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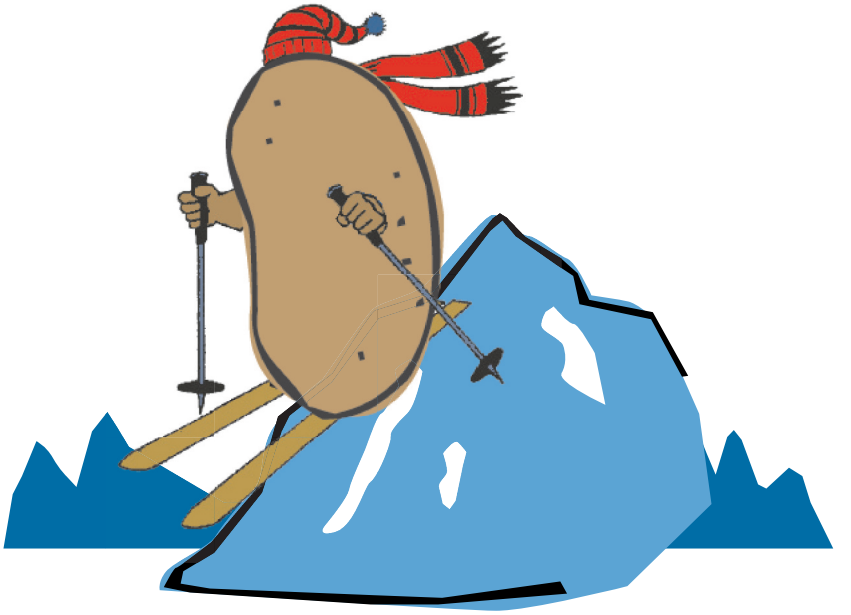
CIS 1184

Storage Management of Alpine Russet Potatoes



Introduction

Alpine Russet is a high-yielding, late-maturing cultivar with long, lightly russeted tubers of moderately high specific gravity and excellent storage characteristics.

Released in 2008 by the USDA Agricultural Research Service and the agricultural experiment stations of Idaho, Oregon, and Washington, Alpine Russet has excellent processing characteristics and long tuber dormancy. It produces a high percentage of U.S. No. 1 tubers and is resistant to sugar ends, tuber malformations, and most internal and external defects.

Alpine Russet's long-term storability is a special advantage of this cultivar. Its long inherent dormancy—longer than that of Russet Burbank—coupled with its naturally low glucose concentrations result in light-colored fries from potatoes coming out of long-term cold storage.

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About the study

Alpine Russet potatoes were grown at the University of Idaho's Kimberly Research and Extension Center from G2 seed in 2004, 2005, and 2006. After harvest, the potatoes were placed in storage and allowed to cure at 55 °F and 95% relative humidity for 14 days. The temperature was then decreased at a rate of 0.5 °F per day to holding temperatures of 42 °F, 45 °F, and 48 °F.

Potatoes used in assessing dormancy length were not treated with a sprout inhibitor. Samples used for sugar, fry color, mottling, and disease analyses were treated with a thermal aerosol application of chlorpropham (CIPC) at 22 ppm at approximately 60 days after harvest.

Glucose, sucrose, and fry color data were collected each month in storage on three replications of 10 tubers per variety and storage temperature. Glucose and sucrose concentrations were determined using a YSI model 2700 Analyzer (YSI, Inc., Yellow Springs, OH) and expressed on a percent fresh weight basis.

Fry color analysis was performed concurrent with sugar extraction. Fry color was determined on 10 planks per sample after cooking in canola oil at 375 °F for 3.5 minutes. Percent reflectance was read with a Photovolt reflectometer on the stem ends of each plank. The planks were also scored subjectively for mottling and sugar end.

Weight loss for each cultivar at each temperature was determined based on three samples of approximately 10 pounds each placed in mesh bags and weighed monthly throughout the storage season. Weight loss is presented on a percentage basis.

Dormancy

Dormancy length in Alpine Russet is about 10 days longer than in Russet Burbank (table 1). Dormancy length is defined as the number of days until sprout elongation (at least 0.2 inches) occurs in 80% of tubers in the sample. This definition is used because the length of time between initial sprout development (peeping) and sprout elongation varies greatly among potato varieties.

Even though the natural dormancy length of Alpine Russet is about 10 days longer than for Russet Burbank, application of sprout inhibitor is still necessary if the intended storage duration is longer than the dormancy length. Timing of application is comparable to that of Russet Burbank; therefore, apply sprout inhibitors after the curing period but well before dormancy break.

