

Palisade Russet: A Late Blight Resistant Potato Cultivar Having a Low Incidence of Sugar Ends and High Specific Gravity

R. G. Novy • J. L. Whitworth • J. C. Stark • B. A. Charlton • S. Yilma •
N. R. Knowles • M. J. Pavék • T. L. Brandt • S. Gupta • N. Olsen • M. Thornton •
C. R. Brown • D. L. Corsini • J. J. Pavék • S. R. James • D. C. Hane •
H. Lozoya-Saldana • M. I. Vales

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Abstract Palisade Russet is a medium-late maturing, lightly russeted potato cultivar notable for its resistance to late blight (*Phytophthora infestans*) infection of foliage and tuber. Palisade Russet is suitable for processing with low tuber glucose concentrations observed following long-term storage at a temperature as low as 5.6°C with consistently acceptable fry color scores (USDA value ≤ 2.0) following storage at temperatures of 5.6 to 8.9°C. Reducing sugars are also maintained uniformly throughout the tuber, resulting in a low incidence of sugar ends in French fries relative to standard processing cultivars such as Russet Burbank and Ranger Russet. Palisade Russet has shown high specific gravities in western production regions of the U.S. which

may limit its acceptance by the western processing industry. However, in potato production regions with inherently low specific gravities, Palisade Russet could have potential as a processing cultivar. In full-season trials conducted in Idaho, Oregon, and Washington over a 5 year period, the average total yield of Palisade Russet across all three states was very similar to yields observed for Ranger Russet and Russet Burbank. However, the U.S. No. 1 yield of Palisade Russet was 3% and 31% higher relative to Ranger Russet and Russet Burbank, respectively. In addition to late blight, Palisade Russet is also resistant to Verticillium wilt, black dot, and pink rot, and has a moderate level of resistance to net necrosis, PVY, and early blight of both the foliage and

R. G. Novy (✉) • J. L. Whitworth
U.S. Dept. of Agriculture (USDA)-Agricultural Research Service (ARS), Aberdeen Research & Extension (R & E) Center, Aberdeen, ID 83210, USA
e-mail: Rich.Novy@ars.usda.gov

J. C. Stark
Idaho Falls R & E Center, University of Idaho, Idaho Falls, ID 83402, USA

B. A. Charlton
Klamath Basin R & E Center, Oregon State University, Klamath Falls, OR 97603, USA

S. Yilma
Oregon State University, Corvallis, OR 97331, USA

N. R. Knowles • M. J. Pavék
Washington State University, Pullman, WA 99164, USA

T. L. Brandt • S. Gupta • N. Olsen
Twin Falls R & E Center, University of Idaho, Twin Falls, ID 83303, USA

M. Thornton
Southwest Idaho R & E Center, University of Idaho, Parma, ID 83660, USA

C. R. Brown
USDA-ARS, Prosser, WA 99350, USA

D. L. Corsini • J. J. Pavék
Retired from the USDA-ARS, Aberdeen, ID 83210, USA

S. R. James • D. C. Hane
Retired from Oregon State University, Corvallis, OR 97331, USA

H. Lozoya-Saldana
PICTIPAPA, Dept. of Plant Sciences, University of Chapingo, Chapingo, State of Mexico 56230, Mexico

M. I. Vales
ICRISAT, Patancheru 502 324, India

tuber. The disease resistances of Palisade Russet make it a good candidate for organic production, or for use by growers seeking reduced pesticide inputs. Palisade Russet displays a low incidence of second growth and growth cracks, especially relative to Russet Burbank, and is intermediate between Ranger Russet and Russet Burbank for incidence of hollow heart/brown center. Blackspot bruise expression for Palisade Russet is less pronounced than for either Ranger Russet or Russet Burbank, however it is slightly more susceptible to shatter bruise. Palisade Russet was released in 2011 by the USDA-ARS and the Agricultural Experiment Stations of Idaho, Oregon, and Washington, and is a product of the Pacific Northwest Potato Variety (Tri-State) Development Program.

Resumen Palisade Russet es una variedad de madurez mediana a tardía, ligeramente tipo russet, notable por su resistencia a la infección del follaje y del tubérculo al tizón tardío (*Phytophthora infestans*). Palisade Russet es deseable para proceso con concentraciones bajas de glucosa en el tubérculo, observado después de almacenamiento a largo plazo a temperatura tan baja como 5.6°C con consistentemente aceptables calificaciones de color de freído (valor USDA ≤ 2.0) después de almacenamiento a temperaturas de 5.6 a 8.9°C. También se mantienen uniformemente los azúcares reductores por todo el tubérculo, resultando en baja incidencia de azúcar en los extremos en papas a la francesa en relación con las variedades estándar de proceso, tales como Russet Burbank y Ranger Russet. Palisade Russet ha mostrado altas gravedades específicas en las regiones de producción del oeste de los E.U., lo cual puede limitar su aceptación por la industria de procesamiento del oeste. No obstante, en regiones de producción de papa con inherentes bajas gravedades específicas, Palisade Russet pudiera tener potencial como variedad de procesamiento. En ensayos de temporada completa en Idaho, Oregon y Washington en un período de cinco años, el promedio total de rendimiento de Palisade Russet a lo largo de los tres Estados fue muy similar a los observados para Ranger Russet y Russet Burbank. No obstante, el rendimiento de U.S. 1 de Palisade Russet fue 3% y 31% más alto en relación a Ranger Russet y Russet Burbank, respectivamente. Además del tizón tardío, Palisade Russet también es resistente a marchitez por *Verticillium*, mancha negra y pudrición rosa, y tiene un nivel de resistencia moderado a la necrosis, PVY y a tizón temprano, tanto en follaje como en tubérculo. Las resistencias a las enfermedades de Palisade Russet la hacen un buen candidato para producción orgánica, o para uso por productores que buscan la reducción de insumos por plaguicidas. Palisade Russet muestra baja incidencia de crecimiento secundario y de cuarteaduras, especialmente en relación a Russet Burbank, y es intermedia entre Ranger

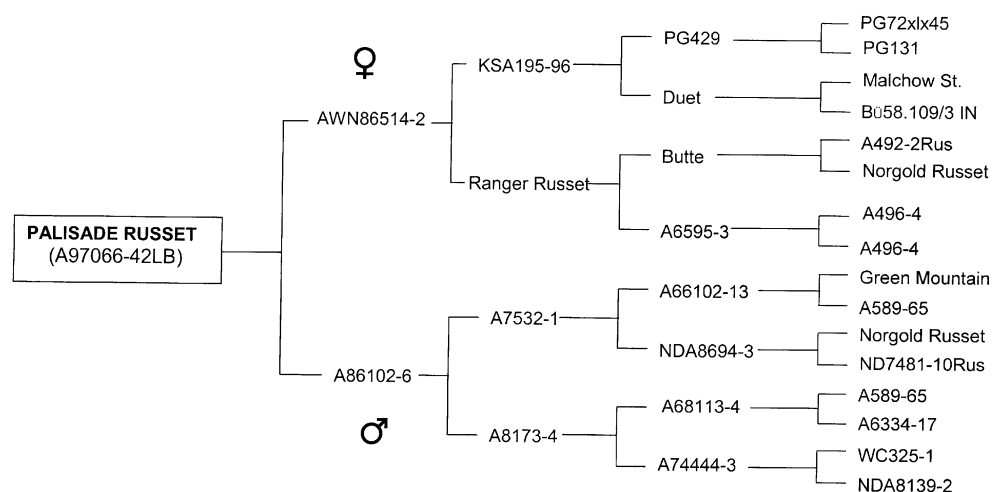
Russet y Russet Burbank en incidencia de corazón hueco o centro café. La expresión de la mancha negra por daño mecánico para Palisade Russet es menos pronunciada que para cualquiera de Ranger Russet o Russet Burbank, no obstante, es ligeramente más susceptible a rompimientos por raspaduras. Palisade Russet se liberó en 2011 por USDA-ARS y las Estaciones Experimentales Agrícolas de Idaho, Oregon y Washington, y es un producto del Programa de Desarrollo de Variedades de Papa del Pacífico Noroeste (Tri-State).

