AGRICULTURAL RESEARCH FOUNDATION
FINAL REPORT
FUNDING CYCLE 2015 – 2017

TITLE: Evaluation of Fresh Fruit Quality of Four Highbush Blueberry Cultivars Harvested With a Hand-held Harvest Aid

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SUMMARY: In 2015, a pneumatic Campagnola 'Golia' olive shaker (Brewt Power Systems, Merced, CA) was used to mechanically harvest blueberries with two different models of shaker heads. The hand-held shakers (short or long vibrating rods) were operated at two pressures of 45 and 65 psi with an air compressor. A woven fabric catch frame was used to collect the berries from the mechanically harvested plants. In 2015, four blueberry cultivars harvested were a 15-year old Legacy, 5-year old Liberty, 6-year old Draper, and 3-year old Aurora. In 2016, three blueberry cultivars harvested were a 16-year old Legacy, 7-year old Draper, and 7-year old Aurora. The mechanical harvest was timed from 1 to 6 minute to compare with hand harvest for total fruit harvested, percent of red and green fruit, fruit firmness and brix, and cold storage quality. Fruits were sliced 24 hours after harvesting to determine internal bruising damage and %TSS of expressed juice. Final analysis indicated that fruits quality such as firmness and internal bruising did not differ between hand-held shaker and hand harvest. Operating pressure did not affect total fruit harvested, and the percent of green and red fruits. There were slight differences between short and long shaker heads in total fruit harvested depending on cultivar. In 2016, BIRD was used to evaluate a packing line. Many impact points along the processing line were identified and all impact measurements were below 100 g, which is a threshold to cause fruit internal damage. BIRD sensor was demonstrated to be valuable tool to assess packing line performance and improve fresh pack out.

OBJECTIVES:

1. Determine fresh fruit quality following harvesting with a hand-held mechanical aid shaker.
2. Use BIRD sensor to improve fresh quality pack out.

PROCEDURES: Popular highbush cultivars commercially grown in the Pacific Northwest were chosen for the study due to their excellent fruit quality for the export market. These cultivars were Legacy, Liberty, Draper, and Aurora. Except for cultivar Aurora (2015) that was grown in a research plot at the North Willamette Research and Extension Center, all others were from commercial blueberry fields in Hillsboro, OR. The design of the harvesting experiment was the same for each cultivar. The control treatment consisted of hand harvesting the plants for four

minutes, and a total of four reps were collected using this method. A pneumatic Campagnola 'Diablo' olive shaker (Brewt Power Systems (Merced, CA)) was used to mechanically harvest the berries, and two different models of shaker heads were tested. One head consisted of two plastic forks set parallel to one another, each with three 4.5 in long tongs, the other head had two plastic fork extensions that were also parallel to one another, with 8 in long tongs, and one fork had three arms while another had two, and the central tongs were slightly bent. We referred to these heads as short and long, respectively. The treatments consisted of both of the heads being operated at two different pressures- 45 psi and 65 psi, which resulted in a total of four different treatments, plus a control. To capture the berries that were shaken from the plant, a wire catch frame lined with netting consisting of two halves was placed around the base of the plant, so that they fully encircled the plant's base. While the harvester was being operated on one side, the catch frame was adjusted to maximize the amount of fruit caught by moving it around. One half of the plant was harvested at a time, and after both sides had been harvested, fruit was pooled into a large paper sack, labeled and set in the shade. Four clamshells were also filled with berries from the paper sack, labeled with the treatment, and placed into a cooler containing ice. Sampling time ranged from one to six minutes, and the amount of time spent harvesting each plant was written on the sample bag, so that in the lab the total yield could be adjusted for the varying sample times. After four replications using the short shaker head at 65 psi had been completed, the head was then exchanged for the long head, and four replications were performed using this head. A couple of samples were collected using a commercial sway harvester (BEI) head, which is a much older, defunct head, and this head broke after only a couple of samples had been taken and so the data was not used. It was also noted that this head resulted in a larger amount of plant damage compared with the plastic heads. Four replications were then performed using both of the head styles operated at 45 psi. It was noted that more fruit was released by the plant when the shaker tongs were set firmly against a branch prior to starting the vibrations. When branches were in between the tongs and not fully in contact with the shaker, far less fruit fell. There was some slight damage that was noticed on branches that had been shaken, but this tended to be minimal. Samples that had been collected by the shaker contained significantly more debris such as twigs and leaves compared with the handpicked samples.

