NEBRASKA

POTATO EYES

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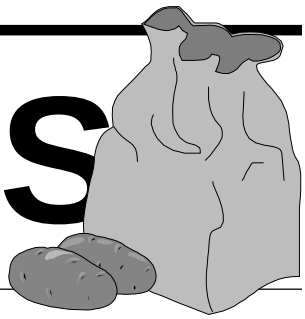


Potato as Neutraceutical

Will eating potato salad replace vaccines?

Future delivery of vaccines to promote people's resistance to diseases may not be through a needle and syringe. It may be through eating genetically-modified (GMO) fruits and vegetables especially the potato. Neutraceuticals are defined as foods producing high levels of a substance(s) promoting good health.

Pass the potato vaccine, please...

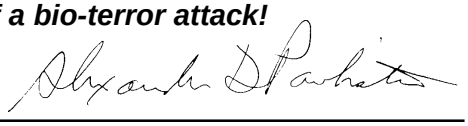
Boyce-Thompson Institute at Cornell University in Ithaca, NY, developed a GMO-potato with a genetic makeup to give immunity against the Norwalk virus, a major food-borne illness. The Norwalk virus is responsible for 90% of the world's viral diarrhea. ("Runs" in the future may mean get to a potato.)

In other research at the Institute, a GMO-potato was developed against hepatitis B in mice. The potato vaccine did not breakdown in the stomach and activated antibiotic production. Being inside the potato cells, the antigen responsible for the immunization was not destroyed by the gastric juices.

In the last couple of years, this anti-hepatitis B GMO-potato was grown in Wisconsin by an ag-technology company, Ag-Tec International, for testing. This is the first-ever large-scale crop being produced as a pharmaceutical. Ag-Tec Int. has developed tapid multiplication minituber technology to grow potato vaccines ("quantum tubers"). This technology allows for pathogen-free, harvestable tubers in 40-50 days followed by two field generations for commercial quantities of seed potato.

Potato vaccines would provide a cheap and painless medicine that would be easily delivered and stored. Research on potato vaccines is on the fore-front of these developments -- Medical Agriculture. "If I were a grower, I'd be really watching what's happening. Things are changing." Dr. Kent Bradford, Director of the Seed Biotechnology Center at the Univ. California - Davis.

Imagine eating a potato to negate the effects of a bio-terror attack!



Inside this issue...

Russet Norkotah Strains

Profile

Since its release in 1987 by Dr. Robert Johansen of No. Dakota State Univ., Russet Norkotah replaced Norgold Russet and became the major fresh-market, early-season russet cultivar in the USA. It is noted for its long and smooth russet appearance, its "football" shaped tubers. Because of its broad adaptability, it is widely used geographically. It does have a few weakness. Its vine is small and does not usually cause row closure thereby weed control can be a concern. It has poor tolerance to hail or heat. The roots are shallow and concentrated. And, the cultivar is sensitive to many pests including early dying and early blight.

For these reasons, in the early 1990s, Drs. Dave Holm of Colorado St. Univ. and J. Creighton Miller, Jr., of Texas A & M Univ. embarked on looking for giant hill strains of Russet Norkotah. This was much like the earlier search on giant hill strains of Norgold Russet in the 1980s in Nebraska (Leever, Trank, Shaver, Miller, Pavlista. 1994. Am Potato J 71:133-144). From the efforts on Russet Norkotah, Dave picked two strains -- CO # 3 and # 8, and Creighton identified several others -- TX # 102, 112, 223, and 278, and more recently # 296. A common characteristic of all these strains are a later maturity and a larger vine.

CO #3 is the largest and matures the latest of these strains. It is upright and three to six inches taller than the standard Russet Norkotah. Maturity may be as much as two weeks later than Russet Norkotah. It has shown some tolerance of heat in Texas. It yields well at less nitrogen but has a tendency to form mis-shaped tubers. If nitrogen is over-used, tuber initiation is delayed and tuber bulking slowed.

CO #8 is more prostate than #3 and not quite as tall, 1-3 inches over the standard. It matures about a week later than the standard Russet Norkotah. It yields well is resistant to producing off-type or mis-shaped tubers.

TX strains #102, #112, #223, #278, and #296 were selected for better tolerance to late season diseases especially the early dying complex. They seem to be more forgiving of weather stress. They also tend to produce more US grade 1 and less mis-shaped tubers.