Keywords *Solanum tuberosum* · Breeding · Variety · Processing · Pink rot resistance · Black dot resistance · Verticillium wilt resistance

Introduction

Palisade Russet is a product of the cooperative Pacific Northwest Potato Variety Development Program, comprised of the USDA Agricultural Research Service and the Agricultural Experiment Stations of Idaho, Oregon and Washington. Palisade Russet originated from a hybridization made in 1997 by J.J. Pavek, USDA-Agricultural Research Service, between breeding clones AWN86514-2 (Corsini et al. 1999) and A86102-6 (Fig. 1). Potato cultivars in the pedigree of Palisade Russet include Butte (Pavek et al. 1978), Norgold Russet (Johansen 1965), Ranger Russet (Pavek et al. 1992), Green Mountain (Clark and Lombard 1946), and the European cultivars, Duet and Malchow St. (The European Cultivated Potato Database, <http://www.europotato.org/menu.php>, Accessed November 3, 2011).

In 2000, duplicate greenhouse-grown seedling tubers of Palisade Russet were grown in the field at Aberdeen, Idaho and in Toluca Valley, Mexico for evaluation for late blight response. No fungicides for the control of *Phytophthora infestans*, the causal agent for late blight, were applied during the field evaluations at Toluca Valley. The Toluca Valley is a center of diversity and putative center of origin for *P. infestans* and a resistant response to late blight is indicative of broad-spectrum resistance based on the complexity of pathotypes present. On August 29, 2000, Palisade Russet was given a late blight rating of “5” in the Toluca Valley evaluations which corresponds to 25–40% of foliage showing symptoms of late blight infection; late blight susceptible cultivar ‘Alpha’ on that same date was given ratings of “8 to 9” corresponding to 75% to 100% infection of foliage. Thirteen days later on September 11, late blight ratings for Palisade Russet remained unchanged at “5” with no additional data being provided on ‘Alpha’ by cooperators because of death of all ‘Alpha’ plants due to late blight. Based on its ratings

Fig. 1 Pedigree of Palisade Russet

in the Toluca Valley, which indicated resistance to late blight, and its good agronomic traits in the concurrent planting in the field at Aberdeen, Palisade Russet was selected for further evaluation as breeding clone A97066-42LB (prior to its naming).

Palisade Russet was subsequently evaluated as a 12-hill selection in 2001, and from 2002 through 2005 in replicated yield trials in Idaho. Palisade Russet was entered in the Tri-State Variety Trials in Idaho, Oregon, and Washington in 2006 and 2007, and subsequently advanced to the Western Regional Potato Variety Trials where it was evaluated in full-season trials in California, Colorado, Idaho, Oregon, and Washington in 2008 through 2010.

In the variety trials, total and U.S. No. 1 yields of Palisade Russet were comparable or exceeded those of check cultivars Russet Burbank and Ranger Russet, with tubers having a significantly lower incidence of sugar ends following processing into French fries. Favorable agronomic performance, late blight resistance in both the tuber and foliage, and additional resistances to Verticillium wilt, black dot, and pink rot, favored the release of Palisade Russet as a cultivar. While high specific gravities (average of 1.098) in western trial sites may limit the acceptance of Palisade Russet by the western U.S. processing industry which prefers specific gravities for processing cultivars be in the range of 1.082–1.088, Palisade Russet has potential as a late blight resistant, processing cultivar in growing environments prone to producing tubers with low specific gravities.

The name, Palisade Russet, was chosen to denote the “palisade” to late blight conferred by its resistance as well as to acknowledge the scenic Palisades reservoir which is nearby Swan Valley, Idaho—a seed production site of the Aberdeen potato breeding program. Release documents for Palisade Russet were completed in 2011.

Varietal Description

Plant and tuber descriptions of Palisade Russet were obtained from field evaluations conducted at Aberdeen, ID.

Plants (Fig. 2a)

Growth Habit: Medium-large erect vine expressing medium-late maturity. Vine architecture is closed with stems hardly visible. **Stems:** Anthocyanin pigmentation is absent with weakly prominent wings. **Leaves:** Medium-sized, yellow-green with an open silhouette, moderate pubescence, and weak anthocyanin pigmentation on the petioles. **Terminal leaflets:** Broadly ovate shape with an acute tip and cordate base; slightly wavy margins. **Primary leaflets:** Range of two to four pairs with an average of 3.0 pairs; medium ovate with an acuminate tip and cordate base. **Secondary and tertiary leaflets:** Zero to seven pairs, average of 3.1 pairs. **Stipular Leaves:** Large.

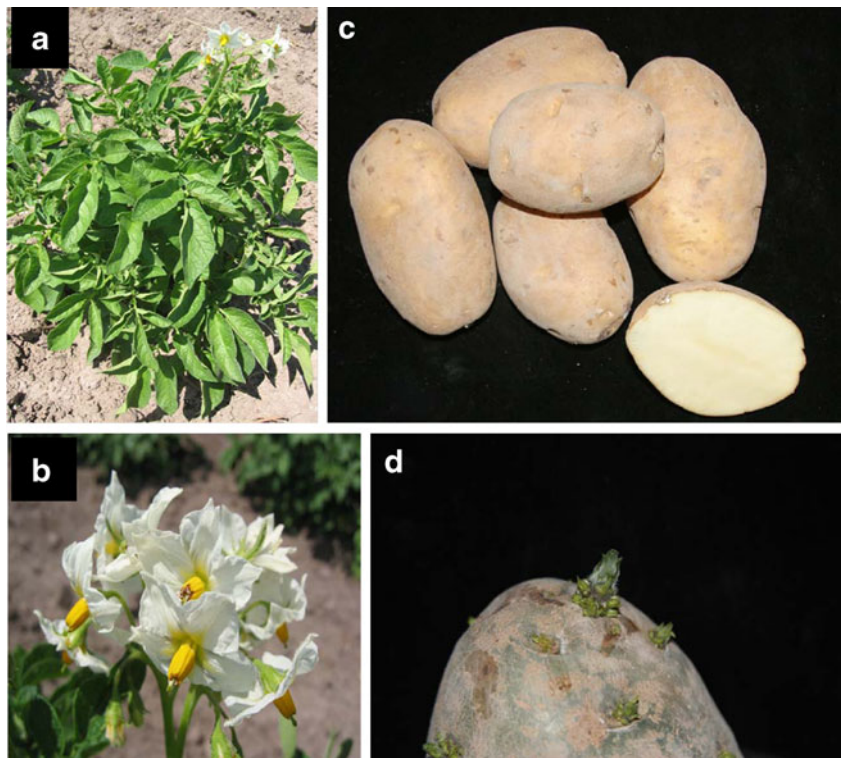
Flowers (Fig. 2b)

The number of inflorescences range from one to eight per plant (average of 3.8), with an average of 16 florets per inflorescence. **Calyx:** Anthocyanin pigmentation is absent. **Corolla:** White with semi-stellate shape. **Anthers:** Yellowish-orange with narrow cone shape. **Stigma:** Capitulate. **Pollen:** Sterile. **Female fertility:** Observed to be very good in crosses with male fertile breeding clones/cultivars.

