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Cultural Management of Clearwater Russet Potatoes

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Cultural Management

CLEARWATER RUSSET is a medium-late-maturing, dual purpose, russet-skinned potato variety. It is notable for its large total and US No. 1 yields and excellent processing quality compared to industry standard Russet Burbank (Table 1). Clearwater Russet exhibits cold-sweetening resistance and can be stored long-term at a temperature of 45°F while maintaining fry-processing colors ≤1 on the United States Department of Agriculture (USDA) Fry Color Scale.

Clearwater Russet resulted from a 1995 cross made between Bannock Russet and the breeding clone A89152-4. It was released in 2008 by the agricultural experiment stations of Idaho, Washington, Oregon, and the USDA Agricultural Research Service. It is a product of the Pacific Northwest Variety Development Program (Tri-State). Since its release, acres planted to Clearwater have risen dramatically, especially due to its acceptance in 2016 as a McDonald's-approved variety.

In addition to management studies conducted at the agricultural experiment stations in the Pacific Northwest, growers and processors have made additional observations that may aid in establishing best management practices for growing this variety. Growers in this region and other regions may find these studies, commercial observations, and recommendations useful as they begin growing Clearwater Russet in their individual production areas.

Growth and Development

Compared to Russet Burbank, Clearwater Russet tends to have a slower emergence and rate of vine development early in the season, which is also reflected in late plant maturity and timing of senescence. Tuber bulking also tends to start later in Clearwater Russet, but the bulking rate is high late in the season, allowing Clearwater Russet to produce relatively high yields under moderate- to long-growing seasons.

Seed Size, Spacing, and Other Planting Considerations

Optimal seed piece size for Clearwater Russet is 2–3 ounces with seed pieces planted 6–8 inches from the top of the seed piece to the top of the hill. Clearwater Russet produces approximately 1–2 more tubers per plant than Russet Burbank, which is often planted at an in-row spacing of 12 inches. In general, in-row spacing for Clearwater Russet should range 10–13 inches for fresh pack or processing depending on the required size profile. Dry-rot potential should be evaluated prior to planting and infected seed lots should be treated with an appropriate fungicide or be rejected, depending on the level of infection. Take care to avoid spreading any dry-rot infection to uninfected tubers.

Disease Response

In contrast to Russet Burbank and Ranger Russet, Clearwater Russet is resistant to tuber late blight (Table 2). Clearwater is susceptible to Fusarium dry rot with reports of stand reductions in commercial fields of up to 60%. Similar to Russet Burbank and Ranger Russet, Clearwater Russet has some level of susceptibility to early blight (*Alternaria solani)*, foliar late blight (*Phytopthora infestans*), symptoms of corky ringspot, soft rot (*Pectobacterium* spp.), potato leaf roll virus, and root knot nematode. Other disease responses are similar to Russet Burbank, except that Clearwater Russet has a higher susceptibility to Pythium Leak and pink eye disorder and a moderate resistance to Verticillium wilt.

Clearwater Russet exhibits unique responses to PVY (potato virus Y) strains O, NTN, and N-Wi. Phenotypically, Clearwater plants remain healthy when exposed to PVY^{O}, indicative of a resistance to systemic infection. Similar to Ranger Russet and Russet Burbank, Clearwater Russet is fully susceptible to PVY^{NTN} and, unlike Russet Burbank and Ranger Russet, shows a partial resistance to $PVY^{N\text{-}Wi}$. Foliar symptoms of PVY^{NTN} include regular mosaic symptoms with no necrotic reactions of any sort. Clearwater Russet plants infected with $PVY^{N\text{-}Wi}$ may exhibit foliar symptoms, including veinal necrosis, necrotic spots, lower leaf necrosis, and leaf drop.

Table 1. Average total and US No. 1 yields, percent US No. 1, specific gravity, tuber size distribution, fry color, and percent sugar ends for Clearwater Russet, Ranger Russet, and Russet. Burbank from seven full-season yield trials (125–135 days) conducted at Aberdeen and Kimberly, Idaho, from 1999 to 2002 (Novy et al. 2010).

