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Yield, Fruit Chemistry, and Consumer Preference of Red and White Currants in Bayfield, WI

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Introduction

There is an opportunity for fruit growers in Bayfield, WI to add currants as a minor crop to diversify offerings to agritourists or as a unique ingredient for area processing markets. However, little is known about the yield, fruit quality, or consumer preference of the available cultivars. In general, currants are very hardy, easy to grow, and well-suited to the growing conditions of Bayfield. To be a viable crop in Bayfield where harvest labor is a challenge, the crop must be easily harvested by employees, especially for processing markets. In addition, the fruit chemistry should be acceptable to the palate of the average consumer or meet the specifications of the processor. To identify suitable cultivars for Bayfield growers, six cultivars of white currants and four cultivars of red currants were planted at each of two commercial fruit farms near Bayfield, WI.

Methods

The red and white currant trials were established in the spring of 2009 with 1-0 bareroot dormant rootstock. Two plants of each variety were planted at each of two locations for two replications at each site. The plants were spaced 4 ft apart and allowed to grow freely with the exception of Pink Champagne, Rovada, and Blanka at Site 1, where they were managed in a flat fan system to horizontal trellis wires (Photo 2). All the

Photo 1. Red and white currants are an attractive fruit with potential in fresh and processed markets. Increased production and sales will require a better understanding of yield potential, required harvest labor, and fruit chemistry.

plants successfully established, with the exception of Jhonkheer Van Tets (JVT), which was re-planted at both sites in 2010. At Site 1, the plants were mulched with sawdust and woodchips and were irrigated with drip irrigation. Weed control was excellent with mechanical cultivation and shielded applications of glyphosate. Nitrogen fertilizer was applied at a rate of 50 lbs actual N per acre each spring from to 2010-2013. At Site 2, the plants were mulched with sawdust and irrigated with drip irrigation. Weed control was poor with significant competition with weeds in 2010 and 2011, but much better in 2012 and 2013. No fertilizer was added to the currants at Site 2.

Photo 2. Currant plants at Site 1 on July 1, 2013. The currants in the foreground are trained to a flat fan on horizontal trellis wires. Currants in the background are grown much like blueberries as an open-grown bush.

Yield, Berry Size, Strig Length

Although the plants produced some fruit in 2010, no data was collected. The fruit was harvested at both sites from all plants in 2011, 2012, and 2013 on August 1, July 15, and August 13, respectively. Harvest was timed based on subjective analysis of color, firmness, and taste. For each plant, the fruit was harvested by hand and weighed and the time to harvest each plant was recorded. The yield and harvest rate was calculated for each cultivar as the average of the two plants of each cultivar at each site. Berry size was determined in 2013 by weighing 10 random berries from each cultivar and strig length was determined in 2011 and 2012 by measuring the length of 5 randomly selected strigs from each plant. Analysis of variance (ANOVA) was used to test statistical significance at the P=0.05 level and Least Significant Difference (LSD) tests were used to separate means.

Consumer Preference

To identify which cultivars were preferred by the consumer a taste-testing was conducted with pick-your-own customers at a fruit farm in Bayfield. For the taste-testing, the strigs were harvested for each variety and put into cardboard berry cartons and arranged on a table without cultivar names. Each consumer ranked the visual quality of the red cultivars from 1 to 4 and the white cultivars from 1 to 6, with 1 being the most preferred. The average ranking was calculated for each cultivar. The consumer then tasted each cultivar and voted for the two most preferred red and two most preferred white cultivars. The votes were then tallied for each cultivar. The consumer then voted for their single favorite cultivar based on overall taste and appearance.

Table 1. Yield of 10 currant cultivars (lbs/plant) in the 2nd (2011), 3rd (2012), and 4th (2013) year after planting at two locations in Bayfield, WI.

		Site 1			Site 2		
	Cultivar	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
Red	JVT	5.81	1.58	1.25	0.39	0.20	2.30
	Rovada	0.22	6.00	11.60	ND	4.21	14.30
	Red Lake	3.97	3.15	7.31	1.49	1.90	7.61
	Red Jade	1.13	2.29	7.84	1.79	0.60	8.70
White	Swedish White	5.81	4.56	5.00	0.99	2.10	2.50
	Blanka	3.66	7.26	12.23	1.49	3.51	7.70
	White Imperial	1.31	5.18	8.41	1.29	3.10	3.40
	White Pearl	2.75	4.20	3.26	0.59	0.47	3.30
	Primus	7.94	5.70	12.09	1.49	1.10	9.10
	Pink Champagne	5.59	3.58	9.43	2.39	3.10	12.80
	LSD(0.05)	**NS**	**NS**	**3.72**	**NS**	**1.25**	**2.98**

Fruit Chemistry

At harvest, a single two-cup sub-sample of the fruit for each cultivar was pulled from the combined

harvest of the two plants, put in a plastic sandwich bag, transported in a cooler, and frozen within one hour of harvesting. The berries were thawed to room temperature and pureed with a blender. The juice was separated from the pulp using fine mesh poly-filter bags. pH of the juice was measured with a pH meter. Brix was measured with a handheld refractometer (Spectrum Technologies REF113 0-32 ATC). To determine titratable acid (TA), a five mL sample of the juice was diluted with 50 mL of distilled water. The sample was titrated with 0.1N NaOH to a pH of 8.35. TA was calculated as the average of five sample runs x .75 x NaOH strength.