Tubers (Fig. 2c)

Oblong, lightly russeted, with intermediate eye depth and white flesh. **Dormancy:** Three years of storage trials with no application of sprout inhibitors were conducted. The tuber dormancy of Palisade Russet averaged 40 days less than Russet Burbank across three storage temperatures. Average

Fig. 2 Palisade Russet: **a** plant, **b** inflorescence, **c** external and internal tuber appearance, and **d** light sprouts on tuber



tuber dormancies for Palisade Russet were 135, 110, and 95 days after harvest (DAH) at storage temperatures of 5.6, 7.2, and 8.9°C, respectively. Russet Burbank tuber dormancies at the same storage temperatures were 175, 155, and 130 DAH, respectively. Duration of dormancy was defined as the number of days from harvest until 80% of potatoes had at least one sprout ≥ 5 mm in length.

Light Sprouts (Fig. 2d)

Spherical shape; tip is green with a closed growth habit and weak pubescence; base of sprout shows blue-violet pigmentation that is weakly expressed with a moderate number of root initials.

Agronomic Performance

Total yield of Palisade Russet did not significantly differ from Russet Burbank or Ranger Russet in five full-season trials conducted at Aberdeen and Kimberly, Idaho; sites located within the commercial potato production regions of southern Idaho (Table 1). However, U.S. No. 1 yield and percent U.S. No. 1 yield (United States Standards for Grades of Potatoes 1997) of Palisade Russet significantly exceeded Russet Burbank by 11.1 t/ha and 20% respectively; Ranger Russet was similar to Palisade Russet for U.S. No. 1 yield and percentage No. 1 yield (Table 1). Palisade Russet had significantly higher specific gravity

than Ranger Russet and Russet Burbank. Palisade Russet had a significantly higher percentage of tubers in the 170–341 g range relative to Ranger Russet and Russet Burbank, with significantly less oversize (>341 g) tubers relative to Ranger Russet. With respect to tubers less than 169 g, percentages were similar for Palisade Russet and Russet Burbank, while Ranger Russet had significantly fewer tubers in this size category. Tuber defects (cull category) were significantly lower for Palisade Russet (9%) than for Ranger Russet (17%) and Russet Burbank (30%). Merit ratings for Palisade Russet did not differ significantly from Ranger Russet or Russet Burbank.

Palisade Russet also was evaluated over a 5 year period in trials conducted in Idaho, Oregon, and Washington (Table 2). Total yields of Palisade Russet were very similar to Ranger Russet and Russet Burbank when averaged across all three states. U.S. No. 1 yield of Palisade Russet consistently exceeded that of Russet Burbank at all locations, averaging 15.0 t/ha higher yields across all sites. Palisade Russet also exceeded the U.S. No. 1 yield of Ranger Russet at the Oregon and Washington trial sites. The percentage of total yield that could be categorized as U.S. No. 1 yield was highest for Palisade Russet at all locations. Specific gravities of Palisade Russet were consistently greater than those of Ranger Russet and Russet Burbank at all locations. Processing merit scores did not differ substantially between Palisade Russet and Ranger Russet, with both exceeding the processing merit of Russet Burbank; fresh pack merit scores were similar for all three.

Table 1 Average total yield, U.S. No. 1 yield, percent U.S. No. 1 tubers, specific gravity, tuber size distribution, merit rating, French fry color, and percentage of sugar ends of Palisade Russet, Ranger Russet,

and Russet Burbank from five full-season yield trials (125–135 days) conducted at Aberdeen and Kimberly, ID from 2003–2005

Cultivar	Yield (t/ha)		% No. 1	Specific Gravity ¹	Tuber size distribution as percent of total yield					Merit ²	Fry color ³		Fry sugar ends ⁴
	Total	U.S. No. 1			>341 g	170–341 g	114–169 g	<114 g	Cull		4.4°	7.2°	
Palisade Russet	50.1a ⁵	40.1a	80a	1.103a	18b	44a	15a	11a	9b	2.6ab	2.6a	0.9b	7b
Ranger Russet	53.7a	42.2a	78a	1.089b	34a	37b	8b	5b	17b	2.7a	3.1a	1.3ab	46a
Russet Burbank	48.8a	29.0b	60b	1.080c	16b	33b	11ab	10a	30a	1.9b	3.2a	1.5a	39a

¹ Specific gravities were determined using the weight-in-air, weight-in-water method within 1 month of harvest.² Merit ratings: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Excellent³ French fry scores rated using USDA standards, with 0 = light and 4 = dark. A rating ≤ 2.0 is an acceptable score. Tubers were evaluated following three to 6 months storage at 4.4 or 7.2°C⁴ Percentage of fries with sugar ends following storage at 7.2°C⁵ Mean values followed by the same letter are not significantly different from one another ($P < 0.05$) based on Tukey's test

In 3 years of evaluations in the Western Regional Potato Variety Trials (Table 3), Palisade Russet had lower total yield relative to Ranger Russet and Russet Burbank, but a higher U.S. No. 1 yield and percentage of U.S. No. 1 tubers relative to Russet Burbank, when averaged across all eight trial locations. The specific gravities of Palisade Russet exceeded specific gravities of Ranger Russet and Russet Burbank at all eight trial sites. Fresh and processing merit scores for Palisade Russet were similar to those of Russet Burbank, with Ranger Russet having the highest merit ratings for both fresh and processing.

Defender, a late blight resistant, processing cultivar also originating from the Aberdeen, Idaho potato breeding program, is most similar to Palisade Russet among potato cultivars (Novy et al. 2006). Late blight resistance of Defender and Palisade Russet trace back to Polish family, KSA-195 with full siblings of this family represented in the ancestry of both. Prior to its release as a cultivar in 2004, Defender was concurrently evaluated with Palisade Russet in three field trials conducted in the period of 2002 and 2003. Data from these three trials is presented in Table 4 and allows for direct comparisons of agronomic and processing characteristics between Defender and Palisade Russet, with data for Ranger Russet also being presented. While no significant differences were observed between Palisade Russet and Defender for total and U.S. No. 1 yields, Palisade Russet had a significantly higher percentage of U.S. No. 1 yield due to its significantly lower incidence of culled tubers. Statistically significant differences in all tuber size categories were also observed between the two, with Palisade Russet having a smaller percentage of tubers in the oversize class (>341 g), and a greater percentage of tubers in the 170–341 g, 114–169 g,

and <114 g size categories. Palisade Russet was also rated higher for merit than Defender, but differences were not statistically significant. With respect to processing attributes, Palisade Russet exhibited significantly better fry color following storage at 4.4°C and 7.2°C, and had a 61% reduction in sugar ends relative to Defender.

