



Regional Specialty Cider Cultivar Performance

From 2012-2015, four cider apple cultivars were collected from three commercial orchards and one research orchard in northwest and central Washington to compare juice quality characteristics. Northwest Washington has a cool, humid summer climate (16.0 °C on average during this study) and is the origin of the state’s cider apple industry, while central Washington has a hot, dry summer climate (22.1 °C on average during this study) and is the center of the state’s dessert apple industry. Each year, a random sample of each of the four cultivars from the four orchards was collected, fruit were pressed, and the juice was analyzed for five characteristics important to cider making: soluble solids concentration (SSC, %), specific gravity (SG), pH, titratable acidity (TA, malic acid g·L<sup>-1</sup>), and tannin (tannic acid %). Results show that none of the juice quality characteristics differed due to region and there were no interactions of region, cultivar, and/or year. There was a significant difference in all five juice quality characteristics due to cultivar and a difference in SG and tannin due to year, which supports the importance of testing juice quality every year.



Brown Snout



Dabinett



Kingston Black



Yarlington Mill

Materials & Methods

**Experimental units** – One crate (18 kg on average) per cultivar was collected from each of the four orchards (Table 1) for four years (2012-2015).

**Site description** – Two orchards were located in northwest Washington, Alpenfire Cider and WSU NWREC, and two were located in central Washington, Snowdrift Cider Co. and Tieton Cider Works.





**Harvest methods** – For Alpenfire Cider and WSU NWREC, apples were harvested when seeds were black and fruit reached the desired SSC threshold, ranging from 11-14 °Brix depending on cultivar and weather. For Snowdrift Cider Co. and Tieton Cider Works, apples were generally harvested when fruit tasted sweet, seeds were black, and/or there was significant ground fall.

**Measurements** – Juice characteristics were analyzed as described by Miles and King (2014):

- ❖ Soluble solids concentration (SSC, measured at °Brix), with a digital refractometer (PA201, Palm Abbe, Cleveland, OH).
- ❖ Specific gravity (SG), with a hydrometer (Bellweather, VeeGeeScientific, Kirkland, WA).
- ❖ pH, with a digital pH meter (Orion 3 Star, Thermo-Scientific, Pittsburg, PA).
- ❖ Titratable acidity (TA), by titration with 0.2 M sodium hydroxide to a reading of 8.1. Malic acid then calculated using: Malic acid = ml NaOH x 0.536.
- ❖ Tannin (tannic acid %), using the Lowenthal method of permanganate titration.

**Statistics** – All data were subjected to analysis of variance using JMP software (version 12.0.0 for Windows; SAS Institute, Cary, NC). Least squares fit tests were performed to evaluate the main effects and their interactions, with orchard site randomized within the main effect of region. Treatment means were compared using Fisher’s least significant difference test with a 5% level of significance.

Table 1. Climatic conditions of the four cider apple orchards from 2012 to 2015.

Orchard	March-September			October-February			Oct-May	Jan-Oct
	Avg. Min. Temp. (°C)	Avg. Max. Temp. (°C)	Avg. Total Precip. (mm)	Avg. Min. Temp. (°C)	Avg. Max. Temp. (°C)	Avg. Total Precip. (mm)	Growing deg. days (base 5.6°C)	Chilling hrs. (base 7.2°C)
	8.4 <sup>z</sup>	17.7	279	3.5	9.9	312	3437	2797
	8.8 <sup>y</sup>	19.0	458	3.5	10.4	517	3651	2529
	10.8 <sup>x</sup>	23.8	123	-0.8	6.9	108	4642	3408
	9.4 <sup>w</sup>	23.0	98	-2.0	7.9	125	4198	3490

<sup>z</sup> Coupeville, AgWeatherNet

<sup>y</sup> WSU Mount Vernon, AgWeatherNet

<sup>x</sup> East Wenatchee, AgWeatherNet

<sup>w</sup> Cowiche, AgWeatherNet

Results

- ❖ On average from 2012 to 2015, growing degree days (GDD) were 25% higher and chilling hours (CH) 30% higher at the two central Washington orchards than at the two northwestern Washington orchards.
- ❖ GDD increased 11% in northwest WA and 8% in central Washington from 2012 to 2015, and CH decreased 14% in northwest WA and 7% in central Washington (Table 1).
- ❖ Juice quality characteristics differed due to cultivar but not region, and SG and Tannin differed due to year, potentially due to variation in duration of cold storage of fruit after harvest each year (5 – 56 days) and due to climactic variation, respectively.

