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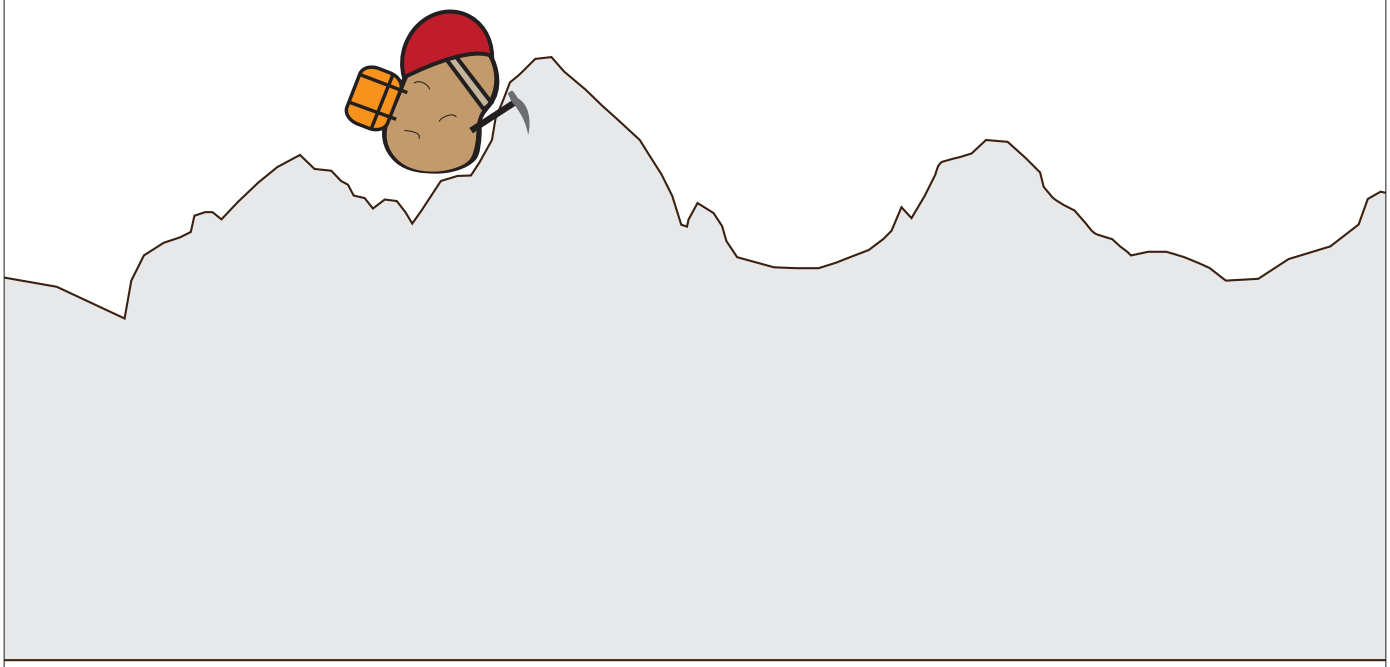
Storage Management of Teton Russet Potatoes



Introduction

Teton Russet is a dual-purpose potato variety released in 2011 by the USDA Agricultural Research Service and the agricultural experiment stations of Idaho, Oregon, and Washington. Teton Russet possesses attributes that make it marketable in both the fresh-pack and frozen processing industries. It is an early to mid-harvest variety with a high U.S. No. 1 yield relative to the industry's standard varieties.

The specific gravity of Teton Russet tubers is comparable to those of standard varieties in early harvest production. In full-season production, its specific gravity is comparable to Russet Burbank's but lower than Ranger Russet's.

Teton Russet is less susceptible to tuber malformation due to stress during the growing season than are Ranger Russet and Russet Burbank. It is resistant to common scab and Fusarium dry rot, and has moderate resistance to net necrosis. Teton Russet has higher vitamin C and protein contents than standard varieties.

