UNIVERSITY OF SASKATCHEWAN

VEGETABLE CULTIVAR AND CULTURAL TRIALS

2011

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Saskatchwan Agriculture and Food

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 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 < l dS, with 4% O.M. In all trials, each treatment plot consisted of a single, 8-m long section of row, with each treatment replicated 3 or 4 times. 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^{o}C, then cooled to 4^{o}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 specific gravity, boiling, baking, chipping, and frying quality of the various lines were evaluated using standard methodologies.

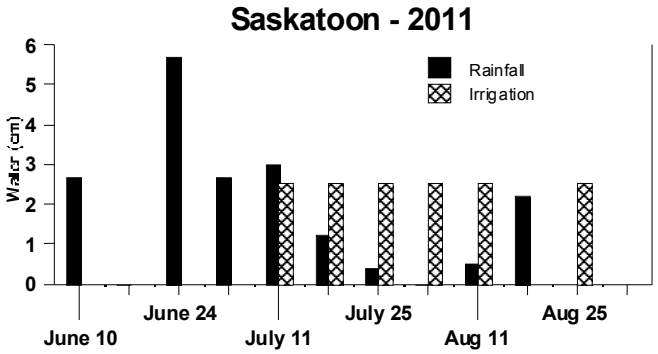
Detailed results from trials conducted from 2005-2010 are available at :

www.usask.ca/agriculture/plantsci/vegetable/potato/pagronomy.htm

New cultivars tested in 2011

Milva - (exclusive to a SSPGA member) a yellow fleshed oval table potato
Yukon Gem - (exclusive to a SSPGA member) a yellow fleshed round table potato
O'Pearle - (exclusive to a SSPGA member) a yellow fleshed "Baby" type potato
Pacific Russet - (SSPGA/EPG exclusive) a russet skinned, white fleshed table potato
Alpine Russet - (SSPGA member as local production/marketing agent) a russet processing potato
Blazer - (SSPGA members as local production/marketing agents) a russet processing potato
Premiere - a russet processing potato
Modoc - (SSPGA member as exclusive agent) a red skinned table potato

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



Rainfall and potato field irrigation in 2011

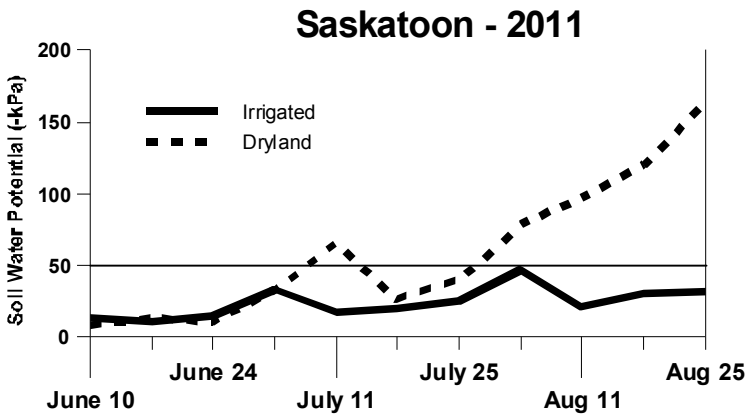
2011 Growing Season

Temperatures were near normal from May-August of 2011 and well above normal in September and October. About 18 cm of rainfall was received from June 1 - Aug 31 of 2011 (normal = 17 cm). The 2011 crop was irrigated 6 times at 2.5 cm/application giving a total of 33 cm of water received by the 2011 crop.

In general, the 2011 potato crop lacked vigor. Emergence was uneven and some trials were so slow to establish that they struggled to compete against weeds. Soil conditions at hilling were not ideal – resulting in some crop damage and a poor quality hill being formed. Extremely large populations of leaf hoppers resulted in hopper burn and an unusually high incidence of purple top – both of which can reduce yields. No late blight was observed in 2011.

