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Storage Management of Mountain Gem Russet Potatoes

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Introduction

MOUNTAIN GEM RUSSET is a dual-purpose potato variety with oblong-long, medium-russeted tubers that are suitable for both fresh market and processing. It was released in 2015 by the USDA-Agricultural Research Service and the Agricultural Experiment Stations of Idaho, Oregon, and Washington, and is a product of the Pacific Northwest Potato Variety (Tri-State) Development Program. Mountain Gem Russet is medium to late maturing and is notable for its high total and U.S. No. 1 yields in both early and full season production. Mountain Gem Russet has excellent culinary qualities.

Mountain Gem Russet has greater resistance to tuber late blight and soft rot than Russet Burbank does. It is also notable for its resistance to common scab which is comparable to that of Russet Burbank. Mountain Gem Russet exhibits moderate susceptibility to *Verticillium* wilt, corky ringspot and net necrosis, and is considered susceptible to foliar early blight, tuber early blight and foliar late blight, with high susceptibility to PVX, PVY and PLRV.

Mountain Gem Russet has demonstrated greater resistance to external tuber defects such as growth cracks and second growth compared to Russet Burbank, but a lower resistance to growth cracks relative to Russet Norkotah. Susceptibility of Mountain Gem Russet to shatter bruise and hollow heart is similar to Russet Burbank. Additional detail regarding the characteristics of Mountain Gem Russet can be found in the variety release publication: *Mountain Gem Russet: A Potato Variety with High Early and Full Season Yield Potential and Excellent Fresh Market and early Processing Characteristics* (Stark et al. 2016).

About the Study

Mountain Gem Russet and Russet Burbank potatoes were grown as a late harvest crop and managed according to best field management practices for a Russet Burbank crop at the University of Idaho Kimberly Research and Extension Center in 2013, 2014, and 2015.

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 temperature treatments of 42°F, 45°F, and 48°F. The potatoes were subsequently stored for 8 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 the sprout inhibitor chlorpropham (CIPC) at 22 ppm approximately 60 days after harvest. Potatoes used in assessing dormancy length were not treated with CIPC.

Dormancy was assessed by monthly evaluations of sprout development, with dormancy length being defined as the number of days from harvest until sprouts at least 0.2 inches long were observed 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 during 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 using the same tubers from the sugar analysis. Fry color was determined on 10 planks (1.2 inch x 0.3 inch) per sample after frying the planks in canola oil at 375°F for 3.5 minutes. Percent reflectance was read with a Photovolt Reflection Meter Model 577 (Photovolt Inc., Indianapolis, IN) on the bud and stem end of each plank. The planks were also scored for mottling (thin veins of dark coloration in the cortex of the fried potato tissue) on a scale of 1 to 4, where 1 = none, 2 = mild, 3 = moderate, and 4 = severe.

In studies designed to evaluate response to *Fusarium* dry rot infection, potatoes were first bruised and then inoculated with *Fusarium sambucinum* (50:50 mix of Thiabendazole resistant:susceptible strains). Following inoculation, potatoes were cured at 55°F and 95% relative humidity for 2 weeks, decreased 0.5°F/day,

and then stored at 45°F. After approximately 3 months in storage, tubers were evaluated for the percentage of dry rot decay, and incidence of dry rot, expressed as the percentage of tubers evaluated having more than 5% decay was recorded.

Percent weight loss was tracked monthly in three replications of 10-pound samples of Mountain Gem Russet and Russet Burbank potatoes throughout three storage seasons (2013–2014, 2014–2015, and 2015–2016).

Dormancy

In the absence of sprout inhibitors, dormancy length of Mountain Gem Russet is shorter than Russet Burbank (Table 1). Results indicate that Mountain Gem Russet breaks dormancy approximately 70 to 75 days earlier than Russet Burbank. Dormancy length in Mountain Gem Russet ranged from 115 days at 42°F to 75 days at 48°F compared to 185 days at 42°F and 150 days at 48°F for Russet Burbank.

