

## **CONTINUING PROJECT**

**Project #:** OSCC-2

**Title:** Cultivars, rootstocks, training systems and fruit quality evaluation in sweet cherry.

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### **Objectives**

- Evaluate new promising cultivars, rootstocks and training systems for tree growth and fruit characteristics including branching and fruiting habit, yield, disease tolerance, and bloom and harvest season.
- Evaluate postharvest quality of different cultivars (firmness, size, °Brix, color, pedicel quality and detachment force).
- Generate fruit and shoot growth curves for promising cultivars to help predict harvest and final fruit size and aid in developing new tree management strategies.
- Evaluate manual crop load regulation strategies (i.e., spur thinning, selective de-fruiting) as options to produce larger fruit.

### **Significant findings for 2003**

- Cultivars and selections showing promise include Santina and Cristalina for the early season and 13S-16-29 (showed good tolerance to powdery mildew) for the late season. Regina showed very good overall quality. 13S-42-49 continues to show promise as a stemless/mechanically-harvested cherry.
- Alternative rootstocks identified as most promising so far include Pontaleb, Maxma 14, Giessen 195-20 and Weiroot 158.
- Postharvest quality analysis based on fruit maturity revealed quantitative differences in firmness, °Brix and stem detachment force (plus subjective evaluation of color and stem

quality) among under-ripe, ripe and over-ripe fruit of 8 cultivars. 'Regina' fruit of all ripeness stages showed good overall quality after storage at 31°F for 0, 14 or 28 days.

- Preliminary developmental growth curves have been generated for fruit and shoots of 'Bing', 'Regina', 'Lapins' and 'Sweetheart'. Curves are based on a recent model involving growing degree hours. These curves will be used to test tree management practices taking into account reproductive and vegetative developmental stages.

## Methods

A collection of sweet cherry cultivars and selections is under evaluation in The Dalles and Hood River. Trials are currently being carried out on rootstocks from France and Germany (Weiroot series) in plots in The Dalles with 'Bing' as the scion cultivar. An NC-140 rootstock trial involving 15 rootstocks was established in 1998 at Orchard View Farms. All rootstocks are evaluated on 'Bing' scion, with Van as the pollinizer.

A postharvest study involving 8 cultivars was initiated in 2003 to assess average fruit weight, size and firmness (FirmTech 2 firmness instrument), °Brix, pedicel detachment force. Fruit quality was assessed immediately upon harvest and periodically after exposure to 14 and 28 days periods of cold storage.

Fruit and shoot growth curves are being developed for 4 cultivars. Periodic growth measurements are related to cumulative growing degree hours (GDH) rather than growing degree days (GDD). A base temperature of 25°F was used with biofix at ca. full bloom. Fruit equatorial diameter measurements made between May 12 and July 14.

## Results

### *Sweet cherry cultivar collection, The Dalles (Tables 1, 2)*

Cultivars that offer potential for the early season include 'Santina' and 'Cristalina'. 'Santina' fruit had good firmness, flavor and acceptable size. In contrast to 'Cristalina', 'Santina' did not show a tendency to overset, and may ripen 1 to 2 days later.

Several cultivars from this plot have shown potential for the late season (13S-16-29, 'Sweetheart' 'Symphony', 'Staccato' and 13S-21-01). Unfortunately, most have shown high incidence of powdery mildew on the fruit. 13S-16-29, although with relatively small fruit, ripened after 'Sweetheart' this year and offers potential as a late material as it produced fruit of acceptable firmness, excellent flavor, and showed no powdery mildew on fruit or leaves at harvest. In sites with low incidence of powdery mildew, 13S-16-29 appears to have good potential as a fruit that would be harvested between 'Regina'/'Skeena' and 'Staccato'.

As reported in previous years, a material with potential as a stemless and/or mechanically-harvested cherry is the selection 13S-42-49. Due to the tendency to lose its stem, 13S-42-49 would probably not be suitable for hand picking and would require unique marketing strategies to compete favorably against fruit with stems. However, its fruit has good flavor, acceptable firmness, a round, slightly flattened shape, and dark flesh color. A summary of main traits observed in several other cultivars and selections during 2003 is shown in the tables below.

