78LC-1 (HiLite), A POSSIBLE REPLACEMENT FOR NORGOLD RUSSET IN THE COLUMBIA BASIN[1]

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Many variety trials are currently being conducted in the Northwest to find lines that will be more profitable for the potato industry to grow, pack, and process. In regional and pre-regional trials, several evaluators look at the same lines grown in various environments and compare results at the end of the season. Each also evaluates other early generation and advanced lines to single out those worthy of extensive trials. Studies are conducted to define cultural methods and environmental conditions best suited to the growing of recently released or soon to be released varieties.

Results of several years of such trials indicate there are four fresh market lines (ND534-4, A74114-4, A74212-1, and 78LC-1) that usually perform better than Norgold Russet in the Columbia Basin. These four lines are being increased by seedsmen. As seed becomes available, they should be tried by Norgold growers and packers in the Columbia Basin to evaluate their performance on a commercial scale. All except A74212-1 usually make acceptable fries, and could be processed if surplus production of early, fresh market potatoes depressed prices below acceptable levels. However, none will likely be grown specifically for early processing because their yields and french frying quality are usually inferior to Russet Burbank.

Brief Descriptions of Possible Replacements for Norgold

ND534-4 (Norkota). This variety has small determinant plants, early maturity, and medium to good yields of large, long, smooth, uniform russeted tubers of excellent type and grade. It seldom has external or internal defects or bruising, except it does express leafroll net necrosis.

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[1] Much of the data reported herein was extracted from published and unpublished reports of studies conducted by Alvin Mosley, Dan Hane, and associates on or near the Experiment Station at Hermiston, Oregon, and by Robert Thornton, Willie Iritani, Norris Holstad, and associates, who conducted studies in the Othello and Pasco, Washington, areas. Several growers and fresh market packers also generously shared data for this report. We express appreciation to all the above for letting us report a summary of their results along with our own.

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It occasionally has some growth cracking, knobs, or hollow heart. It has low to medium solids levels, moderately high sugar levels, and produces french fries that range from poor to acceptable in different trials. It has fair storability and dormancy, retaining good firmness. It is susceptible to early dying diseases, scab, leafroll virus, PVY, nematodes, soft rot, and Colorado potato beetles, but has some resistance to early blight rot. ND534-4 has been increased and tested on a commercial scale in several areas and looks like a good replacement for Norgold. It has been commercially processed into satisfactory frozen french fries.

A74114-4. This line has small to medium plants, slow emergence, early maturity, and medium to good yields of large, long, smooth, russeted tubers, somewhat non-uniform but of good grade. It often has sparse tuber set. It generally has few external defects, except some growth cracking. It occasionally has serious internal brown spot, hollow heart, and vascular discoloration, and shows some leafroll net necrosis. It is resistant to bruising. It has fair to good solids levels and sugar levels, so generally processes into acceptable french fries. It has fair storability. It is susceptible to early dying, nematodes, leafroll, PVY, soft and early blight rots, but has some resistance to scab, dry rot, and Colorado potato beetle. This line is currently being considered for release.

A74212-1. This line has large plants, early to mid-season maturity, and very high yields of large, oblong to long, sometimes rough and knobby, often pear-shaped, light-russeted tubers of generally good grade. It occasionally has sugar or dark ends, growth cracking, and blackspot or shatter bruising. It seldom has internal defects, except it does express leafroll net necrosis. It has low to medium solids levels, and high sugar levels, so produces dark french fries. It has fair storability. It is susceptible to leafroll virus, PVY, and nematodes, but has some resistance to early dying diseases, scab, Colorado potato beetles, and storage rots. This line is being named and released in Oregon as a fresh market variety.

78LC-1 (HiLite). This variety has very small plants, early maturity, and medium to good yields of medium to large, long, often pear-shaped, smooth, russet tubers of good type and grade. It seldom has external or internal defects or bruising, except it sometimes has stem-end browning. It has medium solids levels, and sugar levels, and generally produces good french fries. It has fair storability and dormancy, but tends to soften in storage. It is susceptible to early dying, nematodes, PVY, leafroll virus, early blight rot, and Colorado potato beetle, but has resistance to scab, net necrosis, and storage rots. This line has recently been named and released.

Comparison of 78LC-1 and Norgold in Performance Trials

The line 78LC-1 is being named HiLite and being rapidly increased for further commercial trials, as an early, fresh market cultivar. Its performance, compared to Norgold, will be described in detail in this report. The performance of the other three lines will be described in more detail as they are named and released by North Dakota, Idaho, and Oregon.