Dryland Trial

Several rain events kept the dryland crop in good condition through until mid-July – but from that point onwards the combination of no rainfall and hot conditions put the dryland crop under increasing moisture stress. By the end of the growing season many of the cultivars in the dryland trial had dropped all their leaves.



Soil water potential in irrigated and dryland potato trials in 2011. Readings above the horizontal line at -50kPa indicate moisture stress.

There was no difference in dryland yields for the red-skinned cultivars tested. The two russet type potatoes designed for table use (Pacific Russet and Russet Norkotah) had higher dryland yields than any of the processing russets. Milva produced higher yields on dryland than any of the other yellow fleshed cultivars. The relative yield potential of the various cultivars was generally similar to the irrigated trial – except that the earlier maturing cultivars such as Norland, Yukon Gold and Pacific Russet made greater use of the early season moisture, leading to relatively higher yields in these cultivars.

	Yield (t/ha)	Dryland Yield (% of Irrigated)
Reds		
Modoc	22.4 a	40 c
Norland	22.8 a	57 a
Peregrine	23.7 a	49 b
Russets		
Alpine	16.0 b	39 c
Blazer	19.8 b	51 b
Premiere	17.7 b	44 bc
Pacific Russet	33.7 a	58 a
Russet Burbank	17.8 b	49 b
Russet Norkotah	27.4 a	46 b
Shepody	18.9 b	50 b
Yellows		
Milva	28.3 a	54 a
Opearle	22.4 b	59 a
Yukon Gem	24.9 b	54 a
Yukon Gold	23.7 b	62 a

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

Time of Planting and Harvest Trials

This trial examined the impact of 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 2008-2011 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. 1). Neither of the Dakota series reds tested in 2008 had yields that warranted further testing. Modoc showed promise in the 2010 and 2011 trials, with yields that were comparable to the industry standard reds.