Table 1. Mean dormancy length (days after harvest) of Mountain Gem Russet compared with Russet Burbank potatoes at three storage temperatures. Dormancy break is defined as the point at which sprout elongation (at least 0.2 inches long) begins to occur in 80% of the tubers in the sample. Dormancy evaluations are performed on tubers that are not treated with a sprout inhibitor. Values are means of three years (2013–16).

Variety	42°F	45°F	48°F
Russet Burbank	185	165	150
Mountain Gem Russet	115	90	75

Glucose and Sucrose Concentrations

Potatoes used for frozen fry 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 when 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 an indicator of maturity and stress, and as a carbohydrate pool and, therefore, is monitored at harvest and throughout storage.

Glucose Concentrations at Harvest

Glucose concentrations at harvest in Mountain Gem Russet ranged from 0.025% FW in 2015–2016 to 0.035% FW in 2014–2015 (Figure 1). The 3-year mean harvest glucose concentration was lower in Mountain Gem Russet (0.031% FW) than Russet Burbank (0.039% FW).

Glucose Concentrations During Storage

In general, glucose concentrations in Mountain Gem Russet tubers were similar to 3-year average glucose concentrations in Russet Burbank in storage. In the 2015–2016 storage season, glucose concentrations were significantly lower than in 2013–2014 and 2014–2015 during most of the storage period, especially at the lower storage temperatures (Figure 1).

- At 48°F, glucose concentrations of Mountain Gem Russet remained below 0.08% FW throughout the 8-month storage season during 3 years of testing. At the end of storage season, the 3-year average glucose concentration for Russet Burbank exceeded 0.10% FW.
- At 45°F, glucose concentrations of Mountain Gem Russet remained below 0.10% FW in 2013–2014 and 2015–2016 storage seasons, whereas glucose

concentrations during the 2014–2015 storage season and 3-year average glucose concentrations in Russet Burbank exceeded 0.10% FW at some sampling dates. Glucose concentrations in Mountain Gem Russet during the 2015–2016 storage season were similar to or lower than Russet Burbank at 3, 4, and 6 months after harvest.

- At 42°F, the three-year average glucose concentrations of Mountain Gem Russet and Russet Burbank exceeded 0.10% FW throughout the storage season. This low storage temperature is not recommended for Mountain Gem Russet potatoes destined for processing use. Although glucose concentrations of Mountain Gem Russet during the 2015–2016 storage season were generally lower than those of the 3-year averages for Russet Burbank, and during the 2013–14 and 2014–15 storage season, it exceeded the 0.10%FW acceptability limit.

Sucrose Concentrations

Sucrose concentrations in Mountain Gem Russet at harvest ranged from 0.09% to 0.11% FW and were similar to the 3-year average sucrose concentrations in Russet Burbank (0.11% FW) (Figure 2). In general, the seasonal pattern of sucrose concentrations in