In July berries were collected from 6-year-old (2015) and 7-year-old (2016) Draper plants growing at Forest Hills using the same protocol used to collect the Legacy berries, however, after berries had been collected from both sides of each plant, they were not transferred into a paper bag, but were instead pooled into a single flat, to help reduce excessive damage that could result from being transferred multiple times. The flats were then taken back to the lab, and berry samples were processed using the same methods as before. Berries were harvested from three and four-year-old Aurora plants at the North Willamette Research and Extension Center, Aurora, OR on 30 July, and on 3 August berries were harvested from 5-year-old Liberty plants growing at Forest Hills using the same protocol. On 24 July a sample of Legacy berries was collected from a Littau machine harvester. The berries were brought back to the lab in a small paper sack, and berries were processed in the lab using the usual methods.

In the lab, the total amount of fruit was weighed for each sample, and the amount of sampling time per plant was noted. A subsample of approximately 1lb of fruit was measured into a container, weighed, and was then poured into a wide flat plate where berries were sorted. Red and green berries were separated into different containers, and then weighed separately to determine the percent of green and red berries in each sample. Another subsample consisting of approximately 0.5 lb was removed from the main bag of unsorted berries and placed into a

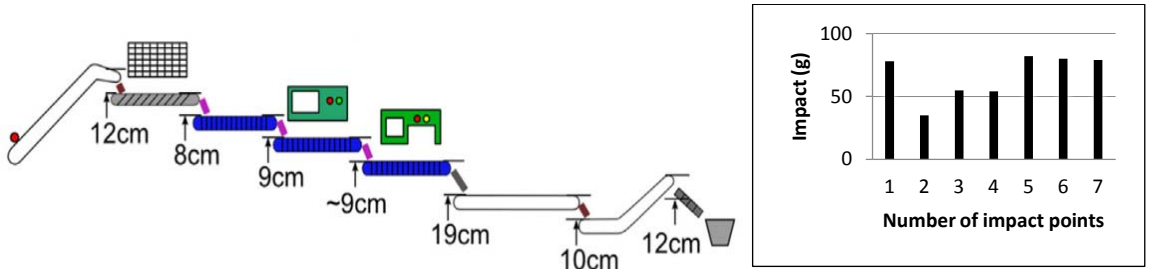
smaller paper bag labeled with the treatment, and was then set aside. After all of the samples had been weighed, a set of 25 ripe berries per treatment was selected from the subsample bags and was run through the FirmTech II (Bioworks, Inc. (Wamego, KA)) to assess firmness. Each berry was carefully placed on its side in the loading wells of the FirmTech 2. These were then placed into plastic quart size Ziploc bags labeled with the treatment, and were then frozen to be tested later for Brix, pH and total acidity at a later date. The clamshells that had been filled in the field and placed into coolers were all numbered one through four (the number corresponded to the number of weeks they would be left in storage before being assessed) for each treatment, and initial weights were recorded. Clamshells were then placed into a large refrigerator at 34F for storage assessment.

SIGNIFICANT ACCOMPLISHMENTS: We demonstrated that using the harvest aid, it is possible to harvest fresh blueberries with the quality compared to hand harvest along (e.g. 'Draper' in Table 1). The difference in final fruit quality was largely dependent on cultivar. 'Draper' performed the best with harvest aid with very little internal fruit bruising damage (Table 1). Using BIRD sensor, individual impact points can be identified to improve packing line performance. As show in Fig 1, up to 7 impact points were identified after BIRD sensor was placed at the beginning of loading point and ran through the packing line. All impact measurements in this particular packing line were below 100 g which is the fruit damage threshold. We plan to use the BIRD sensor to evaluate 10 blueberry packing lines in 2017 based on our successful study in 2016.

Table 1. Effect of mechanical shaker and catch surface on internal bruising damage of 'Draper' blueberry fruit in 2016.

Harvest method	Pressure	Surface	% Fruit with > 20% bruised	Average bruised area
Machine	50	Net	1	2.2
Machine	50	Pad	6.5	3.5
	60	Net	1	1.8
	60	Pad	2	3.4
Hand	--	--	0	0.5

Fig 1. BIRD sensor evaluation of a packing line and fruit impact on the packing line in 2016.



ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:

With the support from ARF, we are able to use the preliminary results to get additional funding from the Oregon Blueberry Commission ($5,000) and the Clackamas County ($15,000) to further support this work.

FUTURE FUNDING POSSIBILITIES:

Two grants have been submitted to the Oregon Blueberry Commission and the Northwest Center for Small Fruits Research in late 2016.