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About the study

Teton Russet and Russet Burbank potatoes were grown at the University of Idaho Kimberly Research and Extension Center in 2009, 2010, and 2011. Russet Norkotah potatoes were grown only in 2010 and 2011. Russet Norkotah serves as a standard, early harvest, fresh-market variety, while Russet Burbank serves as a standard, full-season variety for the fresh market and processing.

After harvest, potatoes were placed in storage at the University of Idaho Kimberly Potato Storage Research Facility 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. The potatoes were subsequently stored for 9 months at these temperatures.

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

Dormancy was assessed by monthly evaluations of sprout development, with dormancy length being defined as the number of days from harvest until sprout elongation of at least 0.2 inches 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.

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

Fry color analysis was performed concurrent with sugar extraction and using the same tubers. Fry color was determined on 10 planks (1.2 inch x 0.3 inch) per sample after cooking the planks in canola oil at 375°F for 3.5 minutes. Percentage reflectance was read with a Photovolt Reflection Meter Model 577 (Photovolt Inc., Indianapolis, IN) on the stem ends of each plank. The planks were also scored subjectively for mottling on a scale of 1 to 4, where 1 = none, 2 = mild, 3 = moderate, and 4 = severe.

In studies to evaluate Fusarium dry rot 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 more than 5% decay.

Percentage weight loss was tracked in three replications of 10-pound samples of Teton Russet and Russet Burbank potatoes throughout three storage seasons.

Dormancy

In the absence of sprout inhibitors, dormancy length of Teton Russet is 30 to 45 days shorter than that of Russet Burbank (table 1) and similar to that of Russet Norkotah. Dormancy length increases for all three varieties with a decrease in storage temperature.

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% fresh weight (FW) are often considered too high for frozen processing. Concentrations of glucose in excess of 0.20% FW exceed the upper limit of acceptability for use in premium dehydrated potato products. Sucrose can serve as a potential pool for glucose formation in stored tubers and therefore is monitored throughout storage.

Glucose concentrations at harvest. Glucose concentrations 7 days following harvest in Teton Russet were on average lower than those in Russet Burbank and Russet Norkotah across the study years, ranging from 0.025% FW in 2009 to 0.045% FW in 2011 (figure 1). The 3-year mean glucose concentration

Table 1. Mean dormancy length (days after harvest) of Teton Russet compared with Russet Burbank and Russet Norkotah potatoes at three storage temperatures. Values are means of three storage seasons (2009–2010, 2010–11 and 2011–12) for Teton Russet and Russet Burbank and two storage seasons (2010–11 and 2011–12) for Russet Norkotah.

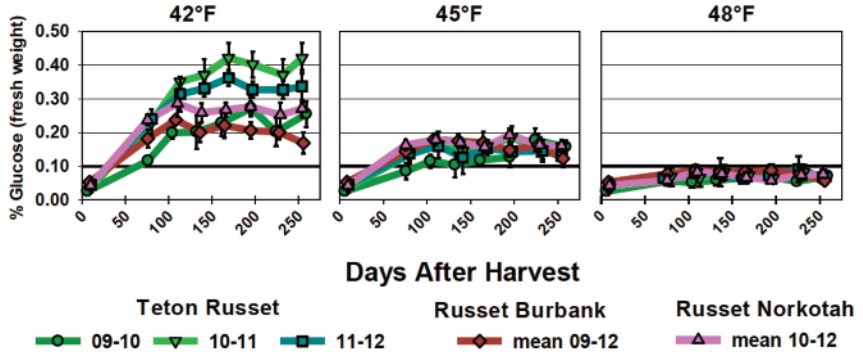
Variety	42 ºF	45 ºF	48 ºF
Russet Burbank	175 days	155 days	130 days
Russet Norkotah	135 days	125 days	105 days
Teton Russet	135 days	115 days	110 days

was 0.053% FW in Russet Burbank, and the 2-year mean in Russet Norkotah was 0.043% FW.