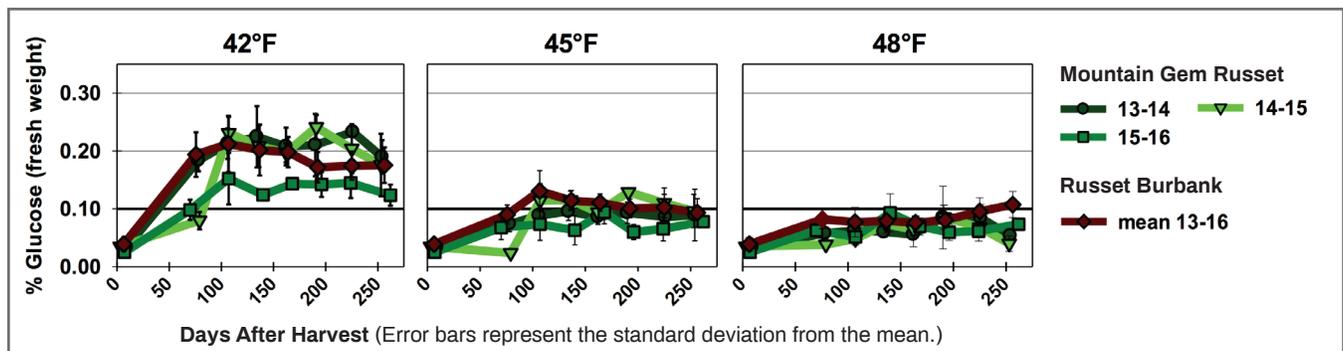


Figure 1. Mean percentage glucose (fresh weight) in Mountain Gem Russet potatoes at harvest and in storage at three storage temperatures in three storage seasons compared with Russet Burbank potatoes (3-year mean).

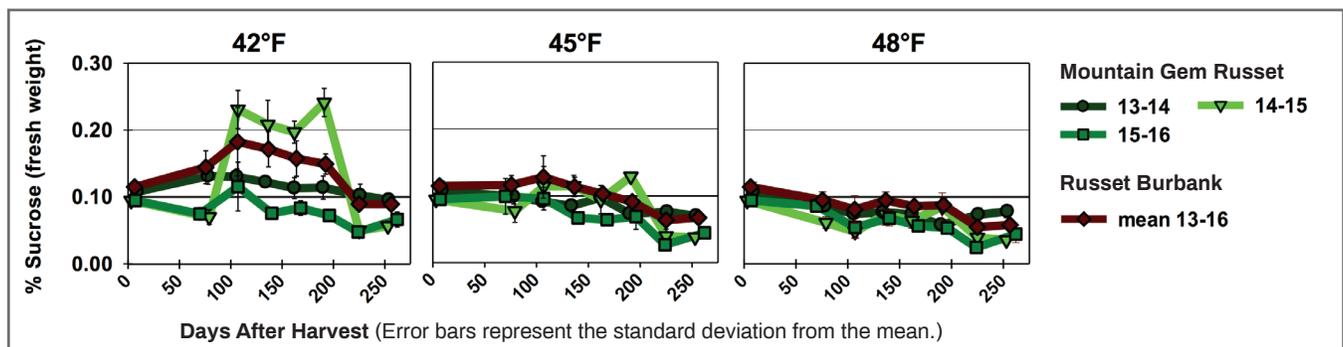


Figure 2. Mean percentage sucrose (fresh weight) in Mountain Gem Russet at harvest and in storage at three storage temperatures and three years compared to Russet Burbank (3-year mean).

Mountain Gem Russet was similar to Russet Burbank, decreasing slightly over the storage season. At 42°F, an increase in sucrose concentration in Mountain Gem Russet was observed after approximately 3 months in storage during the 2015–2016 and 2014–2015 storage seasons, and was also observed in the 3-year average for Russet Burbank. For the 2015–2016 storage season, the sucrose concentrations in Mountain Gem Russet were significantly lower than 3-year average sucrose concentrations in Russet Burbank during most of the sampling dates.

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 rating. Fry colors of USDA 2 or lower ($\geq 35\%$ reflectance) is generally considered acceptable by the frozen potato industry.

Stem-end fry color of Mountain Gem Russet was lighter than that of the 3-year average in Russet Burbank at 45°F and 48°F for all three study years during most of the sampling dates. At 42°F, fry color of Mountain Gem Russet was similar to the 3-year average fry color in Russet Burbank in two of three study years. In 2015–2016, fry color at 42°F in Mountain Gem Russet was a USDA 2 to 3 while in the other years Mountain Gem Russet and Russet Burbank, the USDA fry color was 3 to 4. This trend was observed in the glucose data as well, and highlights that growing-season effects on fry color are often detected at cooler storage temperatures (Figure 3).