Tuber Quality Characteristics and Usage

Processing Characteristics

Palisade Russet is notable for the production of tubers with low glucose concentrations following long-term storage at temperatures as low as 5.6°C (Fig. 3b). Russet Burbank glucose concentrations exceed the acceptable level of 0.10% (Fresh weight basis) at 5.6°C prior to 75 days of storage, whereas Palisade Russet glucose concentrations remained below 0.10%, and were acceptable for processing even following 250 days of storage, indicative of its resistance to cold-induced sweetening. Of note, was that sucrose concentrations for Palisade Russet were consistently higher than those of Russet Burbank, yet glucose concentrations were consistently lower (Fig. 3a and b). The lower glucose concentrations observed in tubers of Palisade Russet correlate well with observations of a 92% reduction in basal acid invertase activity (AcInv) and the presence of A-II isozymes of UGPase relative to Russet Burbank (Gupta, unpublished data). A-II isozymes of UGPase show reduced sugar formation relative to other UGPase isozymes and acid invertase has been identified as a critical enzyme in the conversion of sucrose to reducing sugars such as glucose. Previous research has shown that potato

Table 2 Total yield, U.S. No. 1 yield, percent U.S. No. 1 tubers, tuber specific gravity, fry color, and percentage of sugar ends of Palisade Russet, Ranger Russet, and Russet Burbank in full-season irrigated trials grown in Idaho, Oregon, and Washington, 2006 to 2010¹

	ID	OR	WA	Mean
Total yield (t/ha)				
Palisade Russet	46.4	100.2	75.9	74.2
Ranger Russet	48.7	98.2	75.6	74.2
Russet Burbank	53.2	99.1	70.0	74.1
U.S. No. 1 yield (t/ha)				
Palisade Russet	36.3	88.0	67.0	63.8
Ranger Russet	38.0	81.9	66.0	62.0
Russet Burbank	31.2	59.8	55.4	48.8
% U.S. No. 1				
Palisade Russet	78	88	88	85
Ranger Russet	75	84	87	82
Russet Burbank	60	61	77	66
Specific gravity ²				
Palisade Russet	1.096	1.091	1.097	1.095
Ranger Russet	1.087	1.080	1.087	1.085
Russet Burbank	1.079	1.078	1.078	1.078
Merit Score ³ (Fresh/Processing)				
Palisade Russet	2.8/3.0	1.7/3.7	2.2/3.4	2.2/3.4
Ranger Russet	2.9/3.1	1.7/3.4	2.9/3.4	2.5/3.3
Russet Burbank	2.2/2.6	1.8/2.2	1.9/1.9	2.0/2.2
Fry color from 4.4 °C ⁴				
Palisade Russet	3.2	n.a.	2.2	2.7
Ranger Russet	3.3	n.a.	2.4	2.9
Russet Burbank	3.8	n.a.	2.8	3.3
Fry color from 7.2 °C ⁴				
Palisade Russet	0.7	1.4	0.8	1.0
Ranger Russet	0.8	1.1	0.6	0.8
Russet Burbank	0.7	1.8	1.2	1.2
% Sugar ends: 7.2 °C				
Palisade Russet	7	9	n.a.	8
Ranger Russet	24	12	n.a.	18
Russet Burbank	39	47	n.a.	43

¹ Trial locations were Aberdeen (ID), Hermiston (OR), and Othello (WA). Means represent combined data from the 2006 to 2007 Tri-State Potato Variety Trials and the 2008 to 2010 Western Regional Potato Variety Trials

² Specific gravities were determined using the weight-in-air, weight-in-water method

³ Merit ratings: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Excellent

⁴ French fry scores rated using USDA standards, with 0 = light and 4 = dark. A rating ≤ 2.0 is an acceptable score. Storage at given temperatures prior to frying was 6, 7, and 8 weeks for OR, ID, and WA, respectively. These storage durations follow standard protocols used by industry in allowing 2–3 weeks at 10 to 13°C for tuber wound healing and a 2 to 3° per week lowering of temperature to the desired holding temperature

clones having A-II isozymes of UGPase and low AcInV activity demonstrate a greater resistance to cold-induced sweetening (Gupta et al. 2008).

The lower accumulation of reducing sugars in Palisade Russet tubers is reflected in consistently, acceptable fry color scores (USDA ≤ 2.0) with a low incidence of sugar ends following storage of tubers from 5.6 to 7.2°C (Fig. 3c, Tables 1, 2, 3, 4, and 5). The cold-induced sweetening resistance of Palisade Russet did not extend to temperatures of 4.4°C, with fry color being unacceptable at this temperature (Tables 1, 2, and 4).

Fry color uniformity, measured as the difference in Photovolt light reflectance readings from the stem to bud end of tubers, is important for processing. Palisade Russet consistently displayed uniformity of fry color (≤ 9.0 reflectance unit difference) after 7 months of storage, regardless of trial site. In contrast, Ranger Russet and Russet Burbank produced non-uniform fry color with processed fries from both exceeding the 9.0 photovolt reflectance unit difference between bud and stem ends (Table 5). Fry color uniformity was also evident in the significantly lower incidence of sugar ends in fries of Palisade Russet relative to Ranger Russet and Russet Burbank, with Palisade Russet consistently having $\leq 8\%$ sugar ends in fries following storage of tubers at 7.2°C (Tables 1, 2, 4).

Following 56 days of storage at 8.9°C, the percentage of sprouted tubers and length of sprouts for Palisade Russet was intermediate to observations for Ranger Russet and Russet Burbank (Table 5). The percentage of sprouted tubers and sprout length were consistently greatest for Ranger Russet reflecting its shorter dormancy relative to Russet Burbank and Palisade Russet.

Over a 5 year period, the post-harvest process rating of Palisade Russet (rating based upon fry color, reducing sugar concentrations, tuber specific gravity, and sensory evaluations following harvest from the field without storage, and following 60 days of storage at 8.9 and 6.7°C) was superior to the ratings for Russet Burbank and similar to the ratings for Ranger Russet (Table 6). Of a possible 38 points, Palisade Russet averaged 70% of this maximum value, whereas Ranger Russet and Russet Burbank were 69% and 49% respectively, indicative of the processing merit of Palisade Russet.

Specific Gravity

The mean specific gravities of tubers of Palisade Russet in full-season trials in Idaho and other western sites ranged between 1.095 to 1.103 which were significantly greater than values for Ranger Russet and Russet Burbank (Tables 1, 2, 3, and 4). The high specific gravity of Palisade Russet across western trial sites may limit its acceptance in

Table 3 Total and U.S. No. 1 yield, percent U.S. No. 1 tubers, specific gravity, and fry color of Palisade Russet, Ranger Russet and Russet Burbank in full-season trials in the 2008 to 2010 Western Regional Potato Variety Trials¹

	CA	CO	ID			OR		WA	Mean
			1	2	3	1	2		
Total yield (t/ha)									
Palisade Russet	53.2	48.0	45.7	45.6	59.6	96.8	52.4	82.7	60.5
Ranger Russet	54.4	55.6	49.3	48.6	67.4	94.6	62.3	81.9	64.3
Russet Burbank	49.8	59.5	49.7	55.7	67.8	101.7	64.6	79.4	66.0
U.S. No. 1 yield (t/ha)									
Palisade Russet	42.2	36.5	35.6	36.0	53.9	85.0	29.5	73.9	49.1
Ranger Russet	43.6	44.8	37.9	39.1	59.2	80.0	41.0	72.0	52.2
Russet Burbank	36.9	37.9	33.6	44.7	49.3	64.0	37.4	66.0	46.2
% U.S. No. 1									
Palisade Russet	79	76	78	79	91	88	57	89	80
Ranger Russet	80	81	76	81	88	85	68	88	81
Russet Burbank	74	64	68	64	79	63	58	82	69
Specific gravity ²									
Palisade Russet	1.100	1.101	1.096	1.104	1.103	1.087	1.099	1.094	1.098
Ranger Russet	1.094	1.089	1.086	1.089	1.089	1.080	1.092	1.086	1.088
Russet Burbank	1.088	1.091	1.080	1.079	1.084	1.079	1.088	1.079	1.084
Merit Score ³ (Fresh/Processing)									
Palisade Russet	n.a.	2.7/2.0	2.5/3.0	2.2/2.6	2.2/3.3	1.7/3.7	n.a.	2.0/3.4	2.2/3.0
Ranger Russet	n.a.	4.0/3.0	2.7/3.2	3.0/3.3	3.3/4.3	1.5/3.5	n.a.	2.7/3.6	2.9/3.5
Russet Burbank	n.a.	2.7/3.0	2.4/3.0	2.0/3.0	2.7/3.9	2.0/2.5	n.a.	2.1/2.3	2.3/3.0
Fry color ⁴									
Palisade Russet	n.a.	2.3	0.7	0.7	n.a.	1.4	n.a.	0.7	1.2
Ranger Russet	n.a.	2.3	0.9	0.6	n.a.	1.0	n.a.	0.3	1.0
Russet Burbank	n.a.	1.7	0.6	0.5	n.a.	1.8	n.a.	1.0	1.1