Table 2. Weight (g) of a 10 berry sub-sample of each cultivar in 2013.

Cultivar		Site 1	Site 2
		----------grams----------	
Red	JVT	8.23	6.44
	Rovada	10.92	7.69
	Red Lake	6.23	5.21
	Red Jade	5.46	5.21
White	Swedish White	4.64	4.07
	Blanka	12.23	4.30
	White Imperial	4.95	2.61
	White Pearl	3.57	3.59
	Primus	3.52	3.95
	Pink Champagne	9.43	5.27
	LSD(0.05)	**3.61**	**1.61**

Results and Discussion

Yield

Table 1 shows the average per plant yields of the ten cultivars at each of the two locations in the 2nd, 3rd, and 4th years after planting. Yields in the 2nd and 3rd year after planting were variable and relatively low. In the 4th year after planting, overall yields were much higher and more consistent between the two plants of each cultivar. Of the red cultivars in the 4th year after planting, Rovada had the highest yields at both locations. Red Lake and Red Jade were very similar with moderate yields, while JVT did not perform well at either location even after re-planting in 2011. Of the white cultivars, Primus, Blanka, and Pink Champagne were the highest yielding, while White Pearl and Swedish White were the lowest yielding, due primarily to very small individual berry size. The total yields of all the cultivars increased each year at both locations, but the yield increase from 2012 to 2013 was far greater than from 2011 to 2012. This was especially true for the more vigorous cultivars such as Rovada, Blanka, Primus, and Pink Champagne.

At Site 1, Rovada, Blanka, and Pink Champagne were managed with a flat fan system to trellis wires while the other cultivars were open-grown shrubs. All the cultivars at Site 2 were managed as open-grown shrubs. Interestingly, Rovada, Blanka, and Pink Champagne were among the highest yielding cultivars at both sites, thus, the confounding effect of growth form did not seem to affect overall relative yields.

By the third year after planting, the higher yielding cultivars had individual plant yields between 12-14 lbs per plant. With a planting density of 907 plants per acre (4' plant x 12' row spacing) this equates to a total fresh yield of over 10,000 lbs per acre.

Berry Size, Strig Length, Harvest Rate

There were significant differences in berry size as measured by weight of a ten berry sub-sample (Table 2). At Site 1, Rovada and JVT were the largest of the red

Table 3. Average harvest rate (lbs/hr) of 10 currant cultivars in the 2nd (2011), 3rd (2012), and 4th (2013) year after planting at two locations in Bayfield, WI.

		Site 1			Site 2	
	Cultivar	2011	2012	2013	2012	2013
Red	JVT	68.4	20.9	18.8	9.0	31.5
	Rovada	15.0	35.1	9.8	18.4	17.7
	Red Lake	22.4	ND	9.8	11.1	8.2
	Red Jade	13.5	11.5	6.7	6.5	16.3
White	Swedish White	12.0	14.4	6.4	14.1	5.1
	Blanka	17.9	41.5	9.8	20.2	11.5
	White Imperial	7.3	10.4	9.0	13.3	4.4
	White Pearl	9.9	15.6	6.1	5.4	6.3
	Primus	15.4	19.5	9.4	10.3	12.0
	Pink Champagne	10.2	11.1	5.3	10.1	7.3
	LSD(0.05)	**NS**	**8.1**	**2.6**	**5.2**	**7.6**

cultivars and Blanka and Pink Champagne were the largest of the white cultivars. At Site 2, JVT and Rovada were also the largest red cultivars. Statistically the differences among the white cultivars were not as clear, although Pink Champagne and Blanka tended to be the largest. Interestingly, berry size tended to be similar in weight between the two sites except for Rovada, Blanka, and Pink Champagne, which had much larger berries at Site 1 compared to Site 2. These were the only cultivars grown with the flat fan system at Site 1, suggesting the flat fan system may result in larger berry size.

Table 4. Average strig length of each of 10 cultivars in the year after planting and second year after planting at two locations in Bayfield, WI.

