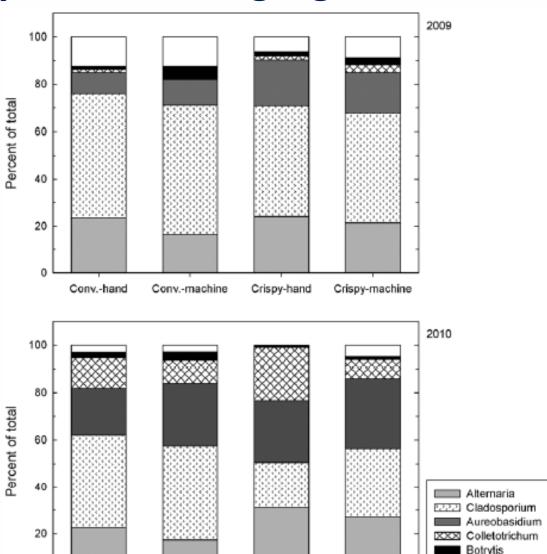
Disease incidence in relation to firmness



- Inverse relationship
- In 2009, >220 g/mm associated with low disease
- In 2010, firmness reached desired levels only in few cases

Contribution by different fungal genera

- Alternaria spp.,
 Cladosporium spp.,
 and Aureobasidium
 pullulans most
 common
- Complex of fungi similar across treatments
- Higher proportion of Colletotrichum in 2010



Crispy-hand

Crispy-machine

Conv.-machine

Others

Data from all 4 cultivars over 4 assessment dates

Cladosporium spp. and Aureobasidium pullulans

- Cladosporium infection limited to velvety mycelial tuft visible at stem scar or cracks near scar
- A. pullulans: wet and slimy appearance of berries

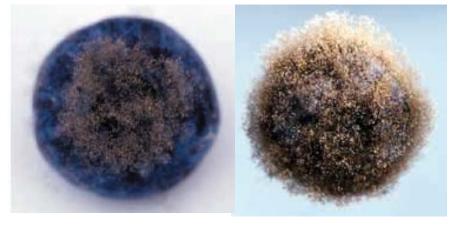


Images courtesy Wharton & Schilder

Alternaria, Botrytis and Colletotrichum spp.



Alternaria spp.



Botrytis spp.



Colletotrichum spp.

Microbial fruit surface contaminants

- Overall contaminant counts (aerobic bacteria, yeast, mold)
 below commonly used thresholds for processed blueberries
- No effect of harvest method or flesh type
- No E. coli detected in either year
- Coliforms detected in:
 - One rep of hand-harvested Primadonna in 2009 (avg. 7 CFU/g)
 - Machine-harvested reps of Farthing and Sweetcrisp in 2010 (avg. 1 and 20 CFU/g, respectively)



Conclusions

- No significant effect of flesh type and harvest method on microbial contaminants
- <u>Natural decay incidence</u>: Lower for hand-harvested fruit; for crispy flesh type
- Machine-harvested crispy flesh equal to or lower than hand-harvested conventional flesh
- Fruit firmness good predictor of post-harvest decay;
 >220 g/mm desirable
- Cladosporium, Alternaria, and Aureobasidium most common
- Artificial inoculation: Lower decay incidence for crispy flesh

Machine-harvested crispy SHB acceptable in terms of postharvest disease and quality

Overall Bottom Line from Mechanical Harvesting Experiments

- For most quality and postharvest attributes, hand-harvested conventional and machineharvested crispy equivalent
- Stay on top of optimal harvest window, avoid hot temperatures
- Field losses (ground drops) still problematic, but can be addressed with pruning, cultural practices, and breeding
- Economics: cautiously optimistic

Fresh-pack blueberry practices to reduce postharvest decay

- Select cultivars for resistance, dry stem scar, crispy fruit
- Use preharvest fungicides
- Timely, thorough harvest (every 4-7 days for highbush, 7-10 day for rabbiteye)
- Handle berries dry
- Provide a clean pick/pack environment
- Cool (dry) pre-pack followed by forced air



Exobasidium Leaf and Fruit Spot (Exobasidium sp.)

