

## **Agronomy of New Potato Lines**

The objective of this on-going project is to evaluate the performance of promising new potato cultivars under Saskatchewan growing conditions. Yield and quality responses to N-fertility, crop maturity, irrigation and in-row spacing were evaluated in trials conducted on the Plant Sciences Department Potato Research plots in Saskatoon. This test site features a sandy loam, pH 7.8, EC < 1 dS, with 4% O.M. In all trials, each treatment plot consisted of a single, 8-m long section of row. Between row spacing was 1 m and unless otherwise specified, the in-row spacing was 25 cm. Weed control was achieved by applying eptam + metribuzin prior to planting, followed by linuron applied at ground crack. The crop was hilled prior to ground crack and again just prior to row closure. In the irrigated treatments, an overhead system was used whenever soil water potentials averaged over the effective root zone (0-30 cm) fell below -50 kPa. Standard insect and disease control practices were employed. Unless otherwise specified, the trials were top-killed using diquat in early September (ca. 110 DAP) and machine harvested by early October using a Grimme harvester. Tubers were cured for 10 days at 15°C, then cooled to 4°C for long-term storage. The tubers were mechanically graded into size categories; small < 44 mm diam., medium 44 - 88 mm, and oversize > 88 mm diam.

Detailed results from trials conducted from 2005-2014 are available at:

**[www.usask.ca/agriculture/plantsci/vegetable/potato/pagronomy.htm](http://www.usask.ca/agriculture/plantsci/vegetable/potato/pagronomy.htm)**

Cultivars are selected for testing each year on the basis of suggestions made by local buyers and producers of seed potatoes. The new cultivars tested in 2014 were;

### **Yellow fleshed**

Milva, Toscana, Yellow Star, Chopin, and Juwel

Yukon Gold was used as the standard check variety in this trial

### **Russet type**

Ludmilla

Russet Norkotah, Shepody, Kennebec, Goldrush and Russet Burbank were used as the check varieties in this trial

### **Red skinned**

Modoc, Belvedere and AC Peregrine Red

Norland was used as the check variety in this trial

Most of the new lines are exclusive to members of the Saskatchewan Seed Potato Growers Association (see [www.sspga.ca](http://www.sspga.ca)).

**2014 Growing Season** - The 2014 test plots were planted in late May, which represents the standard time for potato planting on the Canadian prairies. Temperatures in May and June of 2014 were slightly below normal with abundant rainfall. July, August and September temperatures and precipitation were slightly below average. Weekly irrigation commenced in mid-July – with a total of 14 cm of irrigation applied over 7 irrigation events.

**Crop Health** - Emergence was uniform and complete in most trials. The combination of hilling and herbicides provided good weed control. Populations of Colorado potato beetles were well below the economic damage threshold in all standard plots and no pest control measures were employed. Despite repeated application of protectant fungicides throughout the growing season, Late Blight was observed in the test plot area in late August. To minimize the risk of development and spread of this disease the plots were desiccated soon after the disease arrived. As the potato crop was still growing vigorously, this early

desiccation step would have resulted in some yield loss relative to the standard approach, which is to desiccate about 10-14 days later.