Glucose and sucrose concentrations

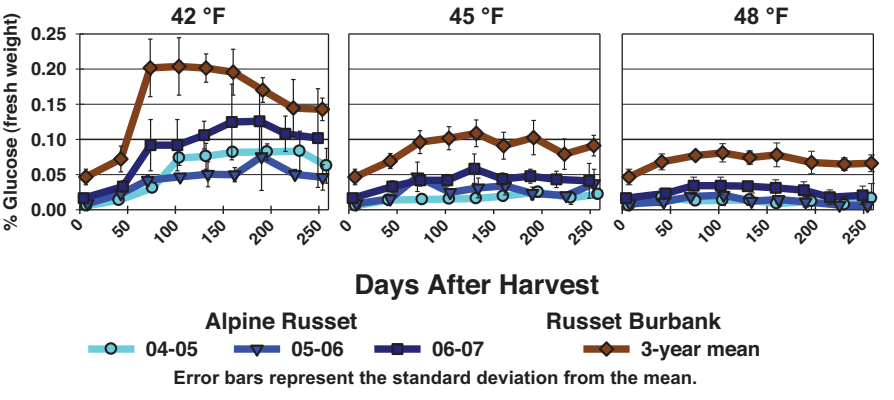
Potatoes used for frozen or dehydration processing must meet reducing sugar criteria specific to the end use. High concentrations of glucose (a reducing sugar) in potato tubers produce a dark coloration in potatoes exposed to high processing temperatures. Glucose concentrations above 0.10% FW are often considered too high for frozen processing. Sucrose serves as a potential pool for glucose formation in stored tubers and therefore is monitored throughout storage.

Glucose concentrations at harvest. Glucose concentrations at harvest (0 days after harvest) in Alpine Russet were very low across the three study years, ranging from 0.005% fresh weight (FW) in 2004 to 0.02% FW in 2006 (figure 1). The year with the highest glucose concentration at harvest also yielded the highest storage glucose concentrations, although

Table 1. Mean dormancy length (days after harvest) over three seasons (2004-2007) of Russet Burbank and Alpine Russet potatoes at three storage temperatures.

Variety	42 °F	45 °F	48 °F
Russet Burbank	175 days	155 days	130 days
Alpine Russet	185 days	165 days	140 days

Figure 1. Mean glucose concentrations (% fresh weight) in Alpine Russet potatoes stored at three temperatures during three storage seasons (2004 through 2007) compared with Russet Burbank potatoes (3-year mean) stored those same years.



they were significantly lower than those in Russet Burbank.

Glucose concentrations during storage. Glucose concentrations in Alpine Russet tubers were lower than in Russet Burbank at all three storage temperatures (figure 1). These low glucose concentrations make this cultivar a very strong candidate for use in the processing market as a long-term storage variety:

- At both 45 °F and 48 °F, glucose concentrations in Alpine Russet remained at or below 0.05% FW throughout the 9-month storage season during 3 years of testing.
- At 42 °F, glucose concentrations in Alpine Russet remained near or below 0.10 % FW throughout the storage season in 2 of the 3 years tested. In 1 of the 3 years, the glucose concentration exceeded 0.10% FW at 140 DAH. At 160 DAH it peaked at 0.13% FW and then decreased over time in storage to 0.11%.

Sucrose concentrations. Sucrose concentrations in Alpine Russet at harvest were very consistent across the 3 years, ranging from 0.19% (2004 and 2005) to 0.21% (2006) FW. These concentrations are significantly higher than those observed in Russet Burbank—0.11% FW averaged over the 3-year study (figure 2).

In general, the seasonal pattern of sucrose concentrations in Alpine Russet was similar to that in Russet Burbank, decreasing slightly over the storage season. Peak sucrose concentrations in Alpine Russet were observed in 42 °F storage:

- 0.26% FW at 76 days after harvest (DAH) in 2004-05
- 0.21% FW at 105 DAH in 2005-06
- 0.21% FW at 102 DAH in 2006-07

Peak sucrose concentrations in Russet Burbank occurred in 42 °F storage at a similar time; however, the mean 3-year peak was 0.16 % FW.

Fry color

Glucose concentrations in potato tubers are a good indicator of fry color. However, the processing industry generally makes fry color determinations using samples of fried potato strips, discs, or planks to assess storage characteristics.

In this study, fry color determinations were made by measuring reflectance of fried planks (1.2″ x 0.3″) with a Photovolt Reflection Meter Model 577 (Photovolt Inc., Indianapolis, IN). The planks came from the same tubers used for the reducing sugar analyses.