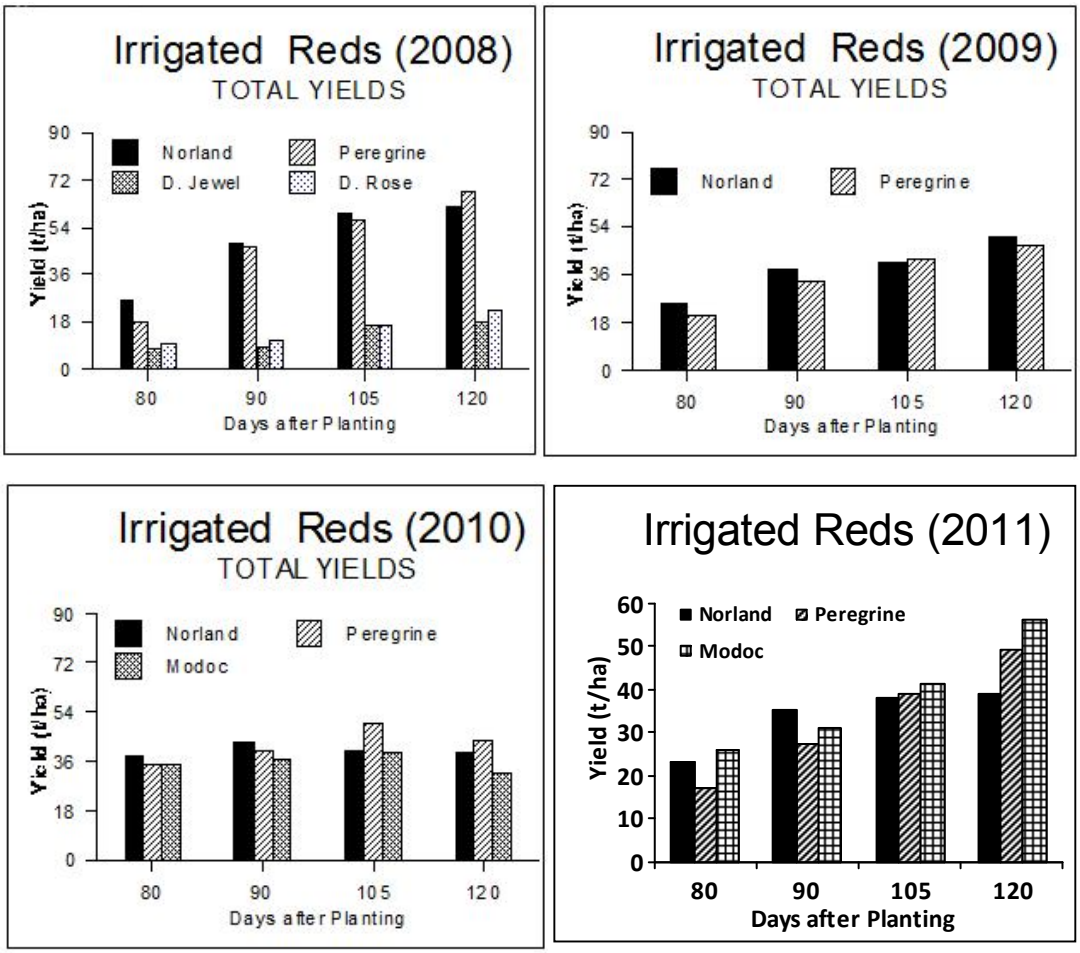


Fig. 1. Yields for various red-skinned potatoes under irrigation from 2008-2011.

Russets – the standard processing variety Russet Burbank performed poorly in all years – producing very low yields, especially at the early harvests (Fig. 2). The new processing cultivars Alpine and Blazer produced yields that were substantially greater than Russet Burbank at all harvest dates in 2010 and 2011. The SSPGA/EPG russet table line Pacific Russet showed excellent early and total yields in 2008, 2010 and 2011 – its yields were equal or superior to the industry standard table russet (Norkotah) at all harvest dates. Yields of the dual purpose cultivar Shepody were highly variable from year to year.