Fertilization

Fertility needs on the two Colorado strains have been studied and reported by Dr. Susie Thompson of CSU, currently with NDSU. These recommendations are given in Table 1, and may also be used as guide for the Texas strains. A study on CO #3 and #8 with respect to nitrogen levels was conducted in Greeley, CO, in 1998, and the yield data are presented in Figure 1. From these data, only CO #8 with 150 lb N/a gave significantly higher yield than the standard with 230 lb N/a. In general, CO #3 requires 40% less nitrogen than standard Russet Norkotah, CO #8 needs 25% less N, and for the Texas strian, #112 needs about 40% less, #223 about 20% less, and #278 about 30% less. The strains seem to need about 50 lb nitrogen/acre less to achieve the same yield in the same number of days as the standard Russet Norkotah. Pre-plant nitrogen is critical and should be half to two-thirds of the total applied.

Continued on page 2

Russet Norkotah Strains

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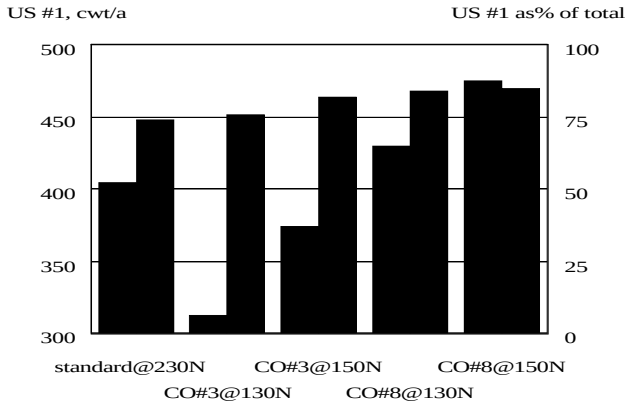
Figure 1. Yield US#1 and % US#1 of Russet Norkotah strains at various N levels (lb/a), Greeley, CO, 1998.



National Trial Performance

The Russet Norkotah strains were first entered in the Western Regional Potato Variety Trials in 1996. The two strains entered were TX #112 and TX #278, and were tested at nine locations. Except at Othello, WA, the two strains out-yielded the standard Russet Norkotah. The mean yield of US#1 for Russet Norkotah over the nine sites was 316 cwt/a while TX #112 yielded 401 cwt/a and TX #278 yielded 381 cwt/a.

In 1997 and 1998, strains CO #3, CO #8, and TX #223 were added to the previous two strains tested. Figure 2 shows total yield of these five strains compared to the standard averaged over nine late-harvest sites and two years, 18 site-years. Strain CO #3 gave the significantly highest yield in these trials, but there was no significant difference between the other strains, CO #8, TX #112, TX #223, and TX #278. The total yield of all were higher than the standard Russet Norkotah.

In 1999 and 2000, two new Texas strains, TX #102 and TX #296, were tested against the standard. They both yielded higher than the standard at all sites. The mean yield of US#1 for Russet Norkotah over the nine sites and two years were 322 cwt/a, while for TX #102 and #296, they were 391 and 395 cwt/a, respectively.

In all the Western Regional Trials, all strains were rated higher for the fresh market than the standard Russet Norkotah.

Figure 2. Total yield of Russet Norkotah and selected strains in the Western Regional Potato Variety Trials, 1997-98.

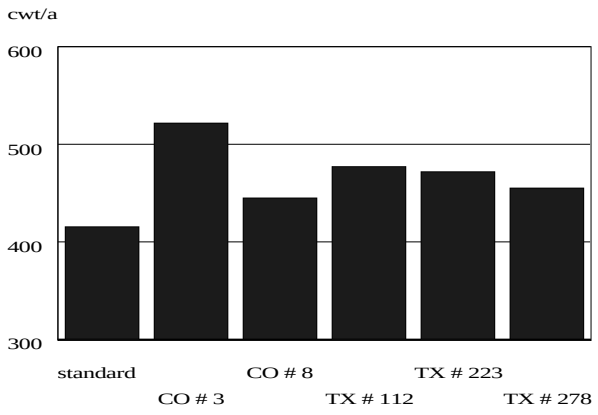


Table 1. Fertility Needs of the Colorado Strains.