		Site 1		Site 2	
	Cultivar	**2011**	**2012**	**2011**	**2012**
		----------inches----------			
Red	JVT	2.95	2.55	3.50	1.25
	Rovada	4.95	3.78	ND	3.53
	Red Lake	2.56	2.03	2.75	1.96
	Red Jade	3.65	2.40	3.75	1.74
White	Swedish White	2.65	2.72	3.25	2.65
	Blanka	5.05	4.08	5.25	3.63
	White Imperial	3.40	3.00	3.38	2.55
	White Pearl	3.05	2.29	1.69	1.83
	Primus	3.70	3.26	3.31	1.90
	Pink Champagne	2.90	3.50	3.50	2.74
	LSD(0.05)	**0.80**	**0.58**	**0.93**	**0.62**

One of the main concerns about commercial currant production is the labor required to pick the berries as the fruit tends to be small and in short clusters along each stem within the center of the plant. Table 3 shows the average harvest rate for each of the 10 cultivars at both sites. Because yields are fairly low and variable in 2011 and 2012 the harvest rates are highly variable. With higher and more uniform yields, the harvest rates are most applicable to mature shrubs in 2013. At Site 1 in 2013, Rovada, Blanka, and Primus, which were among the highest yielding cultivars, were picked at an average rate of 9.63 lbs per hour. At Site 2 in 2013, Rovada was picked at a rate of almost 18 lbs per hour and Primus and Blanka each at around 12 lbs/hr. Interestingly, Pink Champagne, which was also high yielding at both sites, had a significantly lower harvest rate than other higher-yielding cultivars, even when grown on the trellis at Site 1.

The difference in harvest rate was due to a combination of total plant yield, berry size, and strig length. Table 4 shows the strig length of each of the 10 cultivars. Blanka and Rovada had the longest strigs, which contributed to the faster picking rates as the cultivars with longer strigs could be harvested by pulling each strig, similar to the way grapes are harvested (Photo 3). The smaller fruited cultivars with short strigs such as Swedish White were typically harvested by stripping all the berries from the strigs along the length of each stem, which took longer. Pink Champagne was a higher yielding cultivar, but with a shorter strig length, was slower to harvest. Although not directly measured, harvesting the open-grown plants compared to the trellised plants was faster, as a bearing stem could be bent down over a lug and the fruit picked and dropped directly

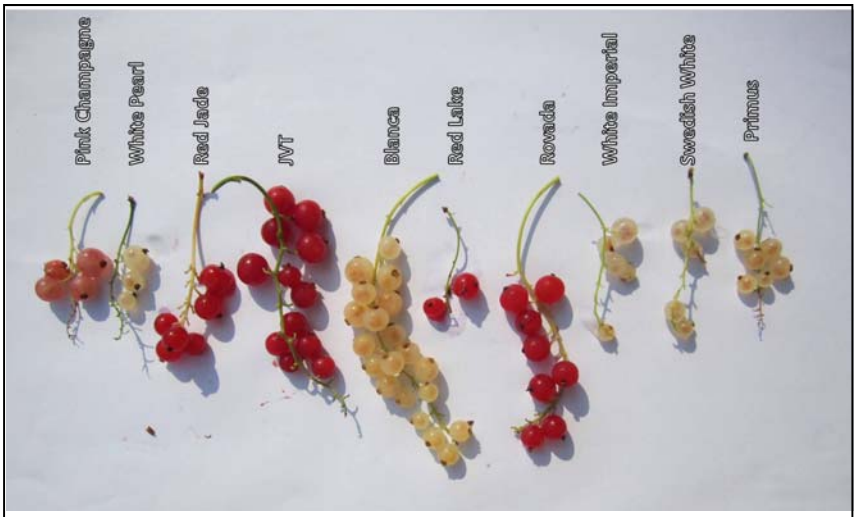

Photo 3. Relative strig length and berry size of 10 cultivars of red and white currants. Strig length can affect harvest rate and presentation of the fruit to customers. The small berry size and short strig length of most of the white cultivars make them difficult to harvest.

in the lug. Whereas, the fruit from the trellised stems had to be picked and placed into the lug. A picker also had full access to the open-grown plant from all sides, but was restricted somewhat in accessing stems in the trellised plants.

In Bayfield most hand harvesting of small fruits is done by college students or other seasonal help. Thus, the harvest rate times for the mature shrubs (2013) of between 9 and 17 lbs/hr is likely a reasonable estimate for growers to use. Using a harvest rate of 11 lbs/hr and an hourly cost of $12/hr ($10/hr plus fringe), the cost to pick is just over $1/lb for the higher-yielding cultivars. The actual cost will be higher if breaks and other non-picking time is accounted for. This is an economically feasible harvest cost if selling to fresh-eating markets such as from farm-stands, but will likely result in a price that is too high for processed markets unless the buyer is able to command a premium price for the finished product.

Table 5. Consumer preference of 10 currant cultivars in 2011.