¹ Trial locations were Tulelake (CA), San Luis Valley (CO), Aberdeen (ID-1), Kimberly (ID-2), Parma (ID-3), Hermiston (OR-1), Klamath Falls (OR-2), and Othello (WA); All sites represent 3 years of data with the exceptions of the Kimberly, ID (08 and 10 only) and Klamath Falls, OR (08 and 09 only) sites with 2 years of data.

² Specific gravities were determined using the weight-in-air, weight-in-water method

³ Merit ratings: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Excellent

⁴ French fry scores rated using USDA standards, with 0 = light and 4 = dark. A rating ≤ 2.0 is an acceptable score. Tubers were evaluated following 6 to 11 weeks storage at 7.2 °C

those growing regions, however, in regions prone to lower specific gravities, it may be a useful, disease resistant processing cultivar.

Tuber Defects

Using a five point rating scale with a value of 5.0 indicative of no defects, Palisade Russet was rated ≥ 4.5 for both growth cracks and second growth (Table 7) during 5 years of evaluations in both the Tri-State and Western Regional Potato Variety Trials. This low incidence of external defects has contributed to its higher U.S. No. 1 yield relative to Russet Burbank, whereas Ranger Russet is similar to Palisade Russet for external defects and percent U.S. No. 1 yield. Palisade Russet is intermediate between Ranger Russet

and Russet Burbank for incidence of hollow heart/brown center and internal brown spot, and is similar to them in susceptibility to net necrosis/vascular discoloration (Table 7). Palisade Russet appears to be slightly more susceptible to shatter bruise than the check cultivars, but less susceptible to blackspot bruise. Tuber shrinkage of Palisade Russet averaged across storage temperatures of 5.6°, 7.2°, and 8.9°C over a 2 year period of evaluation was 2.9% greater than that of Russet Burbank (Table 7).

Disease and Pest Responses

Methodology Evaluations of disease responses for Palisade Russet were based on data collected from replicated field trials

Table 4 Average total and U.S. No. 1 yield, percent U.S. No. 1 tubers, specific gravity, tuber size distribution, merit rating, French fry color, and percentage of sugar ends of Palisade Russet, Defender, and

Ranger Russet from three full-season yield trials (125–135 days) conducted at Aberdeen, ID from 2002–2003

Cultivar	Yield (t/ha)		% No. 1	Specific Gravity ¹	Tuber size distribution as percent of total yield					Merit ²	Fry color ³		Fry sugar ends ⁴
	Total	U.S. No. 1			>341 g	170–341 g	114–169 g	<114 g	Cull		4.4°	7.2°	
Palisade Russet	47.5a ⁵	39.4a	83a	1.098a	24b	44a	15a	11a	6b	2.6a	2.1b	0.8b	7b
Defender	50.7a	38.3a	76b	1.091ab	36a	30b	10b	8b	17a	2.0ab	2.6a	1.5a	18b
Ranger Russet	52.6a	43.7a	83a	1.086b	43a	31b	8b	4b	14a	1.9ab	2.6a	1.2ab	49a

¹ Specific gravities were determined using the weight-in-air, weight-in-water method within 1 month of harvest

² Merit ratings: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good, 5 = Excellent

³ French fry scores rated using USDA standards, with 0 = light and 4 = dark. A rating ≤ 2.0 is an acceptable score. Tubers were evaluated following 3 months storage at 4.4 or 7.2°C

⁴ Percentage of fries with sugar ends following storage at 7.2°C

⁵ Mean values followed by the same letter are not significantly different from one another ($P < 0.05$) based on Tukey's test

conducted for a minimum of 2 years. *Verticillium* wilt (*Verticillium dahlia*) evaluations were conducted at Aberdeen,

Idaho using naturally occurring inocula and protocols described by Corsini et al. (1988). Common scab

Fig. 3 a and b Tuber sucrose and glucose concentrations, and c. fry colors (% reflectance) of Palisade Russet over a two-year period relative to Russet Burbank, following 0 to 250 days of storage at 5.6, 7.2, and 8.9°C; tubers were from research plots at Kimberly, ID. These three storage temperatures reflect an initial storage of harvested tubers for 14 days at 12.8°C followed by an incremental lowering of the temperature by 0.28°C per day until the three storage temperatures were reached. Sugar concentrations and fry colors of Russet Burbank represent a 2 year average. Fry colors with Photovolt light reflectance readings of ≥ 35 and USDA ratings of ≤ 2.0 are considered acceptable