Observations on pitting incidence using fruit stored at 10C and treated at 4C with a pitting tool showed none to slight damage for treated fruit of 'Bing' (Dufur), 'Sonnet', 'Sonata', 'Regina',

'Sandra Rose', 'Attika' and 'Lapins'. Fruit were stored July 10 and evaluated on July 23. 'Sonata' and 'Sandra Rose' had small proportions of fruit (<15%) with severe pitting.

### ***Sweet cherry rootstock evaluation, Hazel Dell, The Dalles (Table 3)***

#### ***French section (7<sup>th</sup> leaf)***

Results for 2003 are summarized below for both sections of the Hazel Dell plot. Pontaleb and Maxma 14 continue to produce excellent yields in the French section, and all rootstocks produced fruit of the same caliber as Mazzard during 2003. Due to the large variability in this planting, no differences in fruit size could be determined among rootstocks. Edabriz did not produce a large yield, and fruit size was still low in 2003, overall a poor performance in 2003. Although, not statistically significant, the data suggest that Edabriz would yield better (but produce small fruit) when trained as an open vase. Maxma 14, which produces a tree of vigor similar to Mazzard, appears to be performing well as a central leader or open vase.

#### ***Weiroot section (6<sup>th</sup> leaf)***

Inadequate replication in the Weiroot section does not allow a proper statistical analysis to conclusively evaluate performance of the 3 rootstocks harvested in 2003. Although both W158 and W72 produced numerically higher yields than Mazzard, such differences were not statistically significant. Fruit size was good and not influenced by rootstock or training system. Mazzard production is still low with relatively high fruit weights. Weiroot 72 and 158 as a central leader had numerically higher yields than open vase. Fruit size of W72 as a central leader was not satisfactory in 2003, an observation also made at the NC-140 rootstock evaluation trial. This was the last year of data collection at the Hazel Dell plot. However, it is recommended that evaluation of rootstocks at this experimental planting continue as a demonstration plot to follow the annual performance of 'Bing' on potentially alternative rootstocks to Mazzard.

### ***NC-140 rootstock trial, Orchard View Farms, The Dalles (Table 4)***

Trees of this trial are trained to the central leader training system. Yield and fruit size trends in 2002 and 2003 suggest that the trees in this plot are approaching mature bearing age. Fruit size for all rootstocks was very good in 2003, whereas in 2000, 2001 and 2002 there were significant differences among cultivars, ranging from 8.1 g/fruit to 10.0 g/fruit in 2002. Giessen 195-20 has produced the best yields throughout the study, although fruit size in previous years has not been optimal (10.5 row average in 2002). Yield of Weiroot 72 during 2003 was lower than in 2002 and 2001, and fruit size was unacceptable in both years.

The correlation between yield and fruit firmness in 2002 to 2003 indicates that in mature trees, high yields do not necessarily result in reduced fruit firmness.

Larger trees tend to have larger and firmer fruit, although increased firmness appears to be related to ripeness stage, with the larger trees tending to have less ripe fruit at the time of harvest. The large Weiroot trees produced low yields, whereas the larger Gisela trees produced the best yields in the study in 2002 and 2003. Based on results obtained so far, the best performing rootstock in this plot is Giessen 195-20. Rootstocks will continue to be evaluated in 2004.

### ***Postharvest fruit quality parameters as influenced by maturity stage at harvest (Table 5)***

Postharvest quality traits (firmness, °Brix, color based on MSU 4-tone scale, overall fruit appearance where 1= best and 4=worst, and stem detachment force) are summarized for 5 cultivars in Table X. Fruit considered ripe, under- or over-ripe based on external color, were separated per ripeness stage. Samples (n=25) were analyzed 0, 14 and 28 after storage at 31°F. All measurements were performed on individual fruit to allow cross-correlations among quality

parameters, although only means and corresponding standard errors are presented. Additional cultivars not shown include 'Sylvia', 'Sandra Rose' and 'Lapins'. Additional measured variables include fruit weight and diameter. This study will be repeated in 2004.