- Storage at 48°F—Fry color in Mountain Gem Russet was lightest when stored at this temperature. The average fry color was less than or equal to a USDA 2 rating.
- Storage at 45°F—USDA fry color rating of Mountain Gem Russet was less than or equal to a USDA 1 during the 2015–2016 storage year and was a USDA 2 to 3 the other two study years.
- Storage at 42°F—Fry color of Mountain Gem Russet was a USDA 2 or lighter during the 2015–2016 storage year. In 2013–14 and 2014–15, stem end fry color in Mountain Gem Russet was similar to that of Russet Burbank, ranging from USDA 3 to 4 after about 2 months in storage and thus are no longer acceptable for French fry processing.

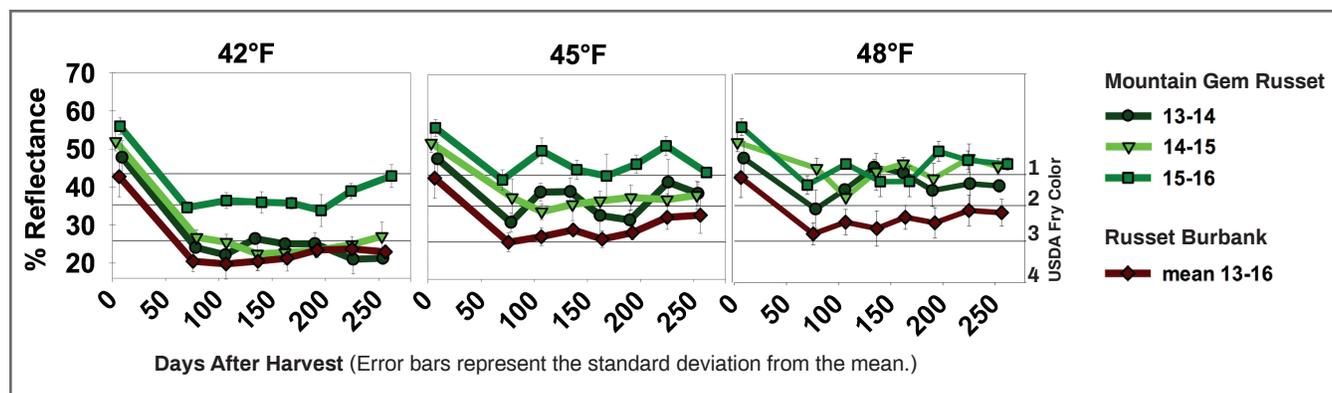


Figure 3. Mean percentage reflectance (stem end) and USDA fry color in Mountain Gem Russet potatoes at harvest and in storage at three storage temperatures in three storage seasons compared with Russet Burbank potatoes (3-year mean). The higher the reflectance reading, the lighter the fry color. Fry color of USDA 2 or lower ($\geq 35\%$ reflectance) is generally considered acceptable by the frozen process industry.