Cultivar	Yield (cwt/a)		% No. 1	Specific Gravity	Tuber Size Distribution (% of total yield)					Fry Color[a]		% Sugar ends
	Total	No. 1			Culls	<4 oz	4–6 oz	6–12 oz	>12 oz	40°F	45°F	45°F
Clearwater Russet	457a[b]	386a	84a	1.085a	6a	9a	16a	41a	28ab	1.9a	0.4a	11a
Ranger Russet	476a	368a	78a	1.087a	17ab	5a	7b	36a	35a	2.8b	1.0b	24a
Russet Burbank	443a	275b	63b	1.075b	28b	10a	11ab	30a	21b	3.0b	1.1b	19a
LSD (0.05)	ns	63	9.6	0.005	13.7	ns	8.6	ns	14.0	0.81	0.50	ns

LSD, Least Significant Difference.

[a]*French fry scores rated using USDA standards, with 0 = light and 4 = dark. A rating of ≤ 2.0 is an acceptable score. Tubers were evaluated following 3–6 months of storage at 40°F or 45°F.*

[b]*Mean values followed by the same letter are not significantly different from one another (P < 0.05).*

Table 2. Disease susceptibility and resistance of Clearwater Russet, Ranger Russet, and Russet Burbank to several potato diseases and pests (Novy et al. 2010). PVX, potato virus X; PVY, potato virus Y; PLRV, potato leaf roll virus.

Disease	Clearwater Russet	Ranger Russet	Russet Burbank
Verticillium wilt (*Verticillium*)	MR	MR	S
Foliar early blight (*Alternaria*)	S	S	S
Tuber early blight (*Alternaria*)	MS	MS	MS
Late blight (*Phytopthora*)	S	S	S
Late blight (tuber)	R	VS	S
Common scab (*Streptomyces*)	MR	S	MR
Corky ringspot	S	S	S
Root knot nematode	S	S	S
Dry rot (*Fusarium*)	S	MS	S
Dry rot (*F. solani var. coeruleum*)	MS	MS	S
Soft rot (*Pectobacterium*)	S	MS	S
PVX	R	R	VS
PVY^{O}	R[a]	MR	S
PVY^{NTN}	S	S	S
$PVY^{N\text{-}Wi}$	MR	S	S
PLRV foliar infection	VS	S	VS
PLRV net-necrosis/ serious defect[b]	S	MS	S

Responses of Clearwater Russet to diseases were based on a minimum of two years of controlled field evaluations. Responses were defined as 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, Idaho, and Hermiston, Oregon; root knot nematode, corky ringspot–Prosser, Washington; common scab–Aberdeen, Idaho, Presque Isle, Maine, Becker, Minnesota, and Antigo, Wisconsin; early blight, Pectobacterium (Erwinia) soft rot, Fusarium dry rot–Aberdeen, Idaho; virus net necrosis–Kimberly, Idaho; late blight–Corvallis, Oregon.

[a]*Virus susceptibility (Kimberly, Idaho) ratings from ELISA (enzyme-linked immunosorbent assay) tests of plants grown out from plants infected in the field the previous season.*

[b]*Net-necrosis symptoms are based on seedborne infections following aphid-vectored field infection with PLRV from infected source plants interplanted among plots.*

Weed, Disease, and Insect Management

Weeds. Clearwater Russet has shown good resistance to the herbicide metribuzin when applied preemergence and/or postemergence at labeled rates. University of Idaho studies have also shown Clearwater Russet to be tolerant of other potato herbicides, including Matrix (rimsulfuron), Outlook (dimethenamid-p), Chateau (flumioxazin), and Reflex (fomesafen).

The variety has an erect, medium-sized vine with medium-late maturity that can compete reasonably well with weeds after row closure during early to midtuber bulking. In addition, the vines tend to senesce late in the season, which, in turn, could translate as competition with late-germinating weeds.

Diseases. Root knot nematode–infested soils or fields with a history of serious early die issues should receive fumigation prior to potato-crop planting. Early and late-blight fungicide treatments should be considered if weather conditions favor disease development during the growing season. Postharvest treatments may be needed if late-blight, pink rot, or Pythium Leak tuber infections were present during the season or in past seasons. The incidence of storage diseases can be minimized by practicing good harvest procedures to avoid skinning and bruising tubers and avoiding harvesting during weather that is too hot, cold, or wet.