***Post-harvest evaluation of modified-atmosphere packaged (MAP) 'Regina' fruit (Table 6)***

A preliminary study conducted in 2002 revealed that more than 60% of 'Regina' fruit exhibited darkened pulp spots when packaged in MAP. Symptoms suggested damage by elevated CO<sub>2</sub> levels inside MAP bags (Dr. Paul Chen, personal communication). An experiment was conducted to compare fruit quality of Regina fruit packaged in View-Fresh bags with and without a CO<sub>2</sub> scrubber pad (filled with 500 g of hydrated lime powder) to absorb CO<sub>2</sub>. Fruit samples were harvested and packaged July 21, and evaluated after 25, 32 and 39 days of storage. The damage observed in 2002 was not seen in either treatment tested in 2003, therefore the cause of the 2002 damage remains unclear. However, this recent trial revealed that 'Regina' fruit stored for up to 39 days in MAPing maintained very good visual and mechanical quality.

***Update on 2002 spur thinning of 'Bing'/Edabriz***

A replicated trial was conducted in The Dalles (Hazel Dell plot) in 2002 to determine whether crop load management through spur removal (ca. 50% of spurs removed manually) would produce large fruit on Edabriz rootstock. Results of 2002 were inconclusive due to extremely poor fruit set, which was attributed to adverse weather conditions during anthesis. Total yields for all trees were estimated at only 10 to 15 lb/tree (the average in 2001 was 37 lb/tree). Trees were left intact in 2003 but were evaluated for yield and fruit size. Trees produced between 24 and 31 lb/tree with average fruit weight ranging between 8.4 and 8.8 g/fruit. Differences in tree yield and average fruit weight were not statistically significant. These preliminary results indicate that spur-thinning has not been an effective strategy to increase fruit size in 'Bing'/Edabriz. Observations and treatments will continue in 2004.

***Fruit and shoot growth curves (Figure 1)***

A study to generate developmental curves for fruit and vegetative shoots of 4 cultivars was initiated in 2003 in Hood River and The Dalles. Curves relating incremental growth (based on the smaller equatorial fruit diameter) in relation to growing degree hours (GDH) are shown in Figure 1 for 'Bing', 'Lapins', 'Regina' and 'Sweetheart' fruit growing in Hood River (MCAREC). Measurements were made between May 12 and July 14 using a digital caliper. Fruit were about mid Stage 1 at the start of measurements. Although preliminary, these curves reveal differential growth rates among cultivars, with 'Regina' showing greater growth rates (steeper slope) during early development (part of Stage 1). Reductions in growth rate corresponding to Stage 2 (hardening of the pit) are discernible for all cultivars, with 'Bing' and 'Regina' showing a more defined lag period than 'Lapins' and 'Sweetheart'. This information can be potentially useful in fine-tuning the timing of cultural practices such as irrigation, nutrient management and GA<sub>3</sub> sprays. This type of information may also help predict reproductive and vegetative developmental events (as well as harvest date and final fruit size) by tracking accumulation of temperature-related parameters such as GDH. This study will continue during 2004.

## Budget

Title: Cultivars, rootstocks, training systems and fruit quality evaluation in sweet cherry.  
 PI: Roberto Núñez-Elisea  
 Duration: long-term  
 Funding in 2003: \$26,500  
 Current year: 2004  
 Current year request: \$27,500

	Year 2003	Current year 2004	Year 2005
<b>Original request</b>			
Total	41,000	<b>28,000</b>	
<b>Current year request</b>			
Salaries-FRA	17,153	<b>14,310</b>	
OPE (53%)	8,847	<b>12,690</b>	
Travel to res. plots	500	<b>500</b>	
<b>Total</b>	26,500	<b>27,500</b>	30,000

Table 1. Relevant observations on sweet cherry cultivars under evaluation in The Dalles, OR.