The line 78LC-1 has been extensively tested in the Columbia Basin and other places in the Northwest. It has generally performed as well or better than the other three and Norgold in research trials and growers' fields in this area. We entered it in regional trials two years as an early, fresh-market line. It performed well in regional trials conducted in the Columbia Basin, but only mediocre in some other areas.

The line 78LC-1 traces back to off-type plants found in a seed field of Butte in northeastern Idaho by John Cochran. How they showed up in this field is unknown. He has applied for a patent on this variety through the U.S. Patent Office. A reivew of the performance of 78LC-1 in many trials during the past four years indicates it offers the following advantages when compared with Norgold Russet.

Earliness, Yield and Grade

In early-harvested trials conducted in the Hermiston, Oregon, area by Oregon State University personnel; in Othello and Pasco, Washington areas, by Washington State University personnel; and at our Research Center in Prosser, Washington, the yields and grade of 78LC-1 were generally as good or better than those of Norgold (Table 1). These early trials were harvested from July 25 to August 15. In 10 of the 15 trials, 78LC-1 outyielded Norgold, and in 8 of 12 trials, had a higher percent U.S. number 1's. The overall average yield and percent Nr.1's were about the same.

In late-harvested trials (mostly during September), the yields of 78LC-1 were higher than Norgold in 5 of 8 trials, but in 5 of 8 trials the percent Nr. 1's was lower. Again there was not much difference in overall average yield and percent Nr. 1's.

Tuber Number and Sizes

The average number of tubers per plant were determined in seven replicated trials conducted during the period 1983 to 1986. The number of tubers of 78LC-1 per plant ranged from 3.9 to 9.9, with an overall average of 6.4 per plant. In the same trials, Norgold averaged from 2.7 to 7.7 tubers per plant, with an overall average of 5.9 per plant.

Most fresh market packers don't want uniform tuber size, but need a range of sizes, similar to those of Norgold, to satisfy their markets. Especially desirable are smooth tubers 6-10 oz in size for "count" boxes. These and the somewhat larger "baker" size return highest profits to a packer. Extra large sizes (over 12 oz) are of little value and "strippers" (4-6 oz size) provide only minimal profits. In research trials, where tubers were sorted into various sizes, 78LC-1 generally outperformed Norgold (Table 2). Where 78LC-1 was commercially packed, the assortment of tuber sizes was generally more profitable to packers than Norgold (Table 3).

Count boxes of 78LC-1 have been shipped to various markets throughout the United States. In at least one case, evaluation forms were enclosed in each box with a request to return the form, reporting on their condition when they reached the consumer. In all except one case, destination receivers were pleased with 78LC-1. In one shipment, to the Army in southern California, some rotting was reported. A distributor who checked the order reported the rot loss was minimal.

Since 78LC-1 has very small plants, it can be overgrown by adjacent large-vined varieties when grown in single row research trials. When this happens 78LC-1 will have a large portion of undersized tubers and many will be pear shaped. This could account for some poor performance reports from research trials. Results of "competition" trials have shown that 78LC-1 cannot be fairly evaluated when grown where it competes with large-vined lines. When grown in 3-row plots or blocks, where it competes only with itself, it performs well. Someone should try planting 78LC-1 in 3-row beds, with rows only 18 inches apart, by placing a row midway between two rows spaced the standard 3 ft apart. Results of spacing studies indicate that growers could profit by spacing 78LC-1 plants closer together within rows than the standard 9-10"

Tuber Defects

Norgold usually has few second growths, malformations, growth cracks, and other external tuber defects, but 78LC-1 has even fewer of these blemishes. As described above, 78LC-1 will provide pear-shaped tubers if overgrown by large-vined varieties. Water stress or other stresses can also accentuate the tendency of this variety to provide pear-shaped tubers. However, under normal growing conditions, the tuber shape of 78LC-1 is not a problem. The only grading loss is usually a small to medium proportion of undersized tubers.

Unlike Norgold with its occasional severe hollow heart problem, 78LC-1 seldom has serious internal tuber defects (Table 4). In 14 out of 16 trials, 78LC-1 had essentially no hollow heart. In over half of these same trials, Norgold had serious levels of this defect. In one trial in 1982, 78LC-1 had some hollow heart but less than Norgold. In a grower's trial in 1983, much hollow heart was reported in the largest tubers of 78LC-1, but this consisted mostly of very small, late-season cavities without discoloration. Resistance to this defect is a major advantage of 78LC-1 over Norgold.