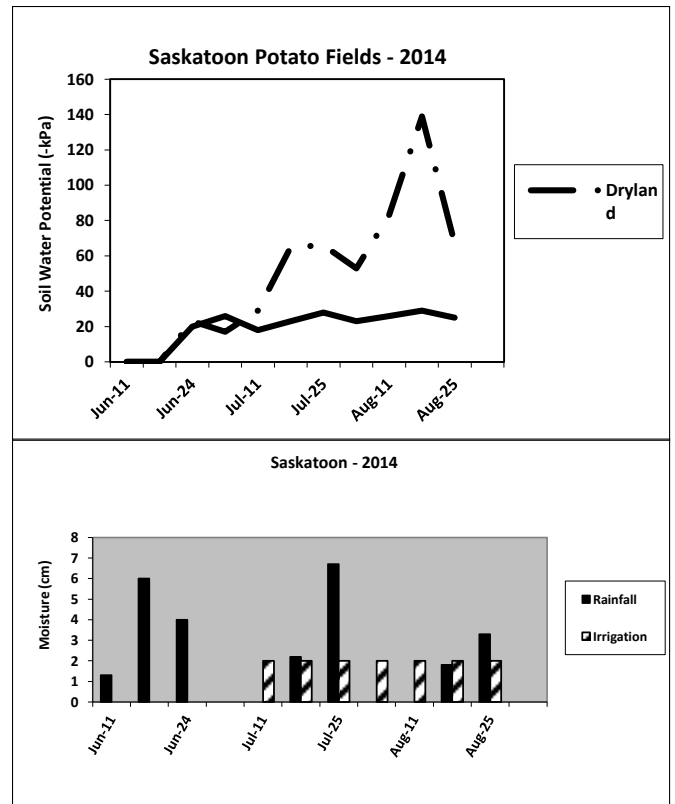
Top kill, harvest and grading of the 2014 potato crop went well. Some tubers had to be graded out due to rot caused by late blight – with levels of grade especially high in blight-sensitive cultivars such as Shepody.

## Results

**Dryland Production Trial** - severe drought (SWP < -100kPa) was limited to just 7 days in mid-August in 2014. Overall yields and yields as a % of irrigated in the 2014 dryland trial were considerably higher than in past years of testing. These yield differences correspond with the relative severity of the drought stress encountered in each year of testing.

In tests conducted from 2012-2014, Modoc was more sensitive to drought stress than the other red-skinned cultivars tested. All the russet varieties tested produced similar yields in the 2014 dryland trial – except for Goldrush which yielded far less than the other lines. As Goldrush also performed poorly in the irrigated trials, there may have been a problem with the quality of Goldrush seed used in 2014. As seen in previous trials, Milva was more productive than any of the other yellow fleshed cultivars under dryland conditions.

Damage of potatoes by Common Scab tends to increase if the crop has exposed to drought stress, particularly at the time of tuber set. As was seen in previous trials, Norland was the least scab sensitive of the red-skinned cultivars tested in 2014. Scab sensitivity of Modoc appeared comparable to Norland in the 2014 trial – whereas in all previous trials it had been more sensitive to scab. As expected, AC Peregrine was very prone to scab damage under dryland conditions. Grade out due to excessive scab was much less common in the thick skinned russet varieties relative to the thinner skinned red or yellow varieties. The new russet cultivar Ludmilla had an extremely thick skin – rendering it completely immune to scab. By contrast, the skin of Shepody is quite thin and it showed a very high rate of grade out to scab in 2014. Of the yellow fleshed cultivars tested, Milva and Yellow Star once again showed outstanding scab tolerance. As was seen in previous trials, Yukon Gold, which is presently the standard yellow fleshed cultivar grown in Saskatchewan, was very sensitive to scab.



Soil water potentials, rainfall and potato field irrigation in 2014

Table 2014-1.

**Yields under dryland conditions, dryland yields as a % of irrigated yields and scab intensity levels under dryland conditions in 2014.**

	Yield (t/ha)	Dryland Yield (% of Irrigated)	Scab Intensity	Yields After Grade Out to Scab (t/ha)
<b>Reds</b>				
AC Peregrine	44.1 a	79 a	66 a	0 b
Modoc	29.2 b	56 b	26 b	11.7 a
Norland	38.9 a	69 b	22 b	15.7 a
<b>avg</b>	<b>37.4</b>	<b>71</b>	<b>38</b>	<b>9.3</b>
<b>Russets</b>				
Ludmilla	37.1 a	67 b	0 b	37.1 a
Shepody	37.0 a	83 a	82 a	0
Goldrush	28.8 b	70 b	0 b	28.8 b
Kennebec	34.8 a	58 c	-	-
Russet Burbank	35.4 a	67 b	3 b	35.4 a
Russet Norkotah	33.1 a	62 c	12 b	23.8 c
<b>avg</b>	<b>34.3</b>	<b>68</b>	<b>16</b>	<b>20.9</b>
<b>Yellows</b>				
Belvedere	36.9 b	60 b	40 b	0.7 d
Chopin	46.6 a	80 a	59 a	0 d
Juwel	38.2 b	66 b	22 c	15.3 c
Milva	49.8 a	78 a	6 d	48.8 a
Toscana	44.9 a	76 a	27 c	20.2 bc
<b>Yukon Gold</b>	<b>36.7 b</b>	<b>74 a</b>	<b>52 a</b>	<b>0.7 d</b>
Yellow Star	31.6 c	62 b	10 d	26.5 b
<b>avg</b>	<b>40.7</b>	<b>71</b>	<b>31</b>	<b>16.1</b>