Cultivar/selection	Most significant traits observed in 2003	
	Negative	Positive
Cristalina	Overset crop this year	Early harvest
Santina		Early harvest, good fruit quality
13S-42-49	Large tree size, upright growth habit	Good fruit quality, potential stemless cherry or for mechanical harvest.
Sandra Rose	Very light crop	Very good fruit quality
13S-18-15	Bland flavor, lacks firmness	Good stem quality, harvest between Sandra Rose and Attika.
Newstar	Fruits lack firmness	Very large size
8S-3-13	Fruits lack firmness	Very large size
Attika		Excellent flavor, good firmness
4W-11-08	High incidence of tip cracking (in the absence of rain).	Overall good fruit quality, late harvest.
Symphony	High incidence of powdery mildew, poor stem retention	Late harvest
Sweetheart	High incidence of powdery mildew	Very late harvest
13S-16-29	Small fruit size.	Negligible incidence of powdery mildew, very late harvest (after Sweetheart), good fruit quality.
Staccato	High incidence of powdery mildew	Very late harvest, spreading growth habit.
13S-21-1	High incidence of powdery mildew	Very late harvest, spreading growth habit.

Table 2. Fruit characteristics of sweet cherry cultivars and selections under evaluation in The Dalles. All trees were treated with 25 ppm GA<sub>3</sub>.

Cultivar/selection	Date	Ripeness status	Fruit wt. (g)	Fruit diam. (mm)	Firmness (g/mm)	% of fruit (n = 50 fruit)	
						10-row and larger	9-row and larger
Newstar	26-Jun	ripe-over	12.2	30.7	253.2	100	66
8S-3-13	26-Jun	ripe	12.4	31.7	318.3	100	82
Cristalina	26-Jun	ripe-over	11.0	30.4	339.7	98	74
Santina	26-Jun	ripe	11.8	30.7	380.9	100	80
Bing (Marchand)	30-Jun	harvest	10.7	29.2	321.1	100	34
Bing/Mazzard	30-Jun	harvest	10.5	28.9	287.1	96	26
Bing/G-6	30-Jun	harvest	9.6	28.1	339.9	90	10
Sylvia	30-Jun	ripe-under	12.1	29.9	292.6	96	60
Sonata	7-Jul	ripe-over	13.6	31.9	400.7	100	90
Sandra Rose	7-Jul	ripe-over	14.2	32.6	358.7	100	88
13S-21-07	7-Jul	ripe-over	11.3	30.5	270.0	100	70
Sonnet	7-Jul	ripe-over	11.5	29.8	260.4	90	56
13S-18-15	7-Jul	ripe	13.6	32.3	298.5	100	94
Attika	10-Jul	ripe	12.2	30.1	309.0	100	56
Lapins	14-Jul	ripe	13.1	31.5	364.9	100	82
4W-11-08	17-Jul	ripe	12.0	30.3	409.1	100	64
Regina	17-Jul	ripe	11.6	28.9	353.3	82	34
13S-42-49	17-Jul	ripe	12.3	30.9	389.2	94	76
Sweetheart/G-6	17-Jul	harvest	12.8	30.7	348.0	100	66
Sweetheart/Maz	17-Jul	harvest	10.1	28.5	368.9	96	8
13S-16-29	23-Jul	ripe	10.1	28.9	306.6	98	28
Symphony	28-Jul	ripe	11.2	29.1	261.9	100	32
Staccato	4-Aug	ripe	11.2	-	-	-	-
13S-21-01	4-Aug	unripe	10.1	-	-	-	-

Table 3. Yield, vigor and fruit size of ‘Bing’ on promising alternative rootstocks at Hazel Dell orchard, The Dalles, OR, 2003.

