

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. Yields and quality response to N-fertility, crop maturity, irrigation, and in-row spacing have been 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. Unless otherwise specified, the row spacing was 1 m between rows, with 25 cm between plants within a row. 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. Unless otherwise specified, the trials were top-killed using diquat in mid-September (ca. 120 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 longterm storage. The tubers were mechanically graded into size categories; small < 44 mm diam., medium 44 - 88 mm., and oversize > 88 mm diam. The boiling, baking, chipping and frying quality of the various lines were evaluated using standard methodologies.

Detailed results from trials conducted from 2005-2012 are available at :

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 2012 were;

Yellow fleshed

- Milva – SSPGA members as local production/marketing agents
- Yukon Gem – SSPGA members as local production/marketing agents
- Tosca – SSPGA members as local production/marketing agents

Russet type

- AC Pacific Russet – SSPGA/PGA exclusive line
- Alpine Russet – SSPGA member as local production/marketing agent
- Classic Russet – SSPGA members as local production/marketing agents
- Blazer – SSPGA members as local production/marketing agents
- Clearwater - SSPGA members as local production/marketing agents

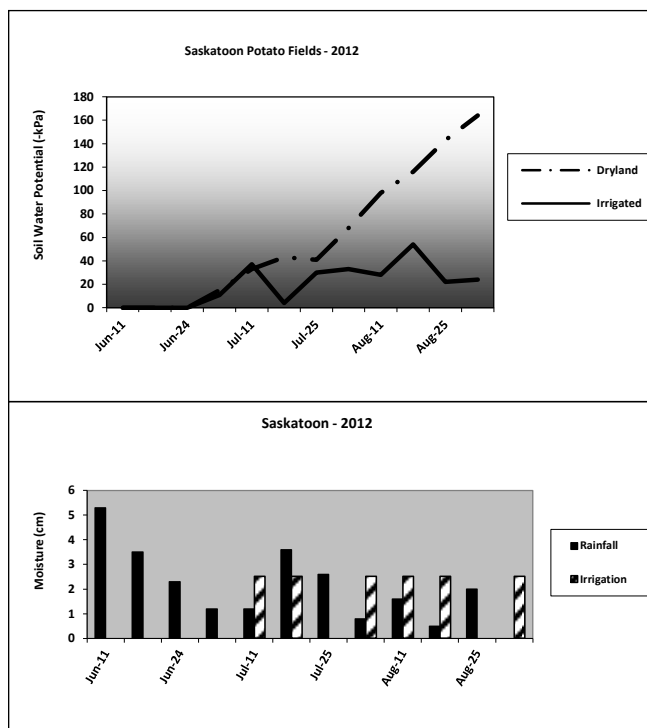
Red skinned

- Modoc – SSPGA member as exclusive agent
- AC Peregrine Red – Exclusive to the SSPGA

Most trials evaluated the new lines against established industry standard lines (Russet Norkotah, Russet Burbank, Yukon Gold, Norland and Sangre).

2012 Growing Season

Temperatures were near normal throughout the 2012 growing season, but a record 40 cm of rain was received from May through July. Although the trial site featured a sandy loam soil there was standing water between the rows for 2 or more days on four occasions. No irrigation was required until the 2nd week of July. The field was subsequently irrigated on 6 occasions with ca 2.0 cm of water applied on each occasion. Total moisture (rain + irrigation) over the course of the 2012 growing season for the potato crop (Jun 10-Sept 10) was ca. 40 cm.



Soil water potentials, rainfall and potato field irrigation in 2012

Dryland Trial

Record rainfall levels minimized drought stress on the dryland potatoes through until late July of 2012. In August the combination of minimal rain and a large healthy crop canopy resulted in a quick drawdown of soil moisture reserves. By the time the crop was ready for top killing in early September the soil in the dryland trial was very dry and the plants had started to drop their lower leaves.

Sangre was the highest yielding red-skinned potato in the dryland trial (Table 2012-1). This was surprising – as in the irrigated trial yields of Sangre consistently lagged behind all other red-skinned lines. Dryland yields of Sangre were >90% of the irrigated crop, whereas for the other red-skinned cultivars, the irrigated crop was at least 30% larger than under dryland conditions. As Sangre is not typically considered to be a highly drought resistant cultivar, these results are unusual. Blazer and Russet Norkotah were the highest yielding Russet-type potatoes under

dryland conditions. Russet Norkotah is an early maturing table type potato – and early maturity is helpful in situations where soil moisture reserves become limited as the growing season progresses. The exceptional performance of the processing cultivar Blazer under dryland conditions is interesting as this line appeared to be quite susceptible to Late Blight – a disease that thrives under irrigated conditions. Milva was more productive than any of the other yellow fleshed cultivars in the dryland trial.