Insects. Applications of systemic insecticides should be considered to protect plants from aphids, psyllids, Colorado potato beetles, and other disease-vectoring insects, especially in areas where insect populations threaten to surpass important thresholds.

Nutrient Management

Nitrogen (N). Proper N management is important for achieving desired yields, maturity, specific gravity, and skin set. Ensuring that N is applied as needed will help plants balance foliar and tuber growth and may help mitigate other physiological disorders and harvest or storage issues. Depending on seasonal environmental conditions, petiole nitrates may not depict an accurate picture of plant N status (Pavek et al. 2017). In seasons with unusually warm springs, nitrate-N levels can quickly fall very low due to rapid foliar growth. Use historical records along with soil and petiole analysis to guide seasonal N applications.

Seasonal N requirements for Clearwater Russet are approximately 25% less than Russet Burbank for a given yield goal. One-third to one-half of the seasonal requirement should be available prior to row closure and the remainder applied as needed based on soil and petiole nitrate concentrations. Finish N applications by the beginning of August since plant uptake decreases significantly toward mid-August.

N-response studies conducted for two years at Aberdeen, Idaho, suggest that petiole nitrate levels for Clearwater Russet should be 18,000–22,000 ppm at the end of tuber initiation and 15,000–18,000 ppm during midbulking. Allow petiole nitrate levels to decrease further during late bulking to 7,000–10,000 ppm.

In areas where growing-degree days > 2,500, maintain petiole levels between 21,000 and 26,000 ppm with soil N levels > 50 lb/A until early bulking. Allow petioles nitrates to decrease to 15,000–23,000 ppm through midbulking and further decrease to 11,000–19,000 ppm at late bulking. Data collected by researchers in the Columbia Basin of Washington showed that N cost-adjusted gross return was maximized between 350 and 375 lb/A N under late management conditions (Knowles et al. 2017).

Avoid overly late or excessive applications of in-season N to Clearwater Russet. They can delay attainment of maximum specific gravity in the tubers and reduce skin development, which can increase losses due to decay and shrinkage in storage. Moreover, applying N too late in the season may affect tuber maturity and lead to color development in potatoes destined for processing. Additional information from commercial operations suggests that applying N as needed versus overapplying led to earlier bulking in some operations, which could be beneficial for an early crop or in areas with shorter growing seasons.

Phosphorus, potassium, and micronutrients. Research done by Washington State University suggests that phosphorus requirements for Clearwater Russet are similar to Russet Burbank. Potassium and micronutrient requirements have not been established for Clearwater Russet and it is recommended that growers follow nutrient-management recommendations for Russet Burbank until new guidelines are established.

Irrigation Management

Irrigation requirements for Clearwater Russet are similar to Russet Burbank with the notable difference that Clearwater Russet is significantly more resistant to water stress–related tuber defects. Available soil moisture (ASM) should be maintained between 70% and 85% to ensure optimal yields and quality. Avoid overwatering toward late August because water uptake will decrease appreciably, even when vines appear relatively green. Adjust irrigation rates accordingly to minimize the chance of developing overly wet soil conditions that may contribute to disease infection and enlarged lenticels. ASM levels, however, should not drop below 60% during tuber maturation and harvest to mitigate tuber dehydration and blackspot bruising. Overly hydrated tubers at harvest may also contribute to shatter bruise.

Harvest Management

Gradually reducing irrigation rates in the weeks prior to vine kill will promote ideal soil and tuber harvest conditions while promoting good skin set. Minimizing tuber impacts during harvest and transport will help to reduce the potential for shatter and blackspot bruising and for infection by tuber pathogens.

To maximize process quality during storage, adjust in-season management to allow proper maturation of the crop at the end of the season. Management inputs should be allocated to permit the crop to complete its growth cycle within the available growing season, which will depend on production region.