Glucose concentrations during storage. Glucose concentrations in Teton Russet tubers vary significantly with storage temperature (figure 1). When stored at 42°F, glucose concentrations in Teton Russet increased to levels higher than those of Russet Burbank and Russet Norkotah in 2 out of 3 years. When stored at 45°F and 48°F, glucose concentrations in Teton Russet were similar to glucose concentrations in Russet Burbank and Norkotah Russet.

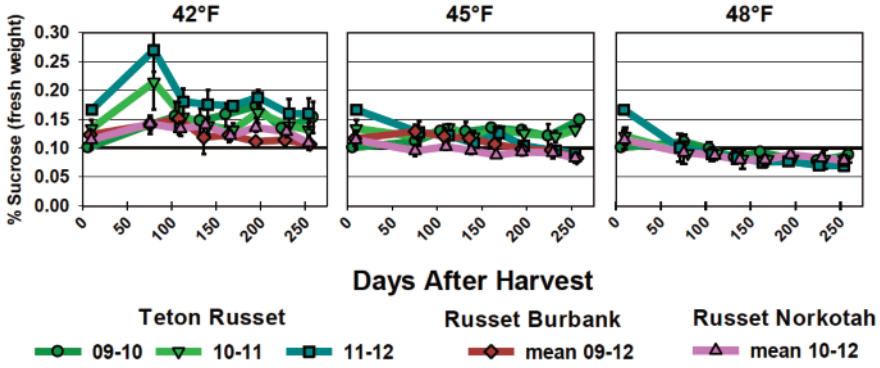
- At 48°F, glucose concentrations in Teton Russet remained below 0.10% FW throughout the 9-month storage season during 3 years of testing and were similar to the mean glucose concentrations for Russet Burbank and Russet Norkotah.
- At 45°F, glucose concentrations of Teton Russet remained at or below 0.20% FW throughout the 9-month storage season during 3 years of testing. Glucose concentrations of Russet Burbank and Russet Norkotah were similar. These concentrations would most likely not be appropriate for frozen french fries but would be appropriate for dehydrated products.
- At 42°F, glucose concentrations in Teton Russet exceeded 0.10% FW within 60 days of harvest and throughout the rest of storage in all 3 years. Glucose concentrations varied season to season at this storage temperature. In 2010–11 glucose concentrations peaked at 0.42% FW at 169 days after harvest (DAH). In 2009–10, the peak glucose concentration was 0.27% FW at 195 DAH.

Figure 1. Mean glucose concentrations (% fresh weight) in Teton Russet potatoes at harvest and in storage at three temperatures during three storage seasons (2009–10, 2010–11, and 2011–12) compared with Russet Burbank potatoes (3-year mean) and with Russet Norkotah potatoes (2-year mean: 2010–11 and 2011–12).



Error bars represent one standard deviation from the mean.

Figure 2. Mean sucrose concentrations (% fresh weight) in Teton Russet potatoes at harvest and in storage at three temperatures during three storage seasons (2009–10, 2010–11, 2011–12) compared with Russet Burbank potatoes (3-year mean) and with Russet Norkotah potatoes (2-year mean: 2010–11 and 2011–12).



Error bars represent one standard deviation from the mean.

Sucrose concentrations. Sucrose concentrations in Teton Russet at harvest varied across the 3 years, ranging from 0.09% FW in 2009 to 0.17% FW in 2011. These concentrations are similar to those observed in Russet Burbank—0.12% FW averaged over the 3-year study—and in Russet Norkotah—0.11% FW averaged over the 2-year study (figure 2).

Generally, the higher the storage temperature, the more consistent the sucrose concentrations were in Teton Russet throughout storage. As the temperature decreased, year-to-year variability increased. The seasonal effects were most pronounced at 42°F, at which sucrose concentrations were highest. A spike in sucrose concentration was observed at 42°F at approximately 70 DAH in 2010–11 and in 2011–12. Identifying the proper chemical maturity of Teton Russet prior to harvest may be necessary for maintaining processing quality in storage.