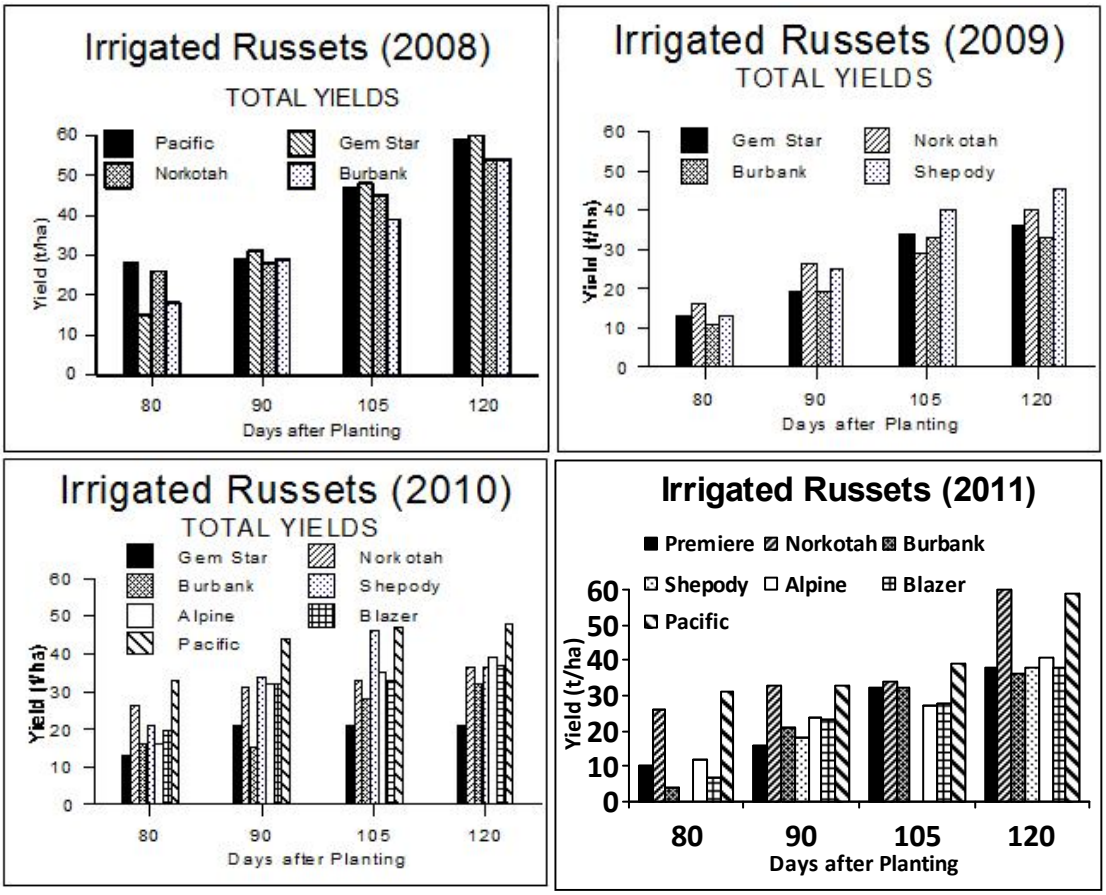


Fig. 2. Yields of russet-type potato cultivars under irrigation in 2008-2011.

Yellow fleshed cultivars – The yield profiles of Milva and O'Pearle were comparable in 2009 (Fig. 3). However in 2010 and 2011 yields of Milva were superior to all the other yellow fleshed lines tested at all harvest dates. Milva appears to be highly tolerant of late blight, which may explain why it's performance was superior to the other less blight tolerant yellow lines tested in 2010. Yukon Gold and Yukon Gem are very similar in appearance and yields. O'Pearle produces only moderate yields but with a very high proportion of the tubers grading into the premium small or "Baby" potato size category.