The soil at the dryland test site was heavily infested with Common Scab (*Streptomyces scabies*). As common scab also tends to thrive under the dry warm soil conditions that prevail in non-irrigated fields, this trial offered an opportunity to evaluate the relative sensitivity of the various potato lines to scab (Table 2012-1). None of the russet types showed any scab, even with the heavy degree of infestation present at this test site. Of the red-skinned cultivars Norland had the greatest scab tolerance, followed by the new cv. Modoc. Of the yellow fleshed cultivars tested, Milva and Tosca were far more scab tolerant than the standard Yukon Gold.

Table 2012-1. Yields under dryland conditions, dryland yields as a % of irrigated yields and scab intensity levels under dryland conditions in 2012.

	Yield (t/ha)	Dryland Yield (% of Irrigated)	% Grade Out due to Scab
Reds			
Modoc	35.3 b	70 b	92b
Norland	37.6 ab	71 b	77c
Peregrine	36.8 ab	63 b	100a
Sangre	39.0 a	91 a	100a
Russets			
Alpine	32.9 bc	67 b	0
Blazer	38.1 a	71 b	0
Classic	27.3 d	58 c	0
Clearwater	28.6 d	68 b	0
Russet Burbank	30.0 b	61 c	0
Russet Norkotah	34.9 ab	84 a	0
Yellows			
Milva	45.6 a	75 a	0b
Yukon Gem	35.6 b	63 bc	82a
Yukon Gold	33.3 b	68 ab	100a
Tosca	37.0 b	59 c	4b

For each skin colour type, values within columns followed by the same letter are not significantly different ($P=0.05$)
Tubers considered to be unmarketable if >5% of the 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. The trials were planted in mid-May or early June and harvested in late August or mid-September. This combination of planting and harvest dates resulted in plots harvested at 80, 90, 105 and 120 days after planting. Each treatment was replicated four times.

Results

Red skinned cultivars - In trials conducted in 2010, 2011 and again in 2012 Norland appeared to have a slight yield advantage at the early harvests (80 and 90 DAP), while Peregrine produced higher yields at the later harvests (Fig. 2012-1). Modoc showed promise in the all three years, with exceptional yields at the latest harvest. Modoc produces a large number of tubers/plant, which can result in very high yields if the crop is provided with an adequate growing period. The old standard line Sangre performed poorly at all harvest dates in this trial. A high proportion of the tubers in the Sangre crop showed growth cracks and other abnormalities which would have caused them to be graded out in a commercial operation.

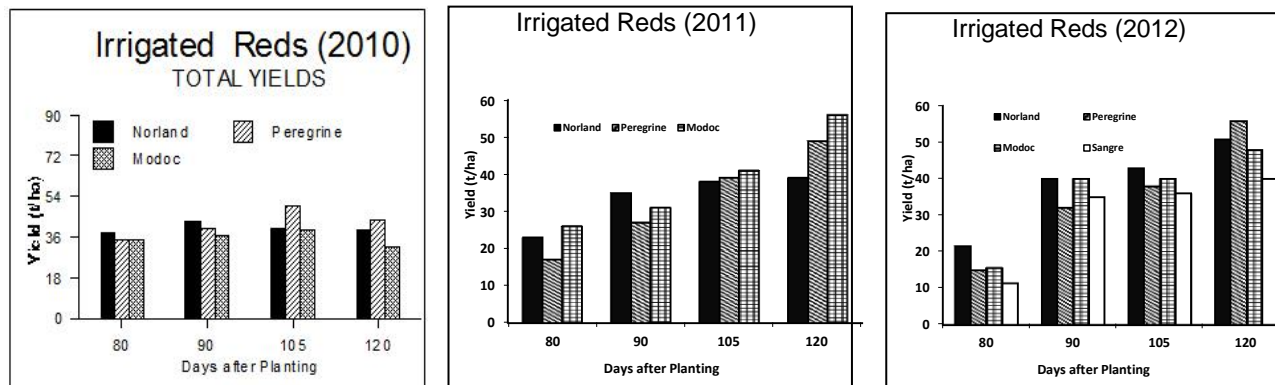


Fig. 2012-1. Yields for various red-skinned potatoes under irrigation for 2010, 2011 and 2012.