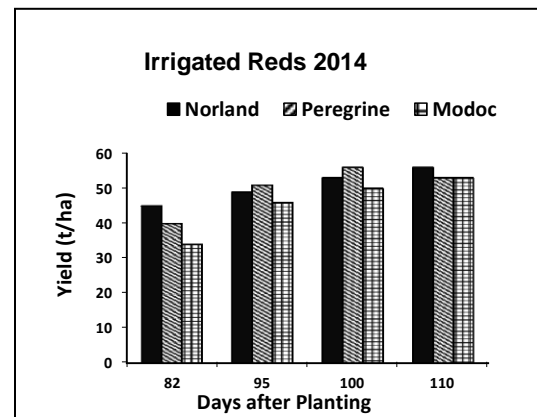
For each skin colour type, values within columns followed by the same letter are not significantly different ( $P=0.05$ )

Scab intensity is the % of tuber surface area affected by scab

Tubers graded out if >5% of the tuber surface area is affected by scab

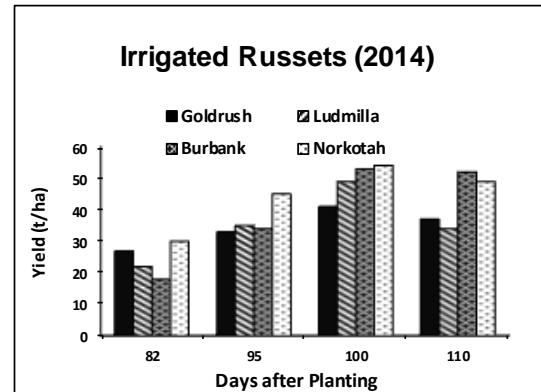
**Time of Planting and Harvest Trials** - This trial examined the impact on time of planting and harvest on yields and quality. Plots were planted in mid-May or early June and were scheduled to be harvested in late August or mid-September. However, in 2014, the date of the final harvest had to be moved forward as late blight arrived in the plot area in late August. An earlier than normal final harvest reduced the yield potential in the trials designed to test yield potential under long growing seasons. Marketable yields at the final harvest (110 DAP) in the 2014 trial were also reduced by the need to grade out a significant number of tubers that were rotting due to late blight. In all years, each treatment was replicated three times.

**Red skinned cultivars** - In the trial conducted in 2014, as well as in previous years, Norland produced the highest yields at the early harvests (80 and 90 DAP), while yields of Peregrine and Modoc caught up and occasionally surpassed Norland at the later harvests (Fig. 2014-1). Both Peregrine and Modoc produced more tubers per plant than Norland. This reduced the average tuber size – which was beneficial in situations where the cultivars were allowed to grow well into the fall. By contrast – if Norland is allowed to grow into September it tends to produce a excessively large tubers



which are prone to physical defects.

**Russets** – the russet processing type potatoes tend to be slow growing and late maturing – as is reflected by their yield profile over time. The yield difference between the 105 and 120 day harvests for the russet lines is much greater than is typically seen for the earlier maturing red-skinned table potato cultivars. The only russet that showed any significant early yields in any of the trials was Russet Norkotah – and it is an early maturing table-type potato. Yields of the standard processing variety Russet Burbank tend to vary greatly from year to year. In 2014, it was one of the highest yielding cultivars in the trial, especially at the later harvest dates (Fig. 2014-2). Ludmilla, tested for the first time in 2014, showed only moderate yield potential at any of the harvest dates tested.