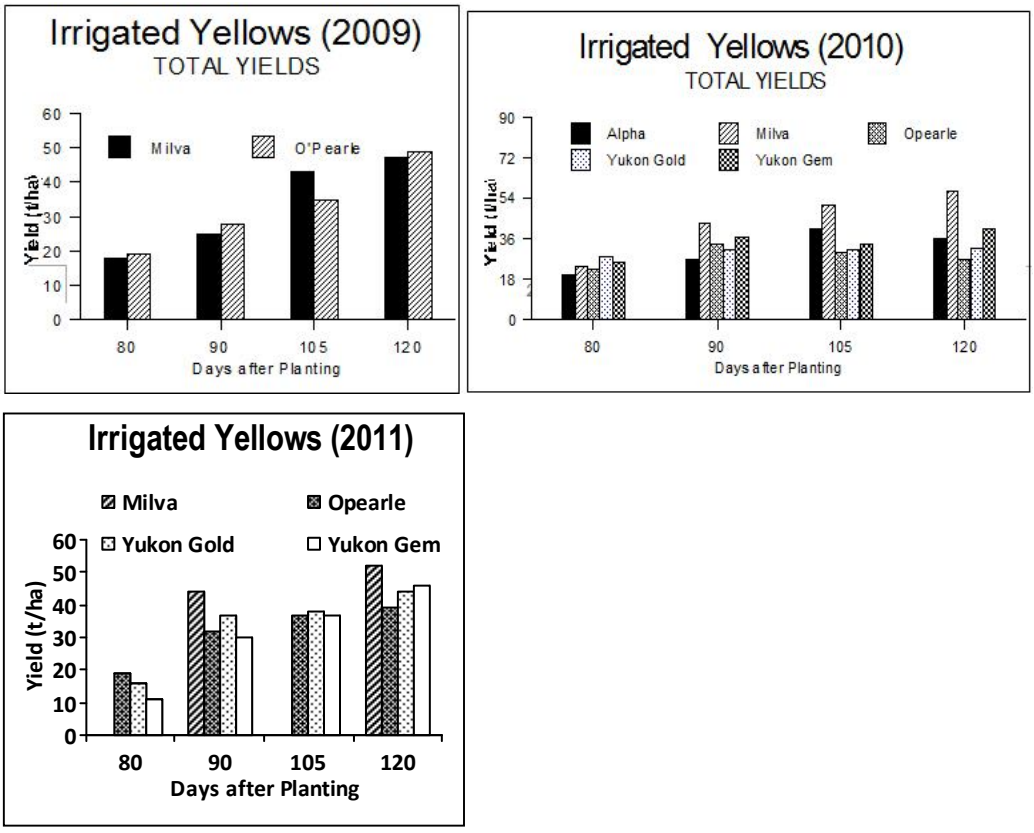


Fig. 3. Yields for irrigated yellow-fleshed potatoes in 2009, 2010 and 2011.

Summary of Time of Planting and Harvest Trials

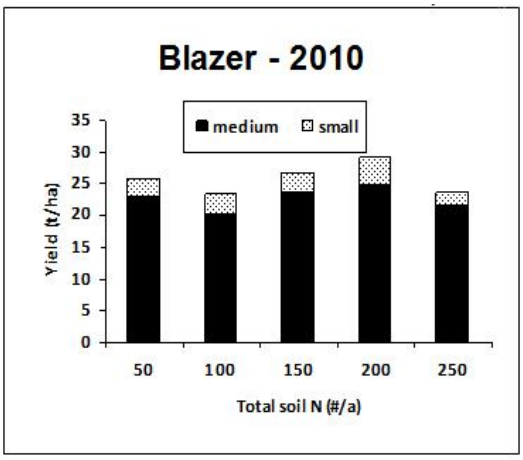
The results of the time of planting and harvest date studies indicate the importance of maximizing the duration of the effective growing season for growers in Saskatchewan. Yields of most new and industry standard cultivars tested increased progressively with duration in the field through to 120 days. 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 Peregrine and Russet Burbank than for earlier cultivars like Pacific Russet 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.

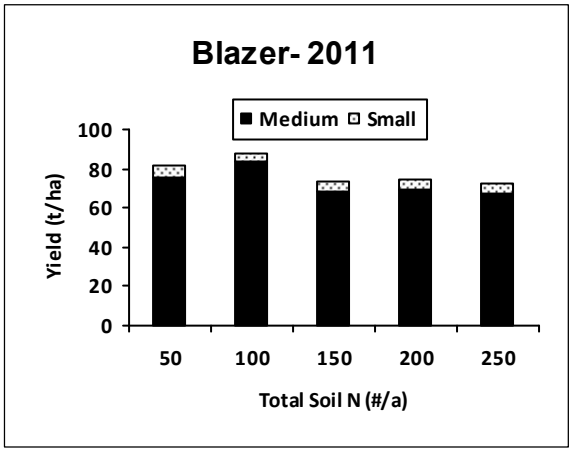
N-Fertility Trials

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.