Fry color

Glucose concentrations in potato tubers are a good indicator of fry color. The higher the glucose concentration, the darker the fry color. However, the processing industry generally makes fry color determinations using samples of fried potato strips, discs, or planks to assess product quality.

When variation in fry color occurs within a potato, it is generally the stem end of the potato (tuber end

closest to the plant and where the stolon attaches) that has the highest levels of sugar and darkest color. Data for stem-end fry color—the most stringent test of fry color—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 > 44% reflectance
- USDA 2 = 35 to 44% reflectance
- USDA 3 = 26 to 34.9% reflectance
- USDA 4 < 25.9% reflectance

The higher the reflectance reading, the lighter the fry color. Fry color of USDA 2 or lower (≥ 35% reflectance) is generally considered acceptable by the frozen potato industry.

Stem-end fry color of Teton Russet was similar to that of Russet Burbank and Russet Norkotah in this test. Fry color was lightest at the highest storage temperature, darker at the lowest storage temperature (figure 3).

- Storage at 48°F—Fry color in Teton Russet was lightest when stored at this temperature. The average fry color was less than a USDA 2 and generally lighter than the 3-year mean of Russet Burbank and 2-year mean of Norkotah Russet.
- Storage at 45°F—USDA fry color rating of Teton Russet was less than or equal to a USDA 3 in all 3 years, while the mean fry color of Russet Burbank and of Russet Norkotah (except at harvest) was a USDA 3.
- Storage at 42°F—Fry colors of Teton Russet, Russet Burbank, and Russet Norkotah were all rated a USDA 4.

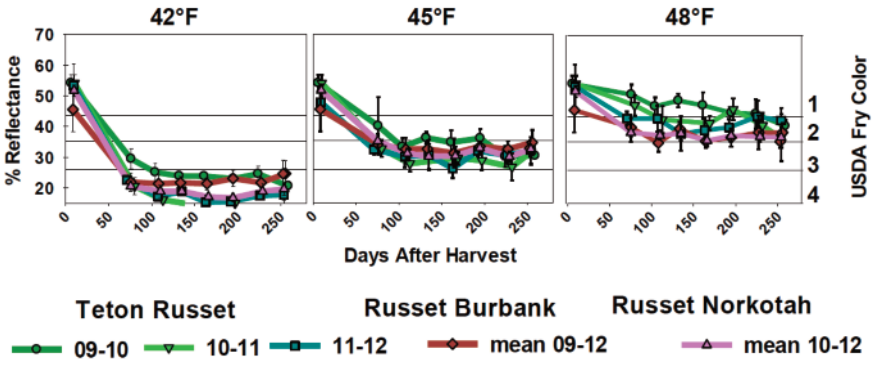
Mottling

Thin, thread-like areas of dark coloration found in the cortex of the fried potato tissue, known as mottling, can occur in some varieties. Mottling in Teton Russet was generally mild to moderate at the 42°F, mild at 45°F, and none to mild at 48°F (figure 4). Russet Burbank and Norkotah Russet performed similarly.

Fusarium dry rot

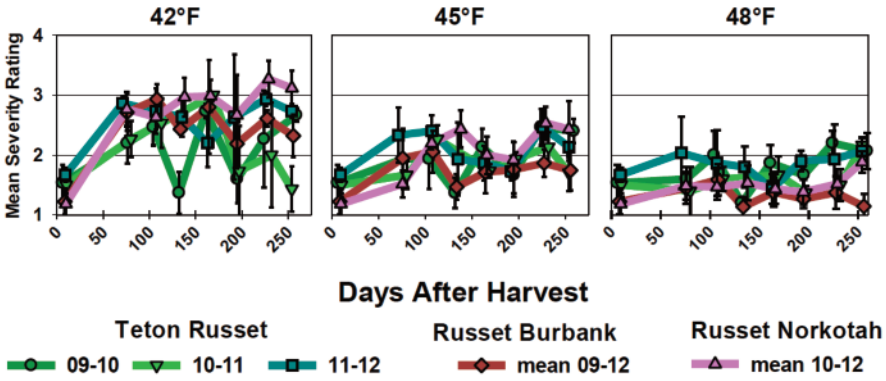
Because Fusarium dry rot is an important storage disease in potatoes, new varieties are screened for susceptibility to this disease. The disease