	Cultivar	Visual Ranking*	Taste Score**	The Best[f]
Red	JVT	2.3	21	3
	Rovada	1.9	12	7
	Red Lake	2.7	19	2
	Red Jade	3.1	5	0
	LSD (0.5)	**0.5**		
	n	28	28	
White	Swedish White	2.7	10	4
	Blanca	3.4	4	0
	White Imperial	3.8	10	3
	White Pearl	4.5	11	0
	Primus	4.4	11	1
	Pink Champagne	2.1	14	0
	LSD (0.5)	**0.8**		
	n	29	29	20

*1=best, 6=worst as ranked within red and white category

**Sum of votes for top 2 tasting cultivars within red and white category

[f]Sum of votes for top overall cultivar based on taste and appearance

Consumer Preference

Currants remain a secondary fruit for most growers primarily due to market acceptance. Currants have a strong flavor and are tart, moreso than the sweet fruits North American consumers prefer. Table 5 shows the results of the tasting trial done with consumers at a local orchard in Bayfield. For the red cultivars, Rovada tended to have the highest visual ranking and Red Jade the lowest. Interestingly, Rovada did not rank among the two best-tasting red currants as often as JVT or Red Lake. For the white cultivars, Pink Champagne and Swedish White had the highest visual ranking. Many of the consumers commented that the other white cultivars looked like fish eggs. Taste-wise, Pink Champagne was voted among the top two best-tasting white cultivars more often than the other cultivars, while Blanka clearly was not preferred by the consumers. Overall, Rovada was voted as the best cultivar more often than any other cultivar.

Fruit Chemistry

Fruit chemistry was analyzed in 2001 and 2013 for each of the red and white cultivars harvested at Site 2. There was little variation in pH among the red and white cultivars and were similar in the two harvest years (Table 6). The Brix was higher in 2013 compared to 2011 and there was more variability among cultivars.

Table 6. Fruit chemistry of 10 cultivar of red and white currants in 2011 and 2013 from Site 2.

		Brix		Juice pH		Juice TA (g/L)	
	Cultivar	2011	2013	2011	2013	2011	2013
Red	JVT	8.2	10.5	3.1	3.1	22.3	27.4
	Rovada	8.3	11.3	2.9	2.9	27.6	34.5
	Red Lake	8.4	ND	3.0	ND	21.1	20.1
	Red Jade	8.8	5.4	2.9	3.0	33.8	14.8
White	Swedish White	9.8	12.7	3.1	3.1	22.8	20.2
	Blanka	8.4	11.0	2.9	3.0	27.3	27.5
	White Imperial	8.0	12.0	3.1	3.1	23.7	20.4
	White Pearl	10.4	8.7	3.0	3.0	23.2	24.7
	Primus	7.6	12.3	3.1	3.2	22.8	22.6
	Pink Champagne	8.3	8.6	3.3	3.3	22.4	18.3

Harvest timing was based on color, firmness of the fruit, and subjective tasting. It is possible the higher Brix in 2013 was due to a later harvest timing. Tritratable acid varied significantly among cultivars with Rovada tending to have higher acid than the other red cultivars and Blanka tending to have higher acid than the other white cultivars.

Photo 4. Currants are an attractive and easy to grow small fruit. Some cultivars are higher yielding than others and some are much faster to hand-harvest. Grower will have to choose the variety that works best for their markets and available labor.

Summary

The results of this study indicate that the tested cultivars can be grouped based on yield with Rovada, Blanka, and Pink Champagne high-yielding, Red Lake, Red Jade, Primus, and White Imperial moderate-yielding, and Swedish White, White Pearl, and JVT low-yielding. Likewise, the tested cultivars can be grouped based on harvest rates with Rovada, Blanka, Red Jade, and Red Lake fast-picking, White Imperial and Primus moderate-picking, and White Pearl, Swedish White, and Pink Champagne slow-picking. Pink Champagne is an attractive cultivar, but may not be viable for processing markets unless mechanical harvest is feasible. More research is needed on the effect of the flat fan trellis system. Though not tested directly, the flat fan system appeared to increase berry size, but made it harder to hand-pick the fruit. Increasing consumer acceptance of currants as a fresh-eating fruit may rely more on marketing and changes in the consumer pallet than cultivar choice, as most of the cultivars are fairly tart with strong flavors. That said, taste-testers did recognize differences among the cultivars and seemed to prefer Pink Champagne of the white cultivars and Red Jade and JVT of the red cultivars. Fruit quality and consumer acceptance could likely be optimized by careful tracking of Brix and TA and harvesting at the optimum time for each cultivar. Such work was beyond the scope of this project. With relatively high acid, processing currants into beverages will require lowering the acids and/or balancing with sugar. The robust yields and unique flavors and aroma suggest currants may have potential as both a fresh and processing market crop in the Bayfield region.

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