French (7 <sup>th</sup> leaf)	2003 yield (tons/acre)		Fruit weight (g)		TCSA (cm <sup>2</sup> )	
	Rootstock	Central leader	Open vase	Central leader	Open vase	Central leader
Pontaleb	6.67 a	4.38 a	10.3	10.1	263.0	250.1
Maxma 14	4.26 b	4.98 a	9.6	9.5	232.0	279.3
Edabriz	2.90 b	3.80 a	8.5	8.9	113.7	123.9
Mazzard	3.12 b	1.33 b	9.6	9.7	221.4	250.7
			ns	ns	ns	ns

Weiroot (6 <sup>th</sup> leaf)	2003 yield (tons/acre)		Fruit weight (g)		TCSA (cm <sup>2</sup> )	
	Rootstock	Central leader	Open vase	Central leader	Open vase	Central leader
W158	7.06	5.66	8.3	9.0	158.8	218.6
W72	8.47	5.20	8.3	7.4	71.5	74.5
Mazzard	2.69	0.51	8.6	9.6	180.2	262.7
	ns	ns	ns	ns	ns	ns

Table 4. Performance of ‘Bing’ sweet cherry on 15 rootstocks at the NC-140 evaluation trial, Orchard View Farms, The Dalles, 2003.

Rootstock	Yield (lbs/tree)	TCSA (cm <sup>2</sup> )	Fruit quality			Fruit appearance
			Weight (g)	Diam. (mm)	Firmness (g)	
195-20	55.0 a	124.1 de	10.5	29.40	308.41 efg	variable/ripe-underripe
Gi-6	52.8 ab	171.8 abc	10.2	28.82	327.44 cdef	uniform/ripe
Gi-4	46.4 abc	79.5 h	9.5	27.45	297.98 fg	uniform/ripe-overripe
Gi-5	45.9 abc	111.3 ef	10.0	28.58	337.08 cde	uniform/ripe
318-17	44.4 abc	163.5 bc	10.2	28.92	327.79 cdef	uniform/underripe
Gi-7	42.8 bc	111.0 efg	10.6	29.01	341.28 cd	uniform/ripe-underripe
<i>P. mahaleb</i>	40.6 cd	180.3 ab	10.3	29.24	338.36 cd	uniform/ripe-underripe
W-158	36.6 cde	146.0 cd	10.2	29.14	381.57 a	variable/underripe
W-53	36.1 cde	72.5 h	9.9	28.91	313.8 defg	uniform/ripe-overripe
Edabriz	36.0 cde	93.2 fgh	9.9	29.04	323.70 cdefg	variable/ripe-overripe
209-1	30.9 de	68.5 h	10.0	28.69	296.63 g	uniform/ripe-overripe
W-154	30.6 de	161.7 bc	9.7	28.80	351.64 abc	variable/underripe
W-72	29.5 de	85.0 gh	10.1	29.27	335.40 cde	uniform/ripe
W-13	29.3 de	194.9 a	9.9	28.94	348.93 bc	uniform/ripe-underripe
W-10	25.8 e	175.7 ab	9.9	28.75	377.56 ab	variable/underripe
			n.s.	n.s.		

Table 5. Postharvest quality of 5 sweet cherry cultivars harvested at 3 maturity stages. Fruit samples collected from The Dalles cultivar evaluation plot.