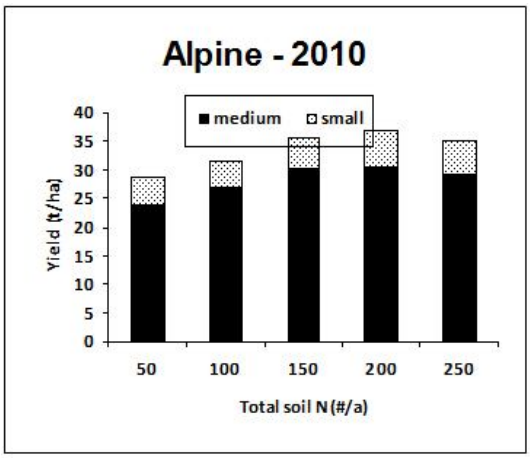
Results

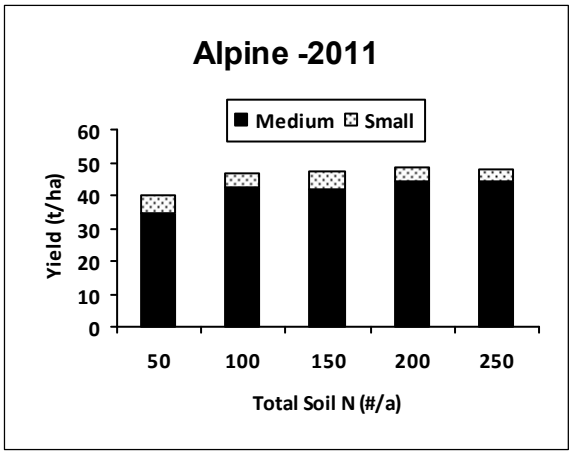
Yields of the new russet cultivar Blazer were low in the 2010 trial and were not influenced by the N fertility treatment. By contrast, yields for Blazer in 2011 were exceptionally high – but again it showed little yield response to N fertility.



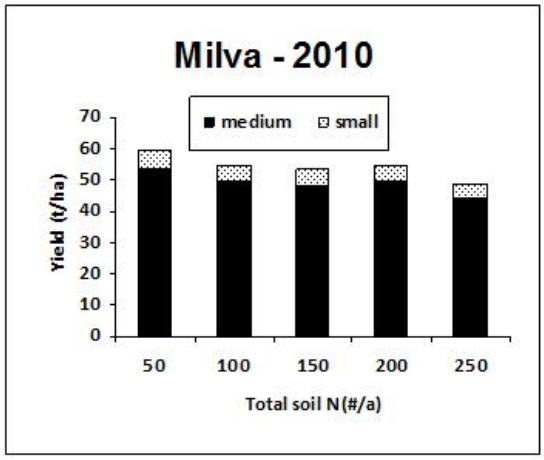


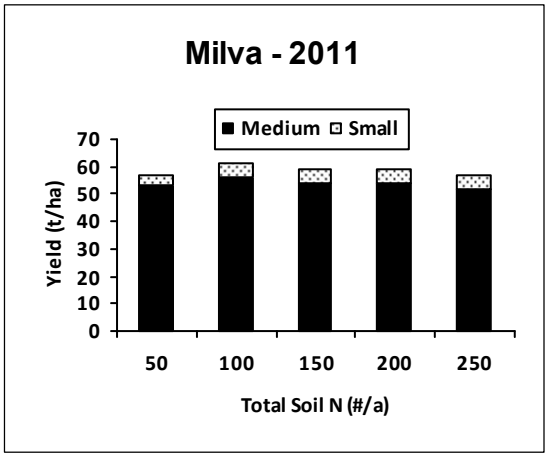
Yields of the new russet cultivar Alpine peaked around 150 #/a of total N in 2010 and at 100 #/a N in 2011.



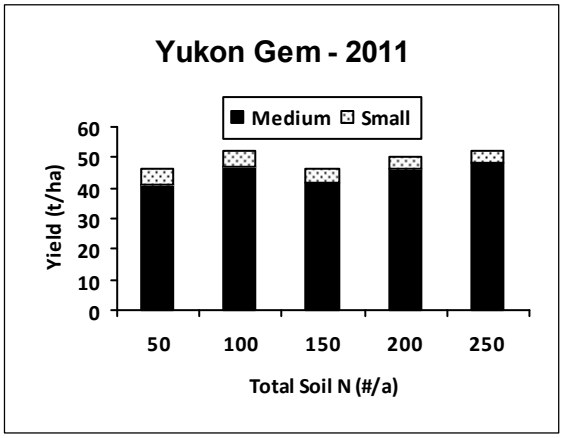


The yellow fleshed table cultivar Milva showed a slight negative yield response to increasing soil N availability in 2010 and no response to soil N in 2011. As Milva consistently produced exceptionally high yields, the lack of N response suggests that this cultivar has very high N-use efficiency.





The new yellow fleshed cultivar Yukon Gem also showed very limited yield response to N fertilizer applications in 2011.