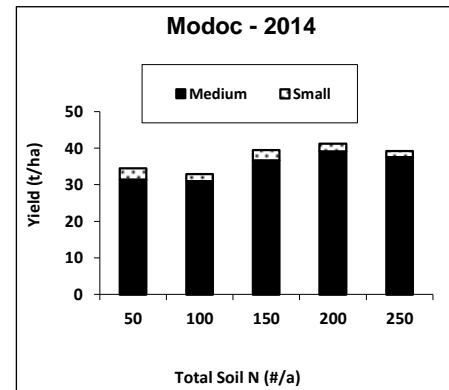
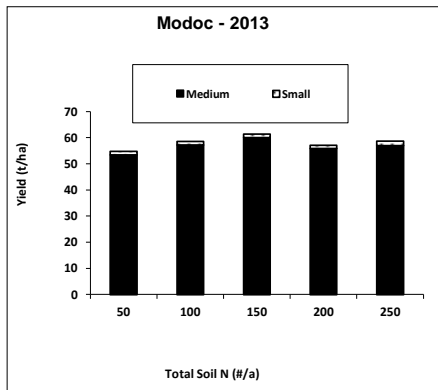
**Yellow fleshed cultivars** – as in previous years of testing, yields of Yukon Gold in the 2014 trial lagged behind almost all of the new lines tested at all harvest dates. Yields of Yukon Gold in 2014 were further reduced due to grade out to Late Blight – as this cultivar appears highly susceptible to this disease. As in previous years, the cv. Milva was the highest yielding at all harvest dates. The new cultivars Juwel and Toscana showed good yield potential, especially at the later harvests. In its first year of testing, the red-skinned Yellow fleshed cv. Belvedere also showed good yield potential at the later harvests. Yellow Star looks very good – but its yields lagged behind the other cultivars included in this trial.

**Table 2014-3. Yields of yellow fleshed potatoes at various times after planting (2014)**

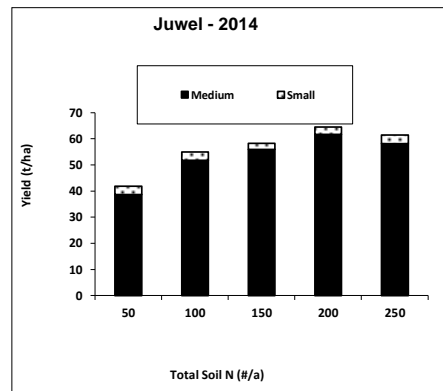
	82	95 Days	100 Days	100 Days	Average
	<b>T/Ha</b>				
<b>Belvedere</b>	30.3	49.7	61.7	58.6	<b>50.0</b>
<b>Chopin</b>	38.1	48.4	57.9	50.8	<b>48.8</b>
<b>Juwel</b>	36.7	51.2	58.2	55.3	<b>50.4</b>
<b>Milva</b>	33.5	50.4	63.9	61.6	<b>52.3</b>
<b>Toscana</b>	27.6	50.4	58.5	59.0	<b>48.8</b>
<b>Yukon Gold</b>	37.8	49.2	47.8	38.4	<b>43.3</b>
<b>Yellow Star</b>	25.2	41.7	50.5	48.7	<b>41.5</b>
<b>Avg</b>	<b>32.7</b>	<b>48.7</b>	<b>56.9</b>	<b>53.2</b>	

**N-Fertility Trials** - At present, N fertility recommendations for potatoes in Saskatchewan range from 150 # N/a (dryland) to 190 # N/a (irrigated). The objective of this trial was to determine optimum N-fertility rates under irrigation for a range of new cultivars. The soil-N treatments (total of 50, 100, 150, 200 or 250 # N/a) were achieved by pre-plant broadcasting sufficient 46-0-0 to supplement the residual soil N (ca. 50 # N/a). The N-treatments were laid out in an incremental design with two replicates.