Strain	Nitrogen	Phosphorus	Potassium
	----	lb/acre	----
standard	210-230	120-200	0-40
# 3	130-150	100-150	0-40
# 8	160-180	120-170	0-40

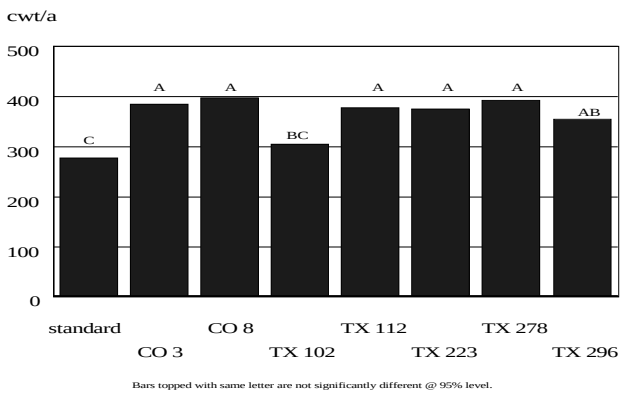
Performance in Nebraska

In early trials in Nebraska, just the two Colorado strains, #3 and #8, were tested. However, in the Nebraska trials of 1999, 2000 and 2001, the two Colorado strains were tested along side the five Texas strains -- #102, #112, #223, #278, and #296. These trials were conducted at three locations in the State -- O'Neill in the north east, Imperial in the southwest and Scottsbluff in the Panhandle. Nitrogen fertilization was above recommendation for Russet Norkotah at O'Neill (Table 2) while, at Imperial and Scottsbluff, it was at or slightly below recommendation. The highest yields were consistently obtained from O'Neill and the lowest at Scottsbluff (Table 2). Percent of total that are US grade A was at Scottsbluff which also had the greatest percent of mis-shaped tubers. Specific gravity was highest at O'Neill and Scottsbluff.

Maturity observations of these strains at Scottsbluff over the three years indicate that CO #3 has the longest maturity, about two weeks later than the standard. The next longest maturity was shown by TX #112. With about a week longer maturity than the standard are CO #8 and TX #223. The strains TX #102, TX #278 and TX #296 have about a three-day longer maturation.

The yields of tubers greater than 1.88 inches are summarized according to location averaged over three years in Table 3. All strains except TX #102 yielded significantly greater than the standard and were not significantly different from each other (Figure 3). When noting the sites when a strain yields significantly more than the standard, one finds that only TX #278 consistently did so at all three sites averaged over the three years. The two Colorado strains and TX #223 yielded significantly more at two of the three sites.

Figure 3. Yield of tubers greater than 1.88 in. diameter across three Nebraska locations and three years.



Bars topped with same letter are not significantly different @ 95% level.

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Russet Norkotah Strains

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Figures 4, 5 and 6 show the percent total yield of tubers > 1.88 inch, percent of tubers that are mis-shaped, and the specific gravities of the strains, respectively, averaged over three sites and three years, nine site-years. With the exception of TX #223, all the strains produced a higher percentage of tubers greater than 1.88 inch (Fig. 4). Significantly higher percentage of mis-shaped tubers was obtained with CO #3, TX #223 and TX #296 (Fig. 5). CO #3 and TX #296 had a greater specific gravity than the standard (Fig. 6).

Overall, TX #278 seems to show the best performance of the strains so far in Nebraska but most of them perform similarly. TX #102 does not show promise. The tendency to mis-shape of CO #3, TX #223 and TX #296 is a caution.

Table 2. Site characteristics for Russet Norkotah clones.

Site	Nitrogen applied lb/a	Yield >1 " cwt/a	% Yield >1 " %	Mis-Shapen Tubers %	Specific Gravity
Imperial	160	357 AB*	86 B	2 B	1.065 A
O'Neill	310	400 A	88 B	4 B	1.071 B
Scottsbl.	160-205	319 B	95 A	19 A	1.073 A

* Numbers in columns not followed by same upper case letter are significantly different at the 95% probability level.

Table 3. Yield of >1 inch tubers of Russet Norkotah clones by site, 1999-2001.

Clone	Imperial	O'Neill	Scottsbluff	Means
standard	272 c*	298 b	264 bc	278 C
CO # 3	369 ab	458 a	328 abc	385 A
CO # 8	345 abc	460 a	387 a	397 A
TX # 102	306 bc	357 ab	251 c	305 BC
TX # 112	434 a	382 ab	319 abc	379 A
TX # 223	368 ab	416 a	341 ab	375 A
TX # 278	385 ab	452 a	343 a	393 A
TX # 296	390 ab	363 ab	317 abc	356 AB

Note: Nitrogen applications were @ Imperial 160 #N/a, @ O'Neill 310 #N/a, and @ Scottsbluff 160 #N/a in 1999 and 205 #N/a in 2000 and 2001.