Conclusion - The N fertility responses of the new cultivars were;

a) quite similar to one another,
b) inconsistent 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 soil 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 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. However tuber yields can be influenced by many factors and consequently the linkage between soil N availability and yield is less clear cut. Defoliation due to late blight may have limited the N fertilizer response in the 2010 trial – however

yields in the 2011 trials were quite high, suggesting that no there were major yield limiting factors at play. The blight resistant cultivar Milva produced exceptionally high yields in both years of testing – and in both years it showed almost no yield response to soil N beyond the baseline of 50 #/a. This suggests that either Milva has exceptionally high N use efficiency or that the soil at the test site has exceptionally high levels of N present in a form not apparent in standard soil tests. Zebarth et al (2004 - Can. J. Plant Sci. 84: 845-854) showed that a combination of relatively modest residual soil NO3, 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 by applying 175 #/a of N fertilizer.

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 and 2011. As seen in previous years, the closer the in-row spacing, the higher the yields - with less obvious differences between yields at the 10 and 14" in-row spacings (Figs. 4 and 5). In both 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.

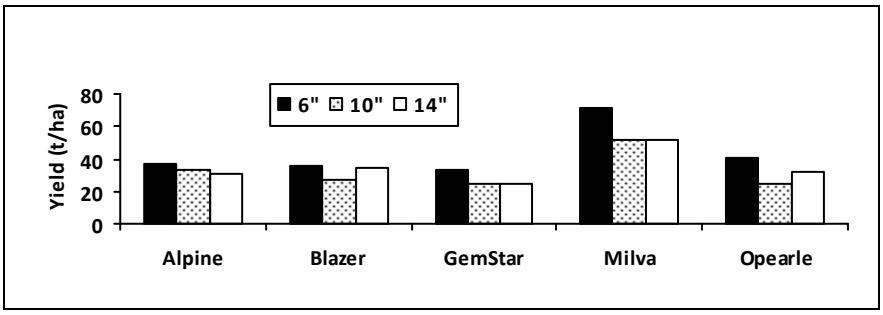


Fig. 4. Impact of in-row spacing on tuber yields in 2010.

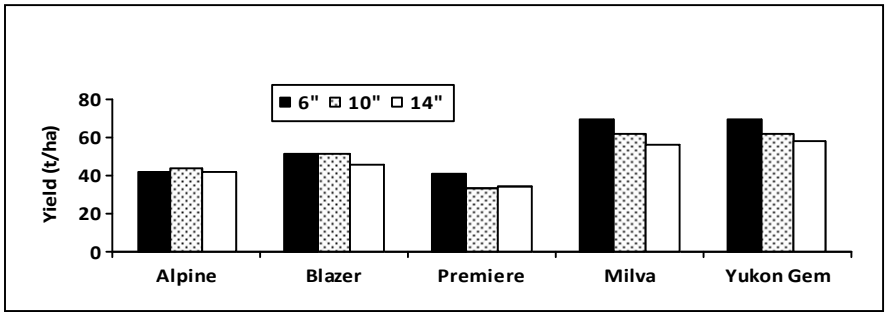


Fig. 5. Impact of in-row spacing on tuber yields in 2011.

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. It is noteworthy that yields were increasing with plant population through to the closest spacing used ie; 6". This raises two questions;

a) Would the trend continue for an even closer spacing?

We suspect that the yield profile would tend to plateau - with the cost:benefit ratio depending on the relative cost of seed versus the harvested crop. For some cultivars like O'Pearle and Peregrine, the yield profile at 6" was already quite small. There is a substantial price penalty in table markets if the tuber size falls below "A" size (1 3/4" or 55 mm diam). If however, the tuber size falls all the way to a "Creamer" size (1" or 25 mm) these tubers command a price premium as "Baby" potatoes. O'Pearle is specifically targeted at this Creamer market. The fact that yields of Creamer sized potatoes for O'Pearle was still increasing as in-row spacing narrowed to 6" suggests that there may be advantages of even closer in-row spacing.

b) Would a commercial grower expect to see the same responses?