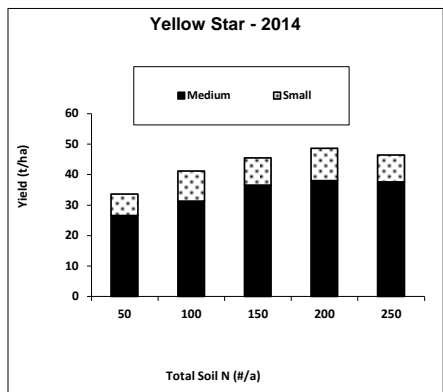
**Modoc** is a red-skinned white flesh table potato similar in appearance to the standard Norland. The yield response of Modoc to increasing rates of applied N was very flat in 2013, but increased until 150 kg N/ha was available in the 2014 trial.



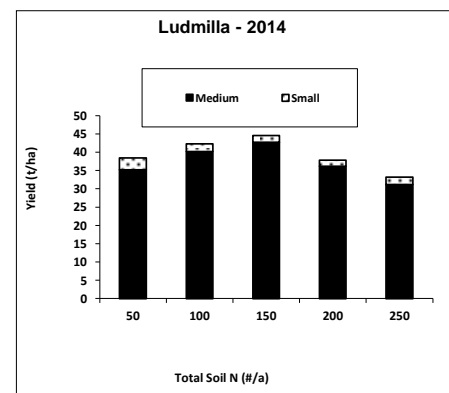
**Juwel** – is a high yielding, late maturing yellow fleshed cultivar. In the 2014 trial, yields of Juwel increased until 200 kg N/ha was available.



**Yellow Star** – is a late maturing yellow fleshed cultivar with limited yield potential under the relatively short growing season available in SK. In the 2014 trial, yields of Yellow Star increased until 150 kg N/ha was available.



**Ludmilla** – is a yellow fleshed cultivar with a heavy russet skin. Yield potential of Ludmilla is only moderate under the relatively short growing season available in SK. In 2014, yields of Ludmilla increased until 150 kg N/ha was available and then declined quite drastically if the crop was supplied with higher levels of N.

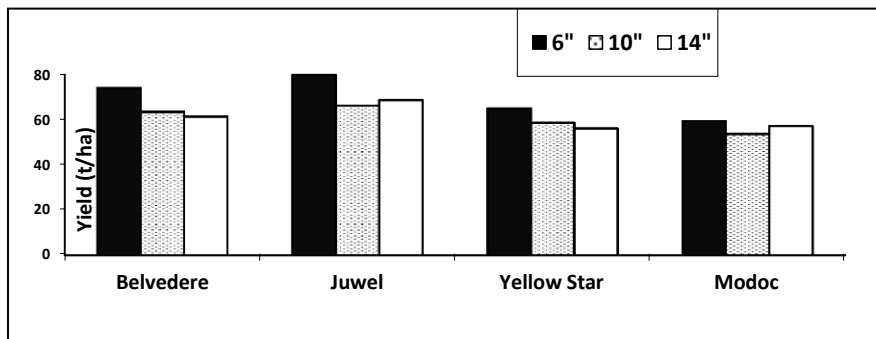


**Conclusion** - The N fertility responses;

- a) varied from cultivar to cultivar,
- b) were quite limited - in that the lowest rate of total N (50 #/a) typically produced yields that were within 10% of the highest yielding treatments.

The observation that yields within 20% of the site maximum were consistently obtained without adding any N fertilizer was unexpected – yet has been seen in previous years of testing. Potatoes are regarded as having a high N requirement, with vegetative growth showing a strong response to N fertilizer applications. However tuber yields can be influenced by many factors and consequently the linkage between soil N availability and yield is less clear cut. Zebarth et al (2004 - Can. J. Plant Sci. 84: 845-854) showed that a combination of relatively modest residual soil NO<sub>3</sub>, plus the N made available through the growing season via mineralization of soil organic matter could provide sufficient N fertility to produce yields within 15% of the maximum achieved using up to 175 #/a of applied N. At present, the economics of potato production dictate that growers should strive to maximize yields, even if it involves the application of very high rates of N fertilizer. As the cost of N increases and/or concerns increase regarding the environmental impact of over-application of fertilizers, the data generated in this study suggest growers of potatoes in SK can cut their N applications substantially without a significant yield penalty - and this management decision may actually increase crop quality.