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 was Russet Norkotah – and it is an early maturing table-type potato. While the standard processing variety Russet Burbank performed poorly in 2010 and 2011, it was one of the highest yielding cultivars in the 2012 trial, especially at the later harvest dates (Fig. 2012-2). The new processing cultivars Alpine, Blazer and Classic all produced excellent yields at the later harvest dates. Classic produces exceptionally larger tubers which makes it popular with processors, but will be problematic for seed growers. Yields of the new late maturing cultivar Clearwater lagged behind all the other russets at all harvest dates.

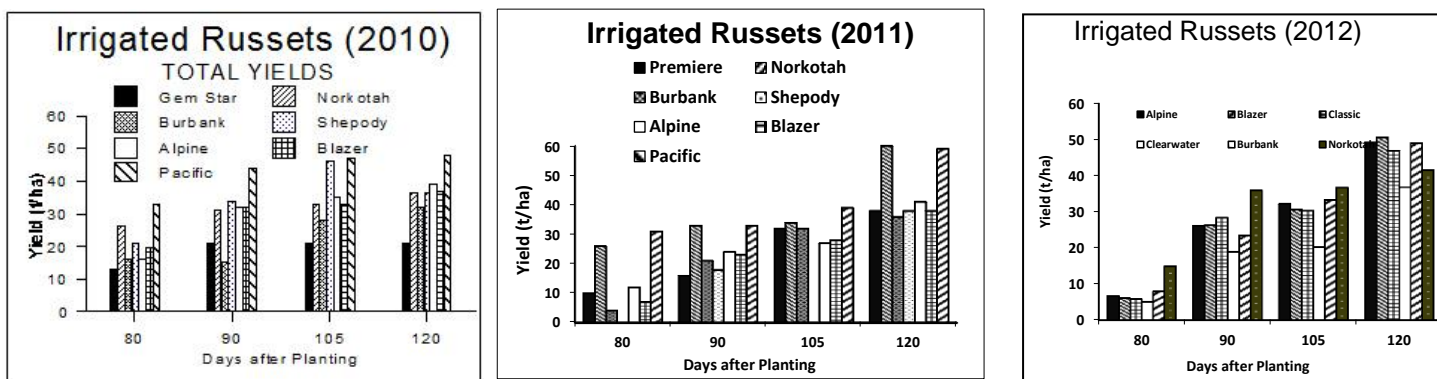


Fig. 2012-2. Yields of russet-type potato cultivars under irrigation in 2010, 2011 and 2012.

Yellow fleshed cultivars – in 2010, 2011 and again in 2012, yields of Milva were superior to all the other yellow fleshed lines tested at all harvest dates (Fig. 2012-3). Yukon Gold and Yukon Gem are very similar in appearance and yields. The average tuber size for Yukon Gold is much larger – and this can be problematic if the crop is provided with an extended bulking period. The new cultivar Tosca was late maturing, but could produce exceptional yields of bright colored tubers if provided with a sufficiently long growing season.

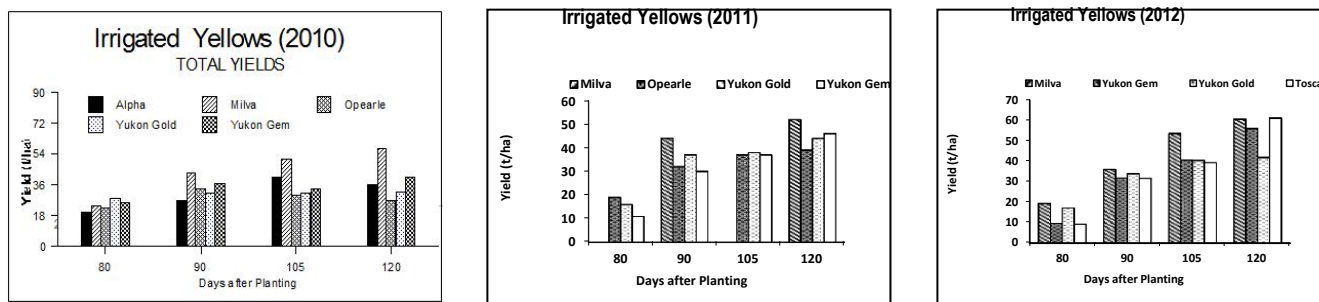


Fig. 2012-3. Yields for irrigated yellow-fleshed potatoes in 2010, 2011 and 2012.