In one of these 16 trials, 78LC-1 expressed stem-end browning (vascular discoloration) in a majority of the tubers. We have seen some weakness to this disorder in 78LC-1 at other times, especially under high irrigation rates. However, this disorder is probably not a severe defect that would cause tubers to be rejected. We need to learn what incites this defect in 78LC-1 and other cultivars, like Nooksack.

Other internal defects, such as leafroll net necrosis, and internal brown spot or heat necrosis are seldom observed in either 78LC-1 or Norgold.

Bruising and Rotting

78LC-1 seldom has blackspot or shatter bruising. In controlled bruising tests over the past five years, 78LC-1 has rated 4.5 to 5.0 on a 1-5 scale for both blackspot and shatter bruising resistance. Norgold rated somewhat lower for both shatter and blackspot resistance, from 3.8 to 4.5, so is apparently somewhat more susceptible to bruising. Both lines are much more bruise resistant than Russet Burbank and Lemhi.

Results of storage rot tests, conducted by ARS, USDA personnel at Aberdeen, Idaho, indicate 78LC-1 has some resistance to Erwinia soft rot and Fusarium dry rot, but is very susceptible to Alternaria early blight rot. We seldom observe storage rotting in 78LC-1 during normal storing, seed handling, and sorting of large numbers of tubers from trials involving this cultivar. Norgold is susceptible to dry rot, but has some resistance to soft and early blight rots. In a replicated test where freshly injured tissue was inoculated with Erwinia soft rot bacteria, 78LC-1 had 14% less rot than Norgold.

Storability

In a replicated storage test, 78LC-1 rated an average of 3 for dormancy on a 1-5 scale and 3.5 for shrivel, compared to a very poor rating of 1.3 for both dormancy and shrivel for Norgold. In another test, the two varieties both rated 3.2 for shrivel. A commercial grower reported that after two months storage Norgold was soft, rotting and starting to sprout, while 78LC-1 in the same storage was starting to soften but had no sprouting or rotting. Neither of these early-harvest, fresh-market varieties should be considered as storage potatoes. However, if short periods of storage are needed while waiting for market prices to improve, 78LC-1 would keep better than Norgold.

Solids and Processing Quality

Occasionally when prices for early, fresh-market potatoes are unacceptable or demand for early-harvested processing potatoes is greater than the supply, early, fresh-market potatoes are processed. An important advantage of 78LC-1 over Norgold is that it usually processes into better french fries because it usually has higher solids (Table 5) and lower levels of reducing sugars. In 13 of 16 trials, 78LC-1 had higher solids than Norgold.

Solids and processing quality in 78LC-1, as in Norgold, are best when harvested early (Table 5). After reaching the peak of its quality in late July or early August 78LC-1 loses quality if not harvested. Its solids and processing quality are also seriously reduced when it is planted in single row trials, adjacent to and overgrown by large-vined types. This could account for some instances where the eating or french fry quality of 78LC-1 was rated low.

Though it has seldom been evaluated in trials as a processing line, a number of people have tried processing 78LC-1, some on a commercial scale. In most cases, it has processed into french fries that were judged by expert evaluators as 100% acceptable. These evaluations were done on tubers directly out of the field and after short periods of storage. Although 78LC-1 can be satisfactorily processed, if needed, it probably should not be grown specifically for this purpose.

Eating Quality

If harvested early, when its solids are highest, 78LC-1 is good for almost all methods of cooking (Fig. 1). There have been several reports that it is particularly good when microwave cooked. It apparently cooks more rapidly than most potato varieties. It usually has a smooth, fluffy texture, a mild flavor, and no off flavors. The line 78LC-1 is not good for boiling because it cooks rapidly and breaks apart easily. In 1986, consumer evaluations were conducted at the Prosser Research Center with 78LC-1 tubers grown on sandy soil and harvested in early September, after solids had diminished to about 1.070 to 1.073. The results indicated this varietiy has good consumer acceptance (Fig. 1). It was rated good to very good by a large majority of several dozen people who took them home over a period of several weeks and cooked them in all the various ways potatoes are prepared.