Figure 3. Reflectance of stem-end fries from Teton Russet potatoes at harvest and in storage at three temperatures during three storage seasons (2009–10, 2010–11, 2011–12) compared with Russet Burbank potatoes (3-year mean) and with Russet Norkotah potatoes (2-year mean: 2010–11 and 2011–12).



Error bars represent one standard deviation from the mean.

Figure 4. Mean severity of mottling in fried planks of Teton Russet potatoes at harvest and in storage at three temperatures during three storage seasons (2009–10, 2010–11, 2011–12) compared with Russet Burbank potatoes (3-year mean) and with Russet Norkotah potatoes (2-year mean: 2010–11 and 2011–12).



Error bars represent one standard deviation from the mean.

Table 2. Mean decay (%) and incidence of tubers with greater than 5% Fusarium dry rot decay in bruised and inoculated lots of Russet Burbank, Russet Norkotah, and Teton Russet tubers. Values are means of two storage seasons (2009–10 and 2010–11).

Variety	Decay (%)	Incidence
Russet Burbank	28	58
Russet Norkotah	7	23
Teton Russet	13	51
LSD (P < 0.05)	7	13

organism infects tubers through cuts or openings in the skin.

Results averaged over 2 years indicate that the percentage of decay due to dry rot in Teton Russet (13%) was significantly lower than in Russet Burbank (28%) (table 2). The incidence of potatoes with at least 5% decay was also significantly lower in Teton Russet (51%) compared to Russet Burbank (58%). The 2-year mean percent decay in Teton Russet was 13% and not statistically different from that of Russet Norkotah (7%), while the mean for Russet Burbank was statistically higher at 28%.

Table 3. Mean weight loss (%) during 9 months in storage in Russet Burbank, Russet Norkotah, and Teton Russet tubers at three temperatures. Values are means of two storage seasons (2009–10 and 2010—11).

Variety	42°F	45°F	48°F
Russet Burbank	6	4	5
Russet Norkotah	6	4	5
Teton Russet	5	5	4
LSD (P<0.05)	ns	ns	ns

Weight loss

There were no significant differences in weight loss among Teton Russet, Russet Burbank, and Russet Norkotah at any of the storage temperatures (table 3). The 2-year means of weight loss ranged from 5.1 to 5.8%.

About the authors

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Storage recommendations for Teton Russet

Harvest conditions. Pulp temperatures at harvest should be 45 to 65°F to minimize wounding and potential pathogen infection and cause disease development of Pythium leak or pink rot.

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

Storage. Maintain 95% relative humidity throughout storage.

- **Frozen processing.** Hold at 48°F to maximize French fry processing quality.
- **Fresh market.** Hold at 42°F.
- **Dehydration processing.** Hold at 45°F to meet premium dehydration market standards.

Sprout inhibition. Apply CIPC before dormancy break but after curing.

- **42°F.** Apply CIPC between 2 and 19 weeks after harvest
- **45°F.** Apply CIPC between 2 and 16 weeks after harvest
- **48°F.** Apply CIPC between 2 and 11 weeks after harvest

Storage duration. Tubers maintain turgidity throughout long-term storage (up to 9 months) when treated with effective sprout inhibitor and in the presence of 95% humidity.

Fry mottling. Slight mottling has been observed in Teton Russet at 48°F storage temperature. At 45°F mottling was mild to moderate, and at 42°F mottling was moderate.

Fusarium dry rot. Teton Russet has a lower susceptibility to Fusarium dry rot than Russet Burbank and a similar susceptibility to Norkotah Russet in our evaluations.

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