**Spacing trial** - As in previous years, the effect of in-row spacing on yields was very consistent across the cultivars tested in 2014. The closer the in-row spacing, the higher the total yields - with a less obvious spacing effect on yields at the 10 versus 14” in-row spacings versus yields at 6 versus 10” spacings (Fig. 2014-4). There was a small but consistent tendency for the average tuber size to decrease along with the in-row spacing – but the effect was not significant in most cases.



**Fig. 2014-4. Impact of in-row spacing on tuber yields in 2014.**

**Conclusion** - The results of the spacing trials conducted from 2010-2014 illustrate the responsiveness of potato to manipulation of plant populations. If the objective is to maximize yields, a close in-row spacing is desirable as long as reaching a certain minimum tuber size is not a priority. In seed production, close in-row spacing would produce high yields and a highly desirable small average tuber size distribution. The table and processing sectors are looking for a larger size profile - and therefore slightly wider in-row spacing might be desirable. The data suggests that this larger sizing can usually be achieved without an excessive compromise in yield potential. It is noteworthy that yields were increasing with plant population through to the closest spacing used i.e; 6".

**Late Blight Sensitivity** - Late Blight was observed in the test plot area in late August of 2014. This provided an opportunity to assess the relative Late Blight sensitivity of the test varieties – both to foliar damage by this pathogen and also to tuber rot.

	<b>Foliar Damage by Late Blight (0-5)</b>
AC Peregrine	2.3
Belvedere	1.7
Chopin	2.3
Goldrush	2.0
Juwel	2.7
Kennebec	1.7
Ludmilla	1.7
Milva	0.7
Modoc	4.0
Norland	3.7
Russet Burbank	1.0
Russet Norkotah	2.0
Shepody	2.3
Toscana	2.0
Yukon Gold	2.7
Yellow Star	1.3

Rating of 0= no damage, 5=100% of the leaves were damaged

The relative susceptibility of the foliage to infection by blight was evaluated 7 days after the disease was first spotted in the field. During the intervening period the field was sprayed twice with fungicides – but further disease development nonetheless occurred. Each row of each cultivar was visually rated for infection of the foliage by blight using a scale of 0 – 5 with 0 = no blight observed, 1= lesions present on 1% of the leaves, 2=10% of the leaves, 3 = 25% of the leaves, 4=50% of the leaves and 5= all leaves affected.

The cultivars Modoc and Norland showed the most blight damage to the foliage. However, as Norland was already senescing by this point in the growing season, some of the observed leaf damage may not have been due to blight. Milva showed the least sensitivity to foliar infection by the blight pathogen. Its resistance to blight has been observed in previous trials.

Although the foliage of Shepody showed only moderate sensitivity to infection by the blight, tuber rot due to blight was far more prevalent in Shepody than in any of the other cultivars tested. As Shepody tubers set close to the surface they are readily accessed by late blight spores washing off the foliage and into the soil. Significant grade out to blight was also seen in Yukon Gold, with lesser levels of decay in Norland and AC

Peregrine. In all the other lines tested in 014 there were very few tubers affected by the disease.

**Consumer Panels** - Yellow fleshed potatoes are becoming increasingly popular in Canada – partially as a function of their “novelty” value but also because of their higher Vitamin A content and their perceived superior flavor. For many years Yukon Gold has been the standard yellow fleshed table potato across North America. However Yukon Gold has some significant production limitations – especially its tendency to go oversize and its sensitivity to common scab. Other aspects of this project have shown that the new yellow fleshed cultivars Milva, Yellow Star and Toscana had agronomic characteristics that were superior to Yukon Gold. The objective of this aspect of the project was to assess consumer reaction to these new yellow fleshed cultivars.