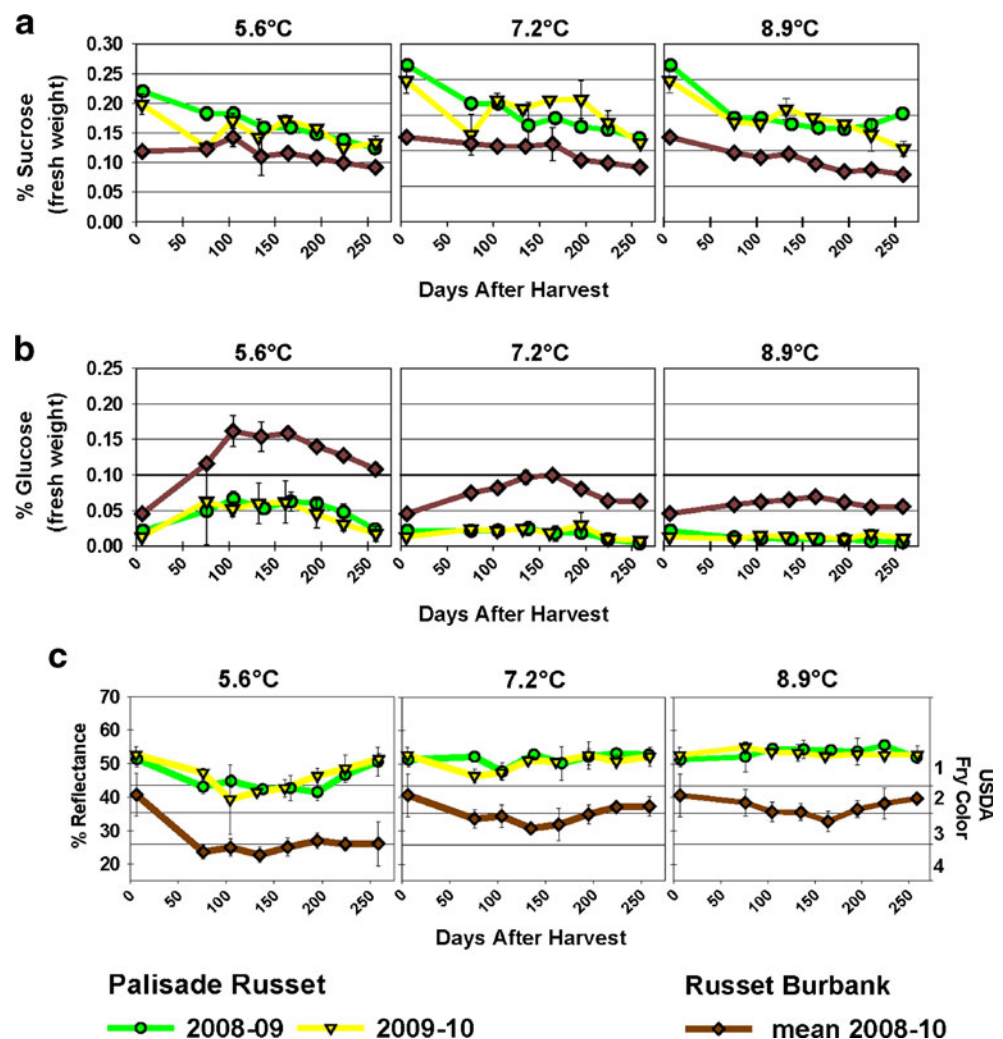


Table 5 Post-harvest ratings of Palisade Russet, Ranger Russet, and Russet Burbank following 7 months of storage (3 months at 8.9°C and 4 months at 6.7°C)

Location/Cultivar	Photovolt Reading ¹			Difference ² : Stem –vs- Bud	USDA Color rating ³	% Reducing sugars ⁴			Tuber Sprouting ⁵	
	Stem	Bud	Avg.			Stem	Bud	Avg.	% of Tubers	Sprout Length (mm)
Washington										
Palisade Russet	41.0	45.5	43.3a	5.9b	0.0	0.71	0.60	0.66	12b	1.9
Ranger Russet	30.1	41.5	35.8b	11.7a	0.8	1.49	0.72	1.10	81a	12.1
Russet Burbank	32.8	41.8	37.3b	9.6ab	0.3	1.21	0.68	0.95	0b	0.0
Idaho										
Palisade Russet	43.8	45.5	44.6a	3.5b	0.0	0.60	0.57	0.58	15b	4.4
Ranger Russet	35.8	42.9	39.3b	9.3a	0.0	0.96	0.63	0.79	73a	5.1
Russet Burbank	30.6	40.3	35.5c	11.3a	0.5	1.37	0.72	1.05	0c	0.0
Oregon										
Palisade Russet	36.4	43.1	39.8a	7.6b	0.0	0.94	0.62	0.78	23b	2.5
Ranger Russet	25.3	39.3	32.3b	14.0a	1.3	1.97	0.77	1.37	92a	15.2
Russet Burbank	22.3	40.7	31.5b	18.4a	1.8	2.33	0.70	1.52	3c	0.6

All post-harvest evaluations and ratings were conducted at Pullman, WA using tubers harvested from 2006–2009 trials at Aberdeen, ID, Hermiston, OR, and Othello, WA

¹ Fries (0.95 cm x 2.87 cm) were fried at 191°C for 3.5 min and color was measured with a Photovolt reflectance meter (model 577, Photovolt Instruments Inc., Minneapolis, MN) within 3 min of removal from oil. A Photovolt light reflectance reading of ≤19 is considered unacceptably dark (see note 3 below). Within a state, means followed by different letters differed significantly (LSD, $P < 0.05$)

² A difference ≥9 Photovolt light reflectance units between bud and stem end constitutes non-uniform fry color. Values represent an average of actual Photovolt differences in each of 4 years and therefore do not relate directly to averaged stem and bud values listed in the table.³ USDA color (0 = light and 4 = dark) ratings were assigned based upon Photovolt light reflectance readings of the darkest ends of fries (typically stem ends); Photovolt readings ≥31=USDA 0, 25–30=USDA 1, 20–24=USDA 2, 15–19=USDA 3, ≤14=USDA 4. Data are averaged over years

⁴ Glucose+Fructose (dry matter basis) were estimated from an algorithm relating fry color to percent reducing sugars assayed by the dinitrophenol method of Ross (1959). Acceptable values for processing are ≤2.6%

⁵ Sprouting was measured following 56 days of storage at 8.9°C

(*Streptomyces scabies*) was evaluated on tubers collected from three replicates from field trials arranged in a randomized complete block (RCB) using naturally occurring inocula at Aberdeen, Idaho. Palisade Russet also was evaluated for common scab response at Becker, Minnesota and Presque Isle, Maine as described by Haynes et al. (2010). Early blight (*Alternaria solani*) foliar evaluations were conducted at Aberdeen, Idaho and Hancock, Wisconsin and were based on visual estimates of the amount of leaf area infected in three replicate plots of a RCB design. Tuber evaluations for early blight were conducted using tubers harvested from plants used in assessing foliar resistance; following 3.5 months of storage at 10°C, tubers were evaluated for early blight tuber lesions.

Late blight (*Phytophthora infestans*) field evaluations were conducted at Corvallis, Oregon as described by Mosley et al. (2003) and in the National Late Blight Germplasm Evaluation Trials as described by Haynes et al. (2002). Tuber inoculation to assess late blight response also were conducted by Dr. Walt Stevenson and Vaughan James, University of Wisconsin-Madison in 2003–2006 with the protocol consisting of three replicates of five tubers being inoculated over the 4 years

Table 6 Mean post-harvest ratings¹ of Palisade Russet, Ranger Russet, and Russet Burbank in full-season trials in the 2006–2010 Tri-State and Western Regional Potato Variety Trials

	Washington	Idaho	Oregon	Mean
Palisade Russet	27.0	29.1	23.8	26.6
Ranger Russet	27.1	31.0	20.8	26.3
Russet Burbank	22.3	19.8	13.6	18.5

Post-harvest evaluations and ratings were conducted at Pullman, WA using tubers produced in trials at Aberdeen, ID, Hermiston, OR, and Othello, WA

¹ Values were assigned based on the sum of individual ratings for fry color from the field, after storage at 8.9 and 6.7°C (56 days) (0–5 scale, 1 = dark, 5 = light), reducing sugar concentrations following 56 days storage at 8.9 and 6.7°C (1–5 scale, 1 = high, 5 = low), specific gravity (0–5 scale, 1 = low, 5 = high), and average sensory evaluations by taste panels (1–5 scale, 5 = best). With three fry color ratings (field, 8.9° and 6.7°C), two reducing sugar concentration ratings (8.9 and 6.7°C), and 1 rating each for specific gravity and sensory evaluation, a maximum rating of 35 could be obtained if the most favorable score (5) is given in each of the seven total ratings. An additional 3 points could be added for high fry color uniformity, resulting in a maximum possible value of 38. Higher values are indicative of superior post-harvest attributes

Table 7 Evaluation of internal and external defects of Palisade Russet, Ranger Russet, and Russet Burbank in Tri-State and Western Regional Trials (2006–2010)