Summary of Time of Planting and Harvest Trials

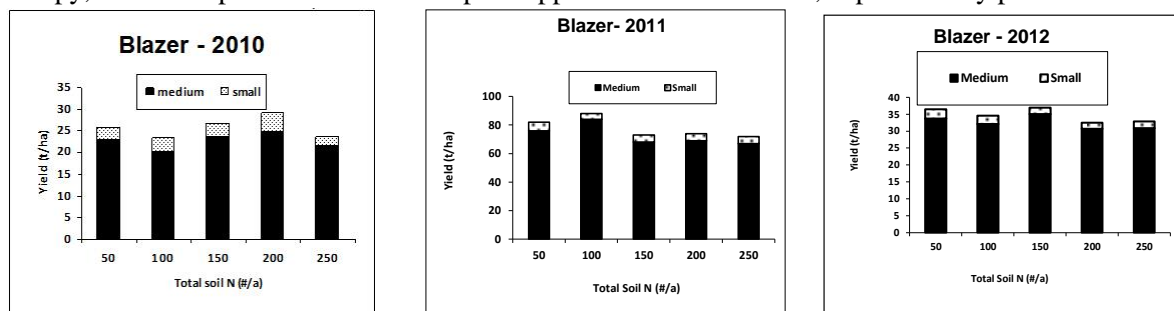
The time of planting and harvest date studies indicate the importance of maximizing the duration of the effective growing season for growers in Saskatchewan. Yields of most new and industry standard cultivars tested increased progressively with duration in the field through to 120 days. A 120 day season represents the effective maximum available to potato growers in Saskatchewan - as earlier plantings or later harvests run into excessive risk of frost damage. By contrast, some growers opt for a very short duration growing season - in the seed industry this is used to minimize the risk of virus infection, whereas in the table sector, growers may opt for an early harvest to catch a high value market opportunity or to keep the size of their tubers within the optimum range desired in the marketplace. The results clearly illustrate the magnitude of yield sacrifice associated with an early harvest. The relative amount of yield loss associated with an early harvest was greater for late maturing cultivars like Modoc, Tosca and Russet Burbank than for earlier cultivars like Russet Norkotah or Norland. This suggests that growers should use caution when growing these slower maturing cultivars, as a slow start to the season, an unusually cool summer or an early fall could severely depress yields. In all cases the increase in yields with time in the field was strictly a function on an increase in average tuber size, rather than any increase in tubers produced.

N-Fertility Trials

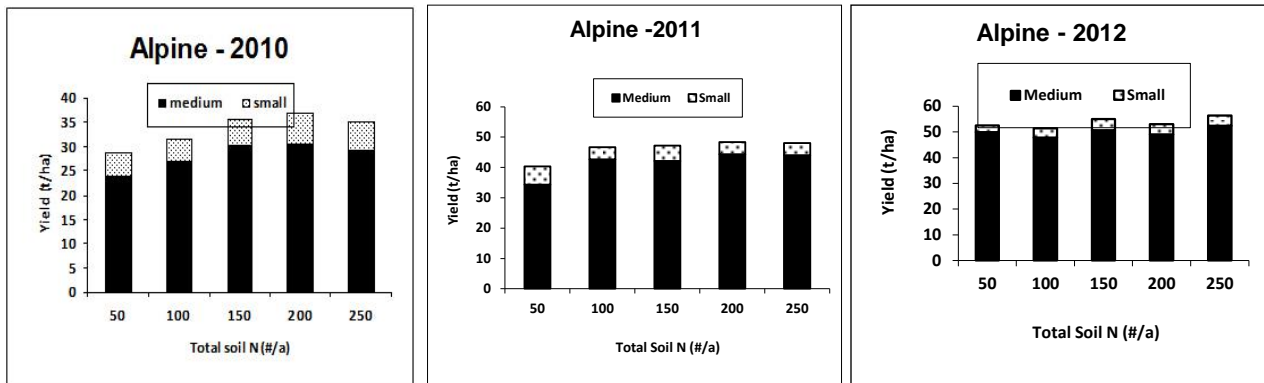
At present, N fertility recommendations for potatoes in Saskatchewan range from 150 # N/a (dryland) to 190 # N/a (irrigated). The objective of this trial was to determine optimum N-fertility rates under irrigation for a range of new cultivars. The soil-N treatments (total of 50, 100, 150, 200 or 250 # 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.