* Numbers in columns not followed by same lower case letter are significantly different at the 90% probability level and numbers not followed by same upper case letters are significantly different at the 95% probability level.

Figure 4. Percent of total yield that is greater than 1.88 in. diameter across three Nebraska locations and three years.

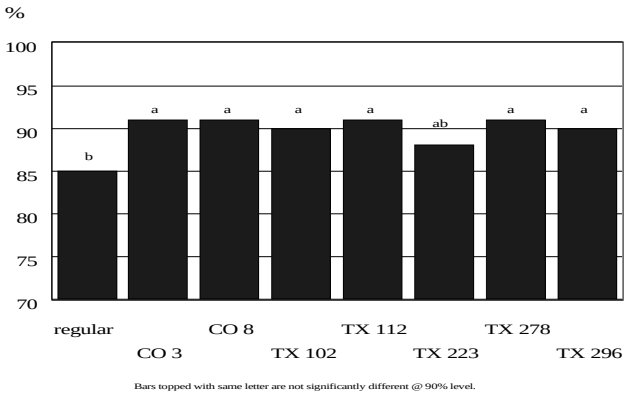


Figure 5. Percent of yield (>1.88in) that is mis-shapen across three Nebraska locations and three years.

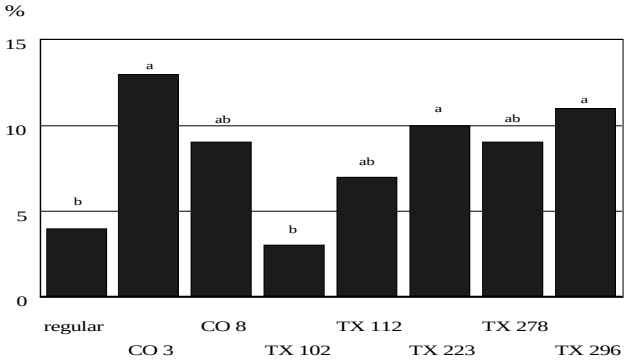
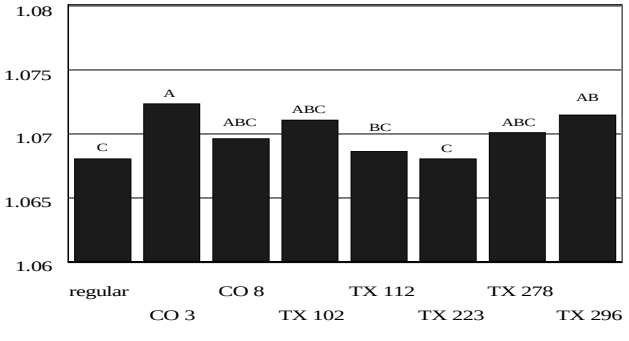


Figure 6. Specific gravity of tubers > 1.88 inch diameter across three Nebraska locations and three years.



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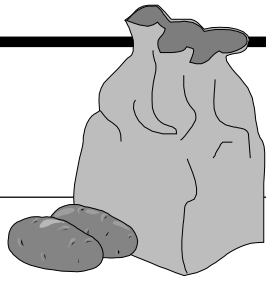

Fuel Costs for Irrigation

In the last couple of years, there has been a dramatic increase in energy prices. Fossil fuel prices are erratic while electricity costs are more stable. Looking over the prices of the last five years in Nebraska (Table below) one sees that the high diesel cost for 2000 and 2001 is 50% greater that that of the low in 1999. The same comparison on electrical costs shows that as an 8% differential. However, in 2001, diesel cost was favorable relative to propane.

Table 1. Representative Energy Prices

Year	Diesel	Propane	Electrical
	$/gal	$/gal	$/kwh
1997	0.84	0.69	0.038
1998	0.71	0.62	0.038
1999	0.67	0.55	0.038
2000	1.02	0.77	0.036
2001	1.02	0.99	0.039

[sources: NASS and Nebr. Southern Power Distr.]
Diesel and propane cost do not include tax.
Electrical cost does not include connect charge.
Rates are for anytime interruptible, the most economical.

Check out the Nebraska Potato Eyes on the WWW at:
http://www.panhandle.unl.edu/peyes.htm