	Growth	Second	Shatter	Hollow	% Internal	% Net necrosis/	Blackspot	Tuber
Cultivar	cracks ^{1,3}	growth ^{1,4}	bruise ^{1,5}	heart/BC ^{2,6}	brown Spot ⁷	Vasc. discol. ⁸	bruise ^{1,9}	shrinkage ¹⁰
Palisade Russet	4.6	4.5	4.0	1.6	1.2	3.0	4.1	7.9
Ranger Russet	4.4	4.6	4.7	0.2	0.5	5.7	3.3	n.a.
Russet Burbank	3.5	3.6	4.7	9.6	2.3	3.0	3.6	5.0

¹ Rated using a 1–5 scale with 1 = severe and 5 = none observed

² Rated as the percentage of tubers >341 g with hollow heart and brown center

³ Average of 38 ratings

⁴ Average of 33 ratings

⁵ Average of 27 ratings

⁶ Average of 41 ratings

⁷ Average of 36 ratings

⁸ Average of 30 ratings

⁹ Average of 23 ratings

¹⁰ Value is percent weight loss following 9 months of storage in 2008 to 2010 (2 years of storage data). Value reflects an average across three storage temperatures of 5.6, 7.2, and 8.9°C conducted at Kimberly, ID

with 1.7×10^4 to 1.2×10^5 sporangia /ml of a US-8 genotype of *P. infestans*. Four shallow wounds (2 mm diameter, 2 mm deep, spaced 2 cm apart on a line) were made on each tuber and a 10 µl drop placed on each wound site. Tubers were then stored 68–70 h at 22°C and 100% relative humidity and were then transferred and stored for approximately 2 weeks at 13°C and 90% relative humidity prior to assessing the incidence of infection (the number of inoculation sites with symptoms) and the severity of infection.

Pink rot (*Phytophthora erythroseptica*) tuber inoculations and evaluations conducted at Wisconsin were identical to the protocols described for late blight with the following exceptions: Inoculations consisted of 3.4 to 8.4×10^4 zoospores/ml and following inoculation and storage for 68–70 h at 22°C and 100% relative humidity, were then transferred and stored for approximately 1 week at 22°C prior to assessing the incidence and severity of pink rot infection. The severity of black dot (*Colletotrichum coccodes*) colonization of aboveground stems was assessed as described by Nitzan et al. (2009). Evaluations of potato leafroll virus (PLRV), potato virus Y (PVY), and potato virus X (PVX) resistances were conducted at Kimberly, Idaho using virus-infected spreader rows as described by Corsini et al. (1994). Corky ringspot (tobacco rattle virus) evaluations were conducted in the Columbia Basin of Washington and Oregon using protocols described by Brown et al. (2000). Storage disease evaluations were performed as described by Corsini and Pavék (1986). Columbia root-knot nematode (*Meloidogyne chitwoodi*) evaluations were conducted in the Columbia Basin using methods described in Brown et al. (2006).

Disease and Pest Response Palisade Russet is notable for its resistance to foliar and tuber late blight, Verticillium wilt, pink rot, and black dot (Tables 8, 9, and 10). It is moderately resistant to early blight of foliage and tuber, net necrosis, and PVY and is considered susceptible to Columbia root-knot nematode, common scab, corky ringspot, PVX, PLRV, and soft and dry rots; levels of susceptibility to these pests and diseases are given in Table 8.

The AUDPC for foliar late blight of Palisade Russet was 28 to 29% of the values observed for Ranger Russet and Russet Burbank, respectively with Palisade Russet also showing statistically less tuber infection than Ranger Russet (Table 9). While statistically significant differences for tuber late blight infection were not observed between Palisade Russet and Russet Burbank in Corvallis field trials (Table 9), stringent late blight tuber inoculations conducted by University of Wisconsin researchers from 2003 to 2006 supports its classification as resistant to tuber late blight; data can be found at: http://www.plantpath.wisc.edu/wivegdis/contents_pages/earlier_reports.html (Accessed November 3, 2011), with each of the 4 years having tuber late blight resistance data. National Late Blight Germplasm Evaluation Trials conducted over a 3 year period at North Dakota, Pennsylvania, Oregon, and Minnesota consistently had Palisade Russet ranked among the top 25% for resistance to foliar late blight with AUDPC values that averaged 24% of the AUDPC maximum (most susceptible value) across the 12 trials (Table 10). The foliar and tuber resistance to late blight of Palisade Russet coupled with its resistances to Verticillium wilt, pink rot, black dot, early blight, net necrosis, and PVY makes it a good candidate for organic production and for commercial potato growers seeking more sustainable production with reduced pesticide inputs.

Table 8 Disease and pest response of Palisade Russet relative to Ranger Russet and Russet Burbank¹

Cultivar	Early Blight				Late Blight		Symptoms of Virus Infection			Viruses		Storage Diseases		
	Vert. Wilt	Pink Rot	Black Dot ²	Root Knot Nem.	Com. Scab	Foliar	Tuber	Net Necrosis	Corky Ringspot	PVX	PVY	PLRV	Soft Rot	Dry Rot
Palisade R.	R	R	R	S	MS	MR	MR	MR	S	VS	MR	VS	MS	S/MS ³
Ranger R.	MR	–	–	S	S	S	VS	MS	S	R	MS	S	MS	MS
R. Burbank	S	S	S	S	MR	S	S	S	S	VS	S	VS	S	S

¹ Responses of Palisade Russet to diseases were based on a minimum of 2 years of controlled field evaluations; the exceptions being tuber inoculations for late blight and pink rot of field grown tubers conducted at Wisconsin represent controlled lab assessments. Responses were defined as very resistant (VR), resistant (R), moderately resistant (MR), moderately susceptible (MS), susceptible (S), and very susceptible (VS). Disease evaluations were conducted at the following locations: Verticillium wilt—Aberdeen, ID; Pink Rot—Madison, WI; Root Knot Nematode, Corky ringspot—Prosser, WA; Common scab—Aberdeen, ID; Presque Isle, ME, Becker, MN; Early blight—Aberdeen, ID and Hancock, WI; *Pectobacterium* (*Erwinia*) soft rot, *Fusarium* dry rot—Aberdeen, ID; Viruses and net necrosis—Kimberly, ID; Late blight—Corvallis, OR (2006–2010) and tuber inoculations at Madison, WI (2003–2006)

² The disease severity index (DSI) for black dot (in parentheses) was calculated following the formula: $DSI = \{\sum (\text{segment height in centimeters})^2 (0 \text{ or } 1)\} / (\text{Max DSI value})$. The values 0 and 1 represented the colonization outcome, where 0 = not colonized at all and 1 = maximum colonization. The determination of black dot disease ratings was based on field testing at Moses Lake, WA in 2009 and 2010 with Palisade Russet and Russet Burbank having DSI values of 0.14 and 0.50 respectively

³ S for *Fusarium sambucinum* and MS for *F. solani* var. *coeruleum*. Other check cultivars showed approximately equal resistance responses for both *Fusarium* species

Table 9 Foliar and tuber data for late blight infection of Palisade Russet, Ranger Russet, and Russet Burbank from US-8 inoculated trials conducted at Corvallis, Oregon from 2006 to 2010, with no fungicides applied for the control of late blight

	AUDPC ¹	Tuber % ²
Palisade Russet	322.1b	3.1b
Ranger Russet	1144.7a	31.5a
Russet Burbank	1126.2a	6.3b

¹ Foliar area under the disease progress curve

² Percent tuber rot resulting from infection by late blight

³ Mean values followed by the same letter are not significantly different from one another ($P < 0.05$) based on Tukey's test

Biochemical and Nutritional Characteristics

Tubers of Palisade Russet, Ranger Russet, and Russet Burbank, grown at Aberdeen, ID, were analyzed 6 weeks after harvest over a five-year period to assess biochemical and nutritional components (Table 11). The high specific gravity of Palisade Russet was also reflected in a high dry matter percentage of 23.6%, which was 1.7% and 3.4% greater than values for Ranger Russet and Russet Burbank, respectively.