The yields obtained in this trial were in excess of those obtained in typical commercial fields in SK. This may reflect efforts to manage all inputs so as to minimize crop stress or competition for resources. These management practices would have allowed the crop to express its full yield potential - even when there were very large numbers of plants competing for resources. However, the cost and cost efficiency of this type of management regime was not considered. If a grower cannot or does not provide the same stress-free production environment, this will lead to competition between plants within the row - with a corresponding reduction in yield potential. This loss of yields will be greatest in situations where a high plant population tends to exacerbate competition effects. Growers will need to tailor their plant populations to match their ability to manage the crop while also factoring in costs of production and anticipated yields and economic returns.

Review of the agronomic responses of the new cultivars tested in 2008-2011;

O'Pearle

The small but uniform tuber size profile of O'Pearle makes it well suited to the baby potato market. It appears to be earlier maturing with a smaller more manageable vine than the present industry standard (Alpha). O'Pearle produces a high proportion of tubers meeting the size standard for "baby" potatoes (<35 mm diam). Yields for O'Pearle responded very favourably to close in-row spacings.

Some concerns regarding O'Pearle are;

a) O'Pearle appeared to be more sensitive to defoliation by late blight than the industry standard Alpha.

b) O'Pearle showed a high percentage of tubers with common scab in the 2010 and 2011 trials.

Milva

Milva is a potential alternative to Yukon Gold as a smooth skinned yellow fleshed table potato. Milva appeared to have exceptional yield potential, even at early harvests. It also appears to require relatively little fertilizer N to achieve these high yields. Milva's tuber size distribution was more uniform than Yukon Gold and it also shows less tendency to oversize. Milva is exceptionally tolerant of Late Blight and also has fewer problems with scab than Yukon Gold. In consumer panels the yellow color and flavour of Milva were consistently preferred over Yukon Gold. The only significant limitation of Milva may be that its tubers are tear-drop shaped - this shape is not familiar in the North American marketplace.

Pacific Russet

Pacific Russet is an early maturing dark russet line designed for use in the table market. Pacific Russet is superior to all other russet lines for yield potential, especially early in the season. While the average tuber size of Pacific Russet is quite large, tuber size can be manipulated by altering in-row spacings. Pacific Russet appears to be quite sensitive to both defoliation and tuber decay caused by late blight. Pacific Russet has limited processing potential.

GemStar

This recently released processing russet had performed well in trials conducted from 2005-2007, but it did not yield well in the trials conducted from 2008-2010. It appears that there may be issues with quality of the seed presently available for GemStar. Until these quality issues are rectified we cannot recommend the adoption of this cultivar.

Blazer and Alpine

Both of these newly released processing type russet potatoes showed promise in the 2010 and 2011 trials – consistently out-yielding the industry standard for processing (Burbank). They also appear to require less N fertilizer than Russet Burbank. Alpine showed superior processing quality compared to Burbank, especially during early harvests. Both Alpine and Blazer showed high levels of tolerance of late blight.

Modoc

This newly released red-skinned table cultivar showed some promise as it produced yields that were comparable to the industry standard reds (Norland and Peregrine). Modoc has superior tuber colour and appearance than Norland and is more scab tolerant than Peregrine.

Yukon Gem

This yellow flesh cultivar is envisioned as a potential replacement for Yukon Gold in the table market. Yukon Gem appears equivalent or superior to Yukon Gold in terms of yield potential, especially in years with significant late blight pressure. The processing quality of Yukon Gem was surprisingly good – it produced the highest quality fries of any line tested in 2010. In taste panels the flavour of Yukon Gem was rated as equal or superior to Yukon Gold. Yukon Gem does not appear to be as sensitive to common scab as Yukon Gold. The only limitation to Yukon Gem may be its appearance – it does not have as uniform tuber shape as Yukon Gold and it has pink eyes. However, the tuber size distribution of Yukon Gem is more uniform than Yukon Gold and it has less tendency to oversize.