Results

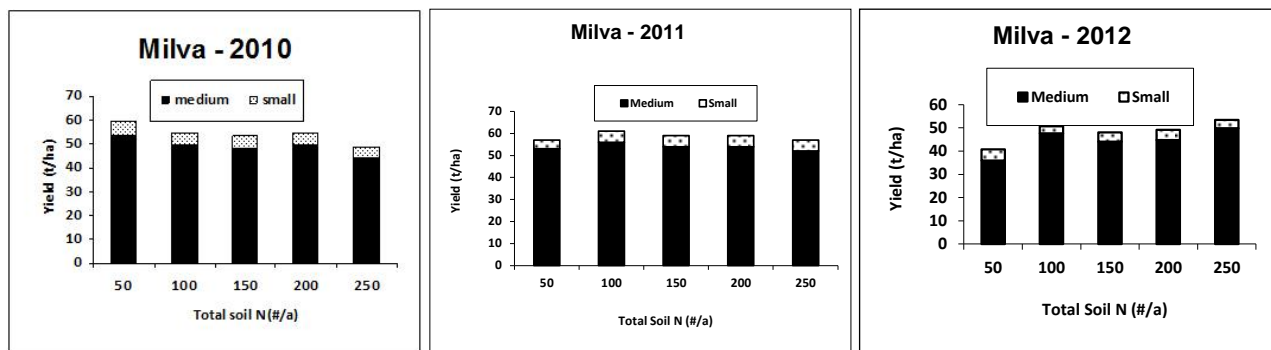
Yields of the new russet cultivar Blazer were low in the 2010 trial and were not influenced by the N fertility treatment. By contrast, yields for Blazer in 2011 were exceptionally high – but again it showed little yield response to N fertility. In 2012, yields of Blazer were more intermediate – and showed a slight tendency to decrease as soil N levels increased. We suspect that both the low yields and apparent negative response to N fertility may be related to problems with Late Blight. Blazer appears to be very sensitive to this disease which can reduce total yields and increase tuber grade out to rots. A large plant canopy, such as is produced when a crop is supplied with abundant N, is particularly prone to this disease.



Yields of the new russet cultivar Alpine were consistent across the 3 years of testing. Yields peaked around 150 #/a of total N in 2010, at 100 #/a N in 2011 and showed very little N response in 2012.



The yellow fleshed table cultivar Milva showed a slight negative yield response to increasing soil N availability in 2010, no response to soil N in 2011 and in 2012 yields plateaued at 100 #/a total N. Milva consistently produces exceptionally high yields with relatively little N, suggesting that it has very high N-use efficiency.



Conclusion - The N fertility responses;

- a) varied from cultivar to cultivar,
- b) were not consistent from year to year and
- c) 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 inconsistency of the N fertility responses from year to year is likely driven by differences in the relative suitability of the growing season for potato growth. In poor growing seasons, yield responses to fertility treatments may be small, as the availability of N is not limiting growth.

While supra-optimal rates of applied N seldom had any significant negative impact on yields they may have had a negative impact on crop quality. The heavy canopy resulting from the application of surplus N may promote development of Late blight and interferes with top-killing and harvest.

The observation that yields within 10% of the site maximum were consistently obtained without adding any N fertilizer – but instead relying solely on the residual soil N supply of ca. 50 #/a - was unexpected. Potatoes are regarded as having a high N requirement, with vegetative growth showing a strong response

to N fertilizer applications. 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

The effect of in-row spacing was fairly consistent across the cultivars tested in 2010, 2011 and 2012. As seen in previous years, the closer the in-row spacing, the higher the total yields - with less obvious differences between yields at the 10 and 14" in-row spacings (Fig. 2012-4). In all years 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.