When variation in fry color occurs within a potato, it is generally the stem end of the potato that has the highest levels of sugar and darkest color. To represent the most stringent test of fry color, the stem-end fry color data are presented in figure 3. Reflectance readings are presented together with the corresponding USDA fry color data. The USDA colors correspond to the following reflectance ranges:

- USDA 1: Reflectance ≥44
- USDA 2: Reflectance ≥35 and <44
- USDA 3: Reflectance ≥26 and <35
- USDA 4: Reflectance <26

The higher the reflectance reading, the lighter the fry color. Fry color of USDA 2 or lower is considered

Figure 2. Mean sucrose concentrations (% fresh weight) in Alpine Russet potatoes stored at three temperatures during three storage seasons (2004 through 2007) compared with the 3-year mean of Russet Burbank potatoes similarly stored the same years.

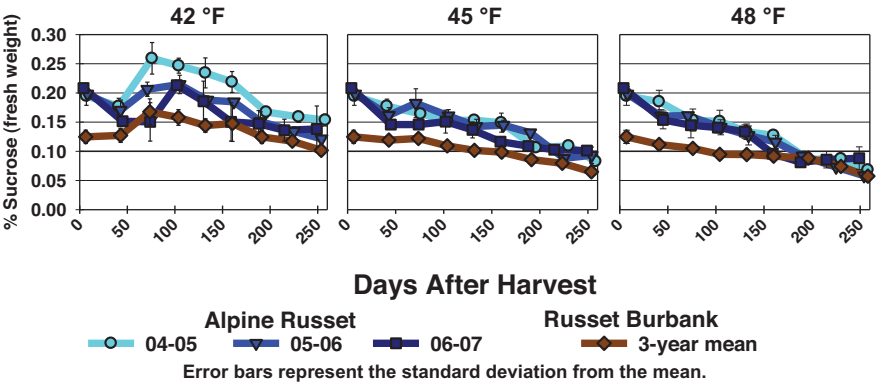
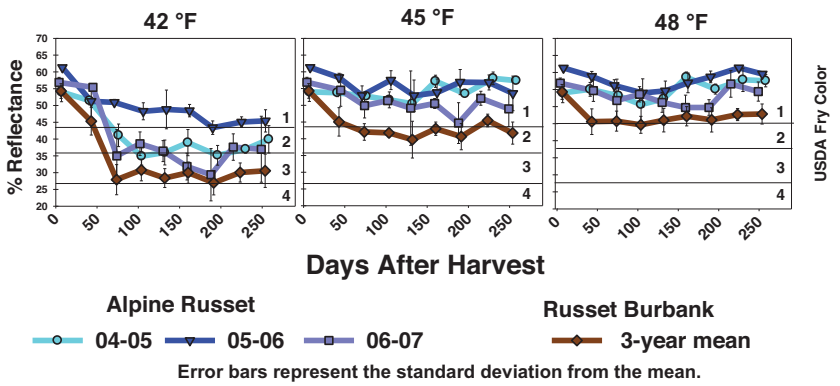


Figure 3. Mean reflectance (%) of stem-end fries from Alpine Russet potatoes stored at three temperatures during three storage seasons (2004 to 2007) compared with the 3-year mean reflectance of Russet Burbank potatoes similarly stored the same years.



acceptable by the frozen potato industry.

Stem-end fry color of Alpine Russet was lighter (higher reflectance) than that of Russet Burbank after storage at 42 °F, 45 °F, and 48 °F (figure 3):

- Storage at 48 °F. Fry color was lowest in Alpine Russet stored at this temperature. The average fry color was less than or equal to a USDA 1 and always lighter than the 3-year mean of Russet Burbank.
- Storage at 45 °F. In Alpine Russet samples, the USDA fry color was less than or equal to a USDA 1, while the average fry color in Russet Burbank was a USDA 1 or 2.
- Storage at 42 °F. Fry color for Alpine Russet was lighter than Russet Burbank and less than or equal to a USDA 2 throughout 2 of 3 years. In 2006-07, fry color in Alpine Russet scored a USDA 3 at 159 and 188 DAH, but then decreased again to an acceptable USDA 2 for the remainder of the storage season

Mottling

Thin, thread-like areas of dark coloration found in the cortex of the fried potato tissue, known as mottling, can occur in some varieties. Each fry was subjectively evaluated for mottling on a scale of 1 to 4, where 1=no mottling, 2=mild, 3=moderate, and 4=severe mottling (figure 4). Mottling in Alpine Russet was similar to that in Russet Burbank during 3 years of testing. Mottling was mild to none at the warmer storage temperatures of 45 °F and 48 °F and mild to moderate at 42 °F in both Alpine Russet and Russet Burbank samples.

Fusarium dry rot

Because Fusarium dry rot is an important storage disease in potatoes, new varieties are screened for susceptibility to this disease. The disease organism infects tubers through cuts or openings in the skin. To induce infection, potatoes were first bruised and then inoculated with *Fusarium sambucinum*. Following inoculation, potatoes were cured at 55 °F and 95% relative humidity for 2 weeks and then stored at 45 °F. After approximately 3 months in storage, tubers were evaluated for the percentage of dry rot decay and the incidence of the disease, expressed as the percentage of tubers evaluated having >5% decay (table 2).