The potatoes used in the consumer panels were all grown, harvested, and graded as previously described. The potatoes were evaluated after 3 months of cold storage (5°C and 50% R.H.). In 2011 and 2012, a sample of 20 marketable sized tubers of cv. Yukon Gold, Yukon Gem, and Milva were randomly selected for each cultivar. In 2012 Toscana was also included in the trial. In 2013 the trial was expanded to include the cultivars Aladdin, Rosara, Juwel, Annabelle, Chopin and Yellow Star in addition to the previously mentioned cultivars. In the 2014 trial, Rosara, Annabelle and Aladdin were replaced by Belvedere and Ludmilla. In 2011, 2013 and 2014, 4 tubers of each cultivar were peeled, then boiled in unsalted water for 20 minutes until cooked, then cooled and cubed prior to the taste assessment. In 2012 the tubers were baked for 45 minutes at 220°C – then allowed to cool before being cut up into cubes for taste assessments. Panelists (10 in 2011, 13 in 2012, 20 in 2013 and 18 in 2014) were asked to rank each cultivar from best (rank of 1) to worst for how “yellow” the flesh color was and for the flavor of the boiled or baked tubers. Panelists were not informed as to the identity of the cultivars they were evaluating.

The results illustrate the subjectivity of panel results. For both color and flavor, most cultivars were rated the “best” (Rank #1) by at least one panellist and the “worst” by another. The color assessments were complicated by the fact that some panelists did not “like” yellow potatoes.

Over the 4 years of testing, Milva and Toscana were consistently rated as having the darkest yellow flesh. Milva received the highest flavor ranking in 2011 and 2012, Toscana was the top rated variety in 2013 and Belvedere was rated as best tasting in the 2014 trial. It is noteworthy that Yukon Gold (see highlighted above), which is presently the industry standard for yellow fleshed varieties, was not highly rated in any of the trials for either flesh color or flavor.

**Table 2014-4. Consumer panel assessment of the color and flavor of yellow fleshed potato cultivars (2011-2014).**

	Yellow Flesh Color mean rank and (range)				Flavor mean rank and (range)			
	2011	2012	2013	2014	2011	2012	2013	2014
Milva	<b>1.3 (1-3)</b>	2.5 (1-4)	<b>2.6 (1-6)</b>	<b>2.2 (1-6)</b>	<b>1.6 (1-3)</b>	<b>1.6 (1-2)</b>	3.6 (1-9)	3.8 (1-8)
Toscana		<b>2.2 (1-4)</b>	5.1 (2-7)	<b>2.2 (1-5)</b>		2.8 (1-4)	<b>1.4 (1-3)</b>	3.4 (1-6)
Y. Gem	2.1 (1-3)	2.9 (1-4)			2.4 (1-3)	2.5 (1-4)		
<b>Y. Gold</b>	<b>2.6 (1.3)</b>	<b>2.4 (1-4)</b>	<b>6.2 (4-8)</b>	<b>5.8 (5-7)</b>	<b>2.0 (1.3)</b>	<b>3.1 (1-4)</b>	<b>4.2 (1-9)</b>	<b>3.5 (2-7)</b>
Rosara			4.2 (2-5)				5.4 (2-8)	
Yellow Star			5.3 (3-8)	3.9 (1-5)			3.7 (1-7)	5.2 (1-8)
Aladdin			7.3 (2-9)				5.4 (2-9)	
Juwel			3.2 (1-5)	5.2 (4-7)			3.8 (1-9)	4.1 (2-7)
Chopin			3.6 (2-6)	6.7 (5-7)			3.7 (2-6)	3.4 (1-7)
Annabelle			<b>1.3 (1-3)</b>				3.6 (1-5)	
Belvedere				2.7 (1-6)				<b>2.4 (1-6)</b>
Ludmilla				7.9 (7-8)				3.9 (1-8)

Low rank values indicate greater consumer preference.

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