Cv.	Stage	Days posthvt.	Firmness (g/mm)	±Std. error	°Brix	±Std. error	Color (1-5; 5=darkest)	±Std. error	Stem qlty. (1-4; 1=best)	±Std. error	Stem detach. force (g)	±Std. error
'Bing'	Over-R	0	323.3	50.6	23.9	3.1	4.2	0.4	1.0	0.0	585.4	255.2
		14	372.0	50.5	22.8	3.1	4.3	0.4	2.4	0.8	416.8	263.6
		28	--	--	22.1	2.3	4.5	0.3	2.5	0.8	440.6	246.7
	Ripe	0	307.9	44.3	21.4	2.9	4.3	0.4	1.0	0.0	676.4	148.5
		14	361.3	72.4	21.4	2.8	4.1	0.4	1.8	0.7	668.7	283.3
		28	445.9	97.2	20.1	2.8	3.9	0.4	2.4	0.6	646.6	206.6
	Under-R	0	371.0	30.2	18.3	1.6	2.7	0.5	1.0	0.0	611.5	121.3
		14	419.6	50.2	17.5	1.4	2.1	0.6	1.8	0.6	627.2	177.4
		28	458.6	72.2	17.6	1.6	2.6	0.5	2.2	0.6	472.1	236.2
'Lapins'	Over-R	0	353.5	51.1	19.2	2.1	4.7	0.3	1.0	0.0	351.2	166.5
		14	--	--	20.5	3.2	4.6	0.3	2.6	0.6	385.8	185.1
		28	410.9	76.8	20.2	2.4	4.5	0.4	2.6	0.6	301.5	188.2
	Ripe	0	338.3	42.0	19.1	2.5	4.3	0.3	1.0	0.0	512.8	209.6
		14	398.7	66.7	18.4	2.0	4.4	0.3	2.3	0.7	491.0	228.8
		28	--	--	18.8	2.5	4.4	0.3	2.3	0.8	411.7	255.3
	Under-R	0	386.4	41.9	20.0	1.6	3.6	0.3	1.0	0.0	604.0	139.3
		14	423.2	65.8	19.1	1.9	3.7	0.2	2.4	0.6	550.6	210.4
		28	--	--	19.2	1.6	3.9	0.3	2.3	0.9	533.4	233.7
'Regina'	Over-R	14	--	--	23.4	2.8	4.9	0.2	2.8	0.6	1109.5	369.4
		28	448.6	77.3	22.6	2.3	4.9	0.1	3.8	0.4	1058.2	431.9
		0	331.8	46.5	22.5	3.0	4.4	0.2	1.0	0.0	1005.4	179.4
	Ripe	14	358.2	47.0	22.7	2.4	4.8	0.3	2.0	0.7	1070.5	304.7
		28	--	--	22.1	2.4	4.7	0.4	1.8	0.7	1052.1	307.4
		0	346.2	66.3	17.9	2.1	3.9	0.4	1.0	0.0	888.7	185.1
	Under-R	14	361.5	46.0	18.2	3.1	4.1	0.6	1.8	0.8	943.5	150.3
		28	--	--	18.2	2.8	4.2	0.4	1.6	0.8	945.6	249.9
		0	405.1	43.0	20.5	2.1	4.3	0.4	1.0	0.0	441.2	200.5
'Skeena'	Over-R	14	--	--	20.6	1.4	4.5	0.3	1.8	0.6	369.5	192.7
		28	487.5	59.2	19.8	1.8	4.5	0.3	2.3	0.6	287.6	199.3
		0	381.5	38.3	20.1	2.1	4.1	0.2	1.0	0.0	420.2	226.0
	Ripe	14	458.7	53.1	19.5	1.5	4.2	0.3	1.8	0.7	434.7	223.3
		28	--	--	19.5	2.6	4.3	0.4	2.4	0.9	431.4	265.6
		0	272.3	40.4	18.1	1.8	4.0	0.2	1.0	0.0	442.8	153.4
'Sweetheart'	Over-R	14	--	--	18.0	2.1	4.0	0.2	1.9	0.9	491.9	196.4
		28	339.0	70.5	19.1	2.5	4.2	0.3	2.9	0.7	402.3	215.8
		0	370.0	50.9	22.3	2.5	4.2	0.3	1.0	0.0	527.4	212.2
	Ripe	14	423.8	63.6	21.9	2.3	4.1	0.5	2.1	0.7	590.4	211.0
		28	512.5	76.0	21.2	2.3	4.1	0.2	1.9	0.6	521.5	240.8

Table 6. Effect of a CO<sub>2</sub> scrubber on MAPed 'Regina' fruit quality. Fruit samples harvested July 21, 2003 and stored at 31°F.