Sucrose percentages for Palisade Russet were half the levels observed in Ranger Russet and Russet Burbank, respectively, whereas glucose concentrations were higher. This is contradictory to observations from long term storage (Figs 3a and b), but values also represent only 6 weeks storage rather than the longer term storage data presented in Figs. 3a and b.

Protein concentrations in tubers of Palisade Russet were comparable to Ranger Russet and higher than Russet Burbank. Vitamin C content of Palisade Russet was lower than either of the check cultivars. Total glycoalkaloids for Palisade Russet were 5.3 mg/100 g tuber fresh weight, which was slightly greater than those of the check cultivars, but far below the critical threshold of 20 mg/100 g tuber fresh weight.

Storage Observations

Over a 2 year period, tubers of Palisade Russet and Russet Burbank were evaluated for response to *Fusarium* dry rot. Tubers were bruised and inoculated with a 50/50 mix of Thiabendazole resistant: susceptible strains of *F. sambucinum* and then were cured at 12.8°C and 95% relative humidity for 2 weeks. Tubers were stored at 7.2°C for approximately 3 months and then evaluated for the percentage of tuber tissue displaying dry rot decay and the incidence of the disease, expressed as the percentage of tubers having >5% decayed

Table 10 Foliar late blight data for Palisade Russet from three locations of the National Potato Late Blight Trials, 2007–2009

	North Dakota			Pennsylvania			Oregon			Minnesota		
	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
AUDPC ¹	204	344	590	185	38	84	199	638	403	722	198	519
Clone Rank ²	2/20	1/40	8/48	5/24	9/40	8/50	2/23	9/40	6/49	2/21	6/40	6/49
AUDPC Minimum	183	344	246	27	8	15	48	171	92	170	29	158
AUDPC Median	705	732	1286	573	315	337	1297	855	930	1519	1044	1757
AUDPC Maximum	719	1495	2353	1038	867	1270	1330	1182	1193	1888	1927	1827

¹ Area under the disease progress curve

² Rank among number of trial entries, with 1 being the most highly resistant to late blight

Data for National Potato Late Blight Trials can be accessed at: <http://www.ars.usda.gov/Services/docs.htm?docid=19450> (Accessed November 3, 2011). Genotypes of *P. infestans* used at each location in each year are detailed in the reports

tissue. The mean percentage of tissue decay for Palisade Russet was 33% while that of Russet Burbank was 18%. The percent incidence of potatoes with at least 5% decay was also significantly higher in Palisade Russet (94%) than in Russet Burbank (71%). Dry rot tests done with one *F. sambucinum* isolate at Aberdeen, Idaho corroborates the classification of Palisade Russet as susceptible to *F. sambucinum*. However, Palisade Russet is only moderately susceptible to dry rot caused by *F. solani* var. *coeruleum* (Table 8). On the basis of these results, additional care during harvest and handling is recommended for Palisade Russet to mitigate wounding that allows for entry and infection of tubers by *Fusarium*.

Tuber dormancy length of Palisade Russet is approximately 40 days shorter than Russet Burbank when held at storage temperatures ranging from 5.6 to 8.9°C. Treatment for sprout inhibition with chlorpropham should be made after wound healing, but within the first 2 months of storage if storing at relatively warmer temperatures of 7.2 to

8. 9°C. Following 9 months of storage at temperatures of 5.6 to 8.9°C, Palisade Russet displayed significantly greater tuber shrinkage or percent weight loss than Russet Burbank, averaging 2.9% greater shrinkage. Storage temperature recommendations for fresh market use of Palisade Russet are from 5.6 to 7.2°C. Palisade Russet can be successfully stored for fresh market up to 9 months with minimal degradation in quality and in the absence of problematic disease development within the storage.

Palisade Russet has excellent processing qualities as previously outlined in the section on processing characteristics. While sucrose percentages over 2 years of evaluations were higher than for Russet Burbank during long-term storage (Fig. 3a), glucose percentages were consistently lower than Russet Burbank following 250 days of storage at 5.6°, 7.2° and 8.9°C, and well below the 0.10% threshold above which fry color becomes unacceptable (Fig. 3b). Fry color is lightest (USDA 1 or lighter) at 7.2 and 8.9°C

Table 11 Biochemical analyses of Palisade Russet, Ranger Russet, and Russet Burbank tubers from Tri-State and Western Regional Trials (2006–2010) conducted at Aberdeen, ID¹

Cultivar	Dry matter (%)	Sucrose ³ (% FWB ²)	Glucose ³ (% FWB ²)	Protein ⁴ (% DWB ²)	Vitamin C ⁵ (mg/100 g FWB ²)	Total Glycoalkaloids ⁶ (mg/100 g FWB ²)
Palisade Russet	23.6	0.04	0.21	5.3	18.0	5.3
Ranger Russet	21.9	0.08	0.17	5.4	28.2	3.0
Russet Burbank	20.2	0.08	0.13	4.7	20.2	3.3

¹ Analyses were conducted on freeze-dried tuber tissue at Aberdeen, ID; tissue was taken from tubers stored at 7.2°C for 6 weeks following their harvest

² FWB = Fresh Weight Basis; DWB = Dry Weight Basis; Sucrose and glucose values of 0.15% and 0.10% respectively are maximum values for acceptable fry color in this evaluation, with glucose being the greater contributor to fry color

³ Sugar concentrations were calculated according to: Glucose and sucrose measurements in potatoes, Application Note No. 102, Scientific Division, Yellow Springs Instrument Co., Yellow Springs, Ohio 45387

⁴ Protein content was determined using a Coomassie blue protein assay developed from the protocol of Bradford (1976)

⁵ Vitamin C (ascorbic acid) content in tubers was determined using a microfluorometric method detailed in the Official Methods of Analysis Handbook, 14th edition, sections 43.069–43.075

⁶ Total glycoalkaloids was determined using the protocol of Bergers (1980)

storage temperatures with the 8.9°C temperature ameliorating seasonal variability in sugar content and fry color. Mottling, a dark, uneven coloration which can occur in fried products, was occasionally observed in Palisade Russet tubers held at 5.6°C, but was not observed at 7.2 and 8.9°C storage temperatures. Although there is a limited occurrence of mottling, periodic observations were made of slightly darker fry color areas scattered throughout the tuber, oftentimes giving what can be best described as a translucent “blotchy” appearance to the fry; the cause of this not being known. The infrequent occurrence of this phenomenon and its minimal impact on fry quality does not seem to warrant undue concern, but authors felt it should be noted. For the frozen processing market, it is recommended to store Palisade Russet at 7.2 to 8.9°C for optimum processing quality unless a known stress occurred during the growing season that may warrant consideration of slighter higher temperatures.

Seed Availability

Seed for research purposes can be obtained by contacting Richard Novy or Jonathan Whitworth, USDA-ARS, Aberdeen, Idaho. Pathogen-free tissue culture plantlets of Palisade Russet are also maintained by Lorie Ewing, Manager of the Potato Tissue Culture Lab, University of Idaho, Moscow, Idaho. An application for plant variety protection (PVP) will be submitted for Palisade Russet.

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