Results of a similar study conducted by cooperators at Washington State University, contradict those from our study. In that study, several new, potential varieties, including Norgold and 78LC-1, were provided under code numbers to several consumers and 78LC-1 was judged to be the least preferred. This doesn't agree with previous experiences with 78LC-1 over the past five years. We have eaten this variety ourselves for several years and have talked to many others who have tried it, and almost everyone seems to like it. The potatoes for the Washington State University study were grown on a heavily-fertilized, heavily-irrigated, sandy loam soil and were not harvested early. Perhaps the growing conditions or late harvest may have reduced cooking quality. This consumer appeal factor of 78LC-1 needs to be further researched.

Fertilization and Irrigation Rates and Stress Resistance

Results of irrigation and fertilization studies indicate 78LC-1 requires only low rates of fertilization and irrigation. These rates would be inadequate and cause stress effects on varieties with larger plants. Generally 78LC-1 does not respond to nitrogen rates above 100 lb/A. Results of petiole analyses of this variety indicate it has higher levels of NO_3 in the plant than other varieties with low fertilization rates. It apparently is an efficient user of available fertilizer elements. The ratio of tuber to plant weight in 78LC-1 indicates it has remarkable photosynthetic efficiency.

Various types of irrigation water stresses have been imposed on 78LC-1 and its response indicates good resistance to water stress. Minimal damage is caused by prolonged interruptions in irrigation during tuber initiation or bulking, or by continuous or gradually increasing water deficits that seriously damage varieties with larger plants.

Responses to Diseases, Pests, and Herbicides

The line 78LC-1 has good resistance to scab and expresses very little net necrosis when infected with leafroll virus. Compared to Norgold it appears to have some resistance to leafroll virus, blackleg, Colorado potato beetles, and both soft and dry tuber rots. It is susceptible to early dying diseases, but not as susceptible to Verticillium wilt as Norgold. It is susceptible to PVY, ring rot, and Columbia root-knot nematode.

We have applied several commonly-used herbicides to 78LC-1 trials and have seen no evidence that it is especially sensitive to any of them. It has been sprayed with twice the recommended rate of metribuzin with no apparent deleterious effect.

Table 1. Total yields and percent U.S. Nr. 1's in 78LC-1 and Norgold Russet in research and commercial trials in the Columbia Basin during a 5-yr period.

		78LC-1		Norgold	
Year	Location	cwt/A	% Nr. 1's	cwt/A	% Nr. 1's
Early Harvest Trials					
1982	Prosser WA	244	61	244	56
1983	Pasco WA	692	82	661	74
1983	Othello WA	440		461	
1983	Umatilla OR	402	76	372	71
1984	Hermiston OR	480		420	
1984	Hermiston OR	430	81	318	69
1984	Hermiston OR	364	80	318	74
1985	Hermiston OR	389	84	363	86
1985	Othello WA	472	91	600	90
1985	Prosser WA	251	56	314	76
1985	Prosser WA	355	62	334	76
1985	Prosser WA	468	77	390	75
1986	Hermiston OR	499	82	640	80
1986	Hermiston OR	560		420	
1986	Hermiston OR	469	63	446	68
	Ave.	434	75	420	75
Late Harvest Trials					
1985	Othello WA	625	84	650	79
1985	Hermiston OR	573	84	562	83
1985	Patterson WA	600	90	640	90
1985	Prosser WA	397	64	316	72
1985	Prosser WA	454	70	440	77
1986	Prosser WA	408	52	358	63
1986	Hermiston OR	463	76	469	78
1986	Othello WA	783	83	733	90
	Ave.	538	75	521	79

Table 2. Tuber size distributions produced by 78LC-1 and Norgold Russet in research trials during the past five years in the Columbia Basin.