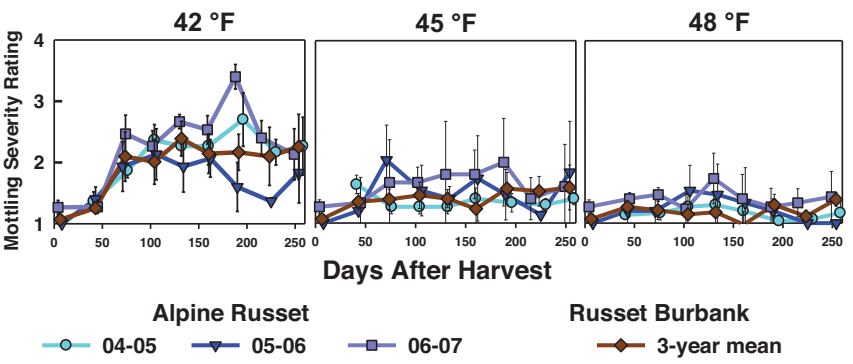
In storage studies done at Aberdeen, Idaho, tubers were washed and inoculated with *F. sambucinum* and then stored at 50 °F for 4 weeks before evaluation. In these studies, conducted in 2002 and 2004, Alpine Russet had an average reading of 3.6 while Russet Burbank had a reading of 3.0 (0–5 weighted scale with 5 = most dry rot).

Results averaged over 3 years indicate that the percentage of decay due to dry rot in Alpine Russet (19%) was significantly higher than in Russet Burbank (10%) (table 2). The incidence of potatoes with at least 5% decay was also significantly higher in Alpine Russet (44%) than in Russet Burbank (30%). These results indicate that Alpine Russet may be more susceptible to initial *Fusarium* infection and further decay development than Russet Burbank. Care should be taken to manage Alpine Russet tubers for good skin maturity and bruise reduction at harvest in order to minimize the opportunity for *Fusarium* infection to occur.

Table 2. Infection severity (% decay) and incidence of potatoes with greater than 5% decay of Fusarium dry rot in bruised and inoculated lots of Russet Burbank and Alpine Russet potato samples at Kimberly, Idaho. Values are means of 3 years—2004 to 2007.

Variety	Infection Severity (% decay)	Incidence (% potatoes with >5% decay)
Russet Burbank	10	30
Alpine Russet	19	44
LSD (*P*<0.05)	5	9

Figure 4. Mean severity of mottling in fried planks of Alpine Russet potatoes stored at three temperatures during three storage seasons (2004 to 2007) compared to the 3-year mean of Russet Burbank potatoes similarly stored during the same time periods.



rating scale: 1 = none, 2 = mild, 3 = moderate, 4 = severe

Error bars represent the standard deviation from the mean.

Weight loss

Percentage weight loss was tracked in replications of 10-pound samples of Alpine Russet and Russet Burbank potatoes throughout three storage seasons (table 3). There was no significant difference in weight loss between Alpine and Russet Burbank at 42 and 45 °F, although at 48 °F Alpine Russet had significantly higher weight loss than Russet Burbank.

Table 3. Weight loss (%) of Alpine Russet and Russet Burbank potatoes after 250 days in storage at three storage temperatures. Values are means of 3 years—2004 through 2007.

Variety	42 °F	45 °F	48 °F
Russet Burbank	4.4%	3.6%	5.0%
Alpine Russet	5.3%	4.6%	8.0%
LSD ($P<0.05$)	ns	ns	2.2

About the authors

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Storage recommendations for Alpine Russet

Curing. Cure at 55 °F and 95% relative humidity for 14 days.

Storage. Maintain 95% relative humidity throughout storage.

- **Frozen processing.** Hold at 45 °F.
- **Fresh market.** Hold at 42 °F.
- **Dehydration processing.** Hold at 42 °F to 45 °F, depending on intended product.

Sprout inhibition. Apply CIPC before dormancy break but after curing. Timing of sprout inhibitor application is comparable to Russet Burbank

- **42 °F.** Apply CIPC between 2 and 20 weeks after harvest
- **45 °F.** Apply CIPC between 2 and 16 weeks after harvest

Storage duration. High processing quality persists throughout 36 weeks after harvest at 45 °F.

Fry mottling. Mottling can occur in Alpine Russet at lower storage temperatures in some years. To minimize mottling, store at 45 °F.

Fusarium dry rot. Slightly higher susceptibility than Russet Burbank. Maximize skin set and minimize bruising at harvest

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