Table 2. Mean juice quality characteristics of four cider apple cultivars for those characteristics for which there was no difference due to region or year.

Characteristic	Cultivar				P value <sup>z</sup>
	Brown Snout	Dabinett	Kingston Black	Yarlington Mill	
SSC (%)	14.64 a <sup>y</sup>	14.04 a	13.64 a	12.22 b	0.01
pH	3.94 c	4.34 a	3.56 d	4.10 b	<0.0001
TA (malic acid g·L <sup>-1</sup> )	3.71 a	1.55 c	4.98 a	1.88 b	<0.0001

<sup>z</sup> Significance of treatment effects were analyzed with analysis of variance (ANOVA) using JMP software (version 12.0.1 for Windows; SAS Institute, Cary, NC).

<sup>y</sup> Values not connected by the same letter within the same row of each main effect are significantly different at a 0.05 level of significance according to Fisher’s least significant difference test.

Table 3. Mean juice SG and Tannin each year and for the four cider apple cultivars (combined for the two regions).

Characteristic	Year					Cultivar				
	2012	2013	2014	2015	P value <sup>z</sup>	Brown Snout	Dabinett	Kingston Black	Yarlington Mill	P value
SG	1.056 a <sup>y</sup>	1.050 b	1.059 a	1.058 a	0.01	1.060 a	1.058 a	1.056 a	1.049 b	0.002
Tannin (tannic acid %)	0.20 a	0.14 b	0.13 b	0.12 b	0.0005	0.13 b	0.17 ab	0.10 c	0.18 a	<0.0001

<sup>z</sup> Significance of treatment effects were analyzed with analysis of variance (ANOVA) using JMP software (version 12.0.1 for Windows; SAS Institute, Cary, NC).

<sup>y</sup> Values not connected by the same letter within the same row of each main effect are significantly different at a 0.05 level of significance according to Fisher’s least significant difference test.

Discussion

- ❖ ‘Dabinett’ was the least acidic apple with the highest pH and the lowest TA. ‘Kingston Black’ was the most acidic and the least bitter apple with the lowest pH, the highest TA, and lowest tannin. ‘Yarlington Mill’ was the least sweet apple with the lowest SSC and SG.
- ❖ On average, ‘Brown Snout’, ‘Dabinett’, ‘Kingston Black’, and ‘Yarlington Mill’ had the same general sweetness, acidity, and bitterness whether they were grown in northwest Washington or central Washington.
- ❖ Juice quality varied year-to-year in this study, as found in Miles and King (2014). Variation in duration of cold storage of harvested fruit each year could account for the variability in SG. Variation in climate, specifically heat accumulation (increased GDD) from bloom to the onset of ripening and during the prior fall (lesser CH), could account for the variability in tannin.

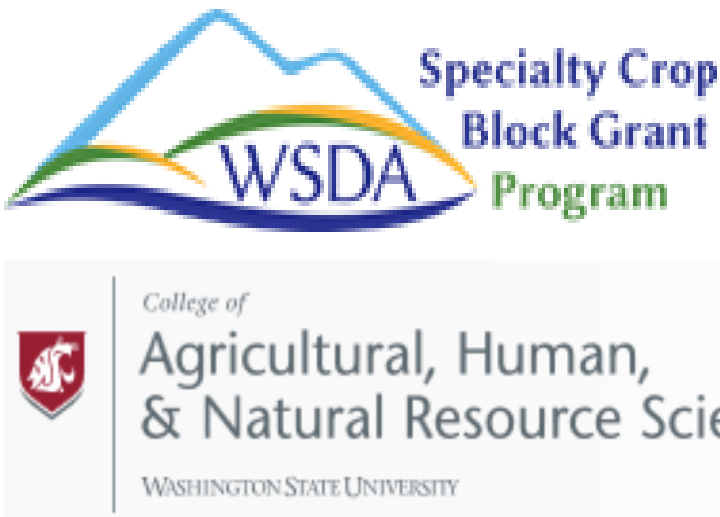
Support

- ❖ WSDA Specialty Crop Block Grant, with NABC
- ❖ WSU Emerging Research Issues (CAHNRS ARC)
- ❖ Northwest Agricultural Research Foundation
- ❖ Alaska Airlines Travel Award

[www.cider.wsu.edu](http://www.cider.wsu.edu)

References

Miles, C.A. and J. King. 2014. Yield, labor, and fruit and juice quality characteristics of machine and hand-harvested 'Brown Snout' specialty cider apple. HortTechnology 24(5):519-526.



Northwest Agricultural Research Foundation