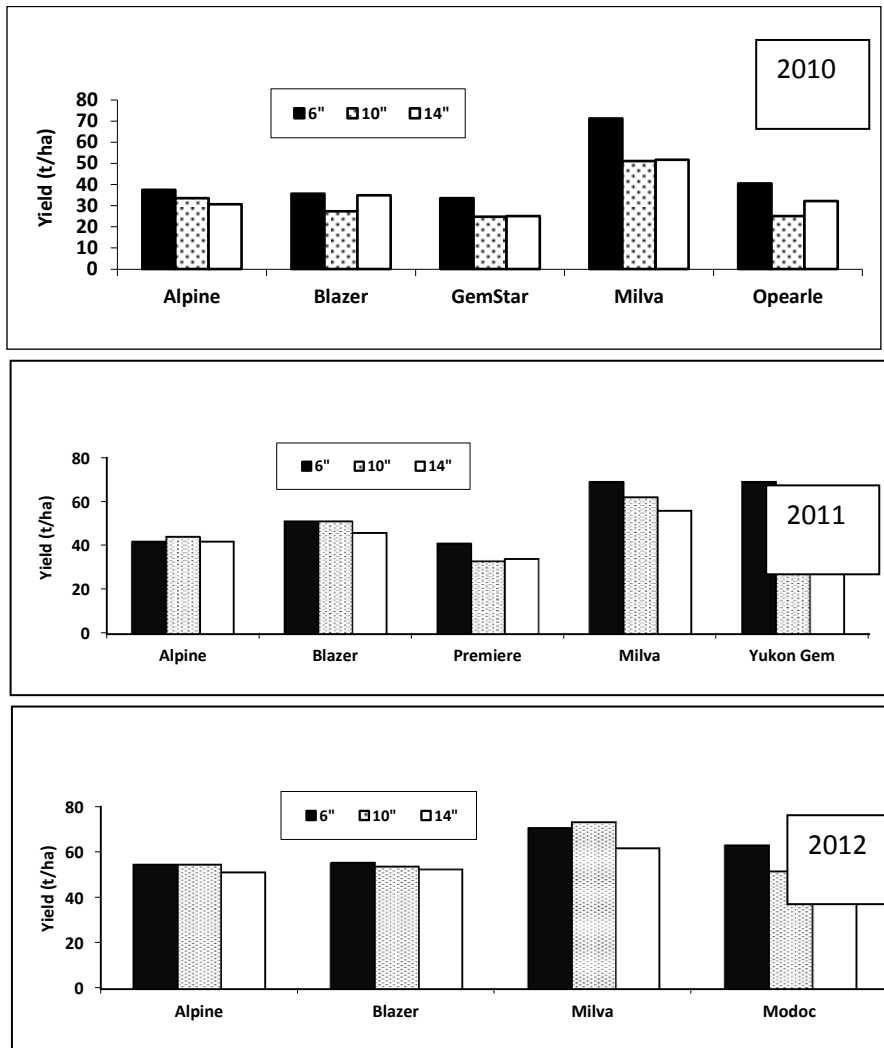


Fig. 2012-6. Impact of in-row spacing on yields of new potato cultivars in 2010, 2011 and 2012.

Conclusion - The results 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 significant issue. 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.

Consumer Panel Results

Yellow fleshed potatoes are becoming increasingly popular in Canada – 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 and Tosca 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 (7°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 Tosca was also included in the trial. Eight of these tubers were used to assess “visual appeal” – with 4 tubers left intact and 4 tubers cut in half to allow the panelists to assess interior color. In 2011 the remaining 12 tubers 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. A total of 13 panelists were asked to rank each cultivar from 1 (best) to 4 (worst) for the visual appeal of the intact and cut tubers and for the flavor of the boiled or baked tubers. Panelists were not informed as to the identity of the cultivars they were evaluating.

Results

	Color mean rank and (range)		Flavor mean rank and (range)	
	2011	2012	2011	2012
Milva	1.3 (1-3)	2.5 (1-4)	1.6 (1-3)	1.6 (1-2)
Tosca		2.2 (1-4)		2.8 (1-4)
Yukon Gem	2.1 (1-3)	2.9 (1-4)	2.4 (1-3)	2.5 (1-4)
Yukon Gold	2.6 (1.3)	2.4 (1-4)	2.0 (1.3)	3.1 (1-4)

Ranking of 1=best and 4=worst

The results clearly demonstrate the subjectivity of panel results. For both appearance and flavor each cultivar was rated the best by at least one panelist and the worst by another. The color assessments were complicated by the fact that some panelists did not “like” yellow color in potatoes.

While the panelists did not show a distinct preference for any cultivar based on its color, **Milva was clearly ranked as superior for its flavor.**