MAP treatment	Fruit wt. (g)	±Std error	Firmness (g/mm)	±Std error	°Brix	±Std error	Color (1-5; 5= darkest)	±Std error	Stem qual. (1-4; 1 = best)	±Std error
<i>15-Aug (25 days postharvest)</i>										
MAP + CO <sub>2</sub> scrubber	12.21	0.25	355.0	8.3	20.9	0.36	4.72	0.03	2.1	0.17
Control (MAP only)	12.82	0.23	349.9	8.2	22.2	0.64	4.79	0.03	1.3	0.11
<i>22-Aug (32 days postharvest)</i>										
MAP + CO <sub>2</sub> scrubber	12.79	0.27	394.3	10.9	21.7	0.32	4.82	0.03	1.6	0.12
Control (MAP only)	12.40	0.30	395.9	15.3	23.2	0.43	4.84	0.04	1.2	0.08
<i>29-Aug (39 days postharvest)</i>										
MAP + CO <sub>2</sub> scrubber	12.36	0.26	349.5	7.8	21.5	0.34	4.75	0.05	1.6	0.10
Control (MAP only)	12.86	0.22	364.7	10.9	21.6	0.50	4.70	0.04	1.6	0.12

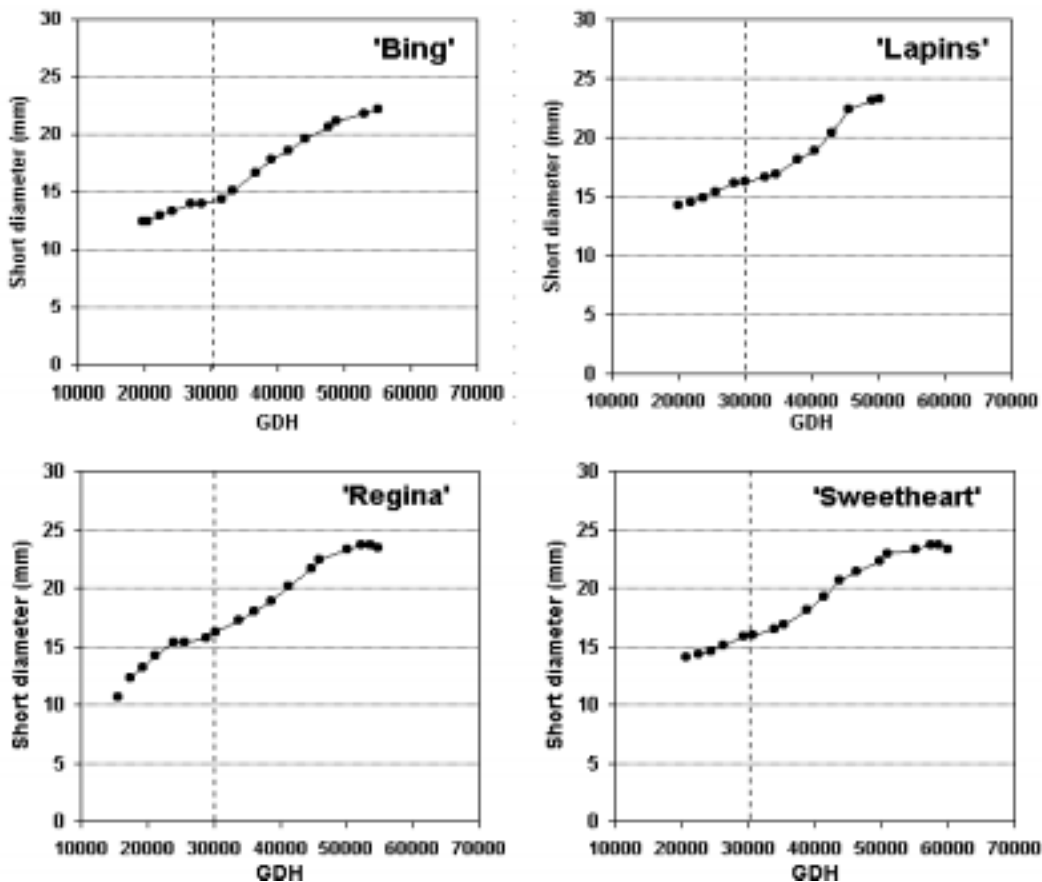


Figure 1. Fruit growth curves for 4 sweet cherry cultivars in relation to cumulative growing degree hours (GDH; base temperature 25°F, biofix at ca. full bloom). Fruit equatorial diameter measurements made between May 12 and July 14. MCAREC, Hood River, 2003.