Optimize other harvest operations to minimize tuber damage and subsequent storage issues as follows:

- Finish N applications at least 30 days prior to harvest.
- Allow soils to dry down to approximately 65% ASM during vine kill and maturation so that tubers are not overly hydrated or dehydrated (firm when pressed).

- Allow tubers to fully set skins between vine kill and harvest, which will help to minimize tuber infections.
- Don't allow tubers to sit under dead vines for an extended amount of time, since fluctuations in soil temperature will affect the retention of postharvest processing quality (Knowles et al. 2017). Managing a field with mostly dead vines to try to increase yield for a small part of the field that is green may lead to reduced storage and processing ability.
    - Columbia Basin producers typically harvest 9–14 days after vine kill, but this interval depends on the region and whether the crop will be processed immediately or placed into long-term storage.
- Irrigating the field a few days prior to harvest may help to reduce bruising from clods, although take care to not increase the ASM too drastically. It may overly hydrate tubers, leading to a greater incidence of shatter bruise and enlarged lenticels, thus providing ideal entry points for disease.
- Consider harvesting Clearwater Russet earlier in the harvest schedule to minimize time under dead vines, where it may be subject to large temperature variations and cold pulp temperatures at harvest.
- Maintain ideal tuber pulp temperatures between 50°F and 60°F from field to storage to minimize disease development during storage. Harvest may continue with pulp temperatures as high as 65°F if tubers can be cooled off quickly in storage.
    - Keep in mind that while soil temperatures may fall in the ideal range in the field, tuber pulp temperatures may rise outside the ideal during transit from field to storage.
- Consider using refrigeration to cool potatoes when needed.
- Operate harvest equipment so that all of your conveyors will be filled to capacity with tubers, thus minimizing drop distances and impact points.

Storage Management

Storage recommendations are based on three years of data collected at the U of I's Kimberly Research and Extension Center for Clearwater Russet tubers grown in southern Idaho.

Tuber dormancy. The dormancy period for Clearwater Russet is shorter than Russet Burbank by approximately 58 days.

Curing conditions. Cure at 55°F and 95% relative humidity for 14–21 days. Good wound healing is particularly important for Clearwater Russet to limit entry points for dry-rot infection.

Ramping. Decrease temperatures 0.3°F–0.5°F per day following the curing period until the final storage temperature is reached. A slower ramp may be appropriate if reducing sugars are high at harvest. Consider communicating with the processor or pack shed to understand their pack plan prior to establishing a final temperature.

Storage conditions. Relative humidity should be maintained at 95% for the duration of storage. Weight loss for Clearwater Russet is similar to Russet Burbank.

Because of its cold-sweetening resistance, Clearwater Russet can be stored at colder temperatures than Russet Burbank for either processing or fresh pack; however, in-season stresses may be sufficient to overcome cold-sweetening resistance, resulting in darker french fries. To avoid processing issues, it may be best to not store Clearwater Russet at temperatures below 45°F.

Sprout inhibition. Avoid treatment for sprout inhibition with chlorpropham (CIPC) for at least 14 days to allow for proper wound healing. Some reports suggest that delaying application of a sprout inhibitor to Clearwater Russet for at least thirty days may have beneficial effects. We recommend that you communicate with buyers to understand their pack plan prior to applying CIPC.

Storage duration. Clearwater Russet has shown the ability to maintain good processing quality throughout nine months of storage. This duration may be extended if the crop is stored at temperatures lower than 45°F, provided that processing quality has not been compromised by in-season stresses.

Note: Stadium fungicide (Azoxystrobin+Fludioxonil+Difenoconazole) has been shown to be effective against Fusarium dry rot in storage. It has not, however, received appropriate maximum residue limits for export at the time of this publication. Therefore, it may be used on potatoes sold domestically if approved for use by the processor or fresh-pack shed. It is recommended that you clear all questions with buyers before using Stadium.

Further Reading

Knowles, R., C. Dean, L. Knowles, and M. Pavek. 2017. "Optimizing Crop Development and Process Quality of Clearwater Russet in the Columbia Basin." Potato Variety Management Institute (Department of Horticulture, Washington State University). 7 p.

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