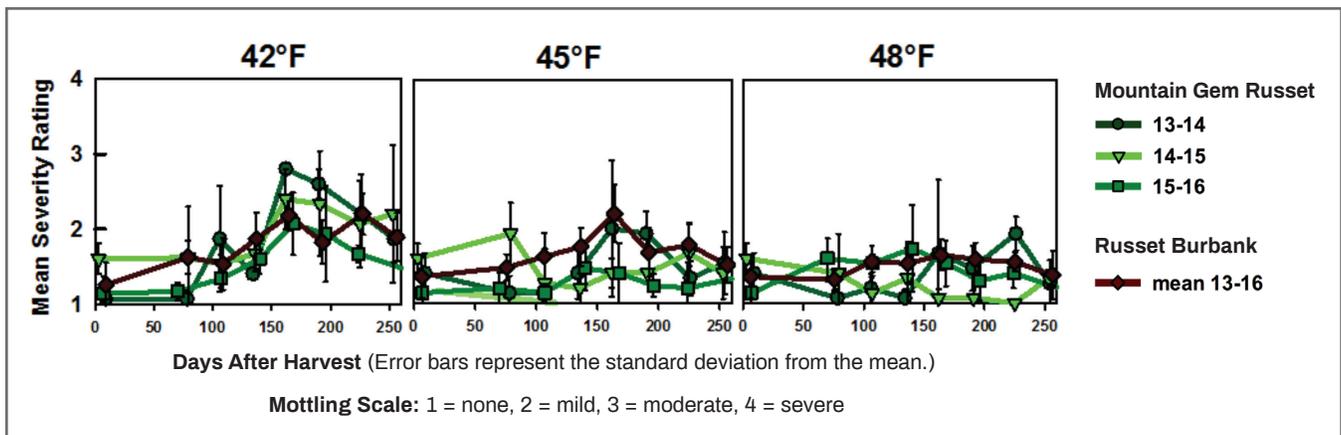


Figure 4. Mean mottling severity in Mountain Gem Russet potatoes at harvest and in storage at three storage temperatures and three years compared to Russet Burbank potatoes (3-year mean).

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 was rated as none to mild at the warmer storage temperatures of 45°F and 48°F and mild to moderate at 42°F after four months of storage in both Mountain Gem Russet and the 3-year average of Russet Burbank (Figure 4).

Fusarium Dry Rot

Because *Fusarium* dry rot is an important storage disease in potatoes, new varieties are bruised, inoculated, and screened for susceptibility to this disease. To provide an entry point for the pathogen, potatoes were first bruised and then inoculated with *Fusarium sambucinum* to evaluate dry rot susceptibility.

Results averaged over 3 years indicate that Mountain

Gem Russet and Russet Burbank have similar susceptibilities to *Fusarium* dry rot (Table 2). No significant difference was detected in percent dry rot decay or incidence. The percentage of tuber decay due to dry rot in Mountain Gem Russet was 31% with a 55% incidence (potatoes with > 5% decay), compared to 33% decay and 66% incidence for Russet Burbank. Thus, Mountain Gem Russet is classified as having moderate resistance to *Fusarium* dry rot.

Weight Loss

There were significant differences in total weight loss between varieties at 42°F and 45°F storage temperatures when averaged over three years. Mountain Gem Russet had weight loss of 8.9% at both temperatures, while Russet Burbank had 6.3% at 42°F and 6.3% at 45°F. Weight loss at 48°F was 9.5% for Mountain Gem Russet and not statistically different from Russet Burbank (7.6%) (Table 3).

Table 2. Percent decay and percent incidence of potatoes with greater than 5% decay of *Fusarium* dry rot in bruised and inoculated lots of Russet Burbank and Mountain Gem Russet potatoes. Values are means of three storage seasons (2013-16).

Variety	% Decay	% Incidence (potatoes with >5% decay)
Russet Burbank	33	66
Mountain Gem Russet	31	55
Isd (P<0.05)	ns	ns

Table 3. Mean total percent weight loss (for nine months in storage) of Russet Burbank and Mountain Gem Russet potatoes at three temperatures. Values are means of three storage seasons (2013-16).

Variety	42°F	45°F	48°F
Russet Burbank	6.3	6.2	7.6
Mountain Gem Russet	8.9	8.9	9.5
Isd (P<0.05)	1.3	2.0	ns

Storage Recommendations for Mountain Gem Russet Harvest Conditions

Pulp temperatures at harvest should be 45–65°F to minimize wounding and potential pathogen infection.

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 sprout inhibitor before dormancy break but after curing. CIPC applied at the label rate used in this study has consistently suppressed sprouting in Mountain Gem Russet for the entire length of the 8 month storage study.

Storage Duration

Mountain Gem Russet tubers may lose up to 2–3% more weight in storage than Russet Burbank over long term storage.

Fry Color and Mottling

Both fry color and fry mottling remain acceptable throughout 8 months of storage at 48°F.

Fusarium Dry Rot

Mountain Gem Russet's susceptibility to Fusarium dry rot development is similar to Russet Burbank and is moderately resistant.

References

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