		% of U.S. Nr. 1's in various size groups	
Year	Location	78LC-1	Norgold
1982	Prosser WA	41% 4-10 oz, 59% >10 oz.	68% 4-10 oz, 32% >10 oz.
1983	Pasco WA	61% 4-10 oz, 39% >10 oz.	64% 4-10 oz, 36% >10 oz.
1983	Umatilla OR	69% 4-10 oz, 31% >10 oz.	79% 4-10 oz, 21% >10 oz.
1984	Hermiston OR	42% 4-6 oz, 50% 6-10 oz, 8% >10 oz.	63% 4-6 oz, 35% 6-10 oz, 2% >10 oz.
1984	Hermiston OR	91% 4-10 oz, 9% >10 oz.	99% 4-10 oz, 1% >10 oz.
1984	Hermiston OR	29% 4-6 oz, 59% 6-10 oz, 12% >10 oz.	61% 4-6 oz, 36% 6-10 oz, 3% >10 oz.
1985	Othello WA	54% 4-10 oz, 46% >10 oz.	64% 4-10 oz, 36% >10 oz.
1985	Othello WA	51% 4-10 oz, 49% >10 oz.	45% 4-10 oz, 55% >10 oz.
1985	Hermiston OR	80% 4-10 oz, 20% >10 oz.	85% 4-10 oz, 15% >10 oz.
1985	Hermiston OR	44% 4-10 oz, 56% >10 oz.	33% 4-10 oz, 67% >10 oz.
1986	Othello WA	10% 4-6 oz, 27% 6-10 oz. 63% >10 oz.	10% 4-6 oz, 23% 6-10 oz, 67% >10 oz.

Table 3. Commercial packouts when 78LC-1 and Norgold Russet were grown together in irrigation circles in the Columbia Basin during the period 1984-86.

		Packout in Commercial Trials	
Year	Location	78LC-1	Norgold
1984	Hermiston OR	Best pack in 1984 Returned $50 more/T than Norgold	Fair pack
1985	Pasco WA	51% 6-14 oz.	56% 6-14 oz.
1986	Pasco WA	100% U.S. Nr. 1's in 60 or 70 count boxes or bakers. Returned $46 more/T than Norgold.	Only a few 60 or 70 count boxes and bakers. Many rejected with hollow heart.
1986	Hermiston OR	63% packout, 50% cartons, 20% bakers, 30% strippers.	35% packout, 50% carton, no bakers, 40% strippers, 10% not saleable.
1986	Pasco WA	30 T/A, 63% packout, 47% carton, 18% bakers, 35% strippers.	
1986	Pasco WA	46% carton, 11% bakers, 43% strippers, no hollow heart, 30% hollow heart in Lemhi.	
1986	Pasco WA	70% packout, 46% carton, 18% bakers, 36% strippers.	
1986	Pasco WA	62% packout, 48% carton, 11% bakers, 41% strippers.	

Table 4. Internal defects in 78LC-1 and Norgold Russet when grown in research and commercial trials in the Columbia Basin during the past five years.

		78LC-1		Norgold	
Year	Location	H.H.[1]	S.E.B.	H.H.1	S.E.B.
1982	Prosser WA	7	4	9	1
1983	Pasco WA	36	--	23	--
1983	Umatilla OR	0	15	23	7
1984	Hermiston OR	very few	--	many	--
1985	Patterson WA	0	0	3	0
1985	Othello WA	6	0	4	0
1985	Hermiston OR	1	9	1	0
1985	Hermiston OR	1	0	8	1
1985	Prosser WA	0	1	11	4
1985	Prosser WA	0	4	0	5
1985	Prosser WA	0	8	0	1
1985	Prosser WA	0	8	0	8
1985	Prosser WA	0	15	0	11
1986	Pasco WA	very few	--	serious	--
1986	Hermiston OR	0	1	5	0
1986	Hermiston OR	0	88	30	12
1986	Hermiston OR	0	1	36	0
	ave.	3	11	10	4

[1] H.H. = hollow heart, S.E.B. = stem end browning, vascular necrosis or vascular discoloration.

Table 5. Comparison of specific gravities of 78LC-1 and Norgold Russet when grown in trials in the Columbia Basin over a 5-yr. period.

Year	Location	Specific Gravities 78LC-1 (1.0--)	Norgold (1.0--)
Early Harvested Trials			
1983	Umatilla OR	77	75
1983	Pasco WA	78	79
1984	Hermiston OR	82	76
1984	Hermiston OR	76	68
1985	Hermiston OR	72	70
1985	Othello WA	81	71
1985	Prosser WA	82	78
1985	Prosser WA	82	71
1985	Prosser WA	78	70
1986	Hermiston OR	71	68
	ave.	78	73
Late Harvested Trials			
1982	Prosser WA	70	68
1985	Hermiston OR	68	68
1985	Plymouth WA	77	80
1985	Prosser WA	73	68
1985	Prosser WA	72	64
1986	Hermiston OR	71	74
	ave.	72	70

Fig. 1. Consumer responses to 78LC-1 when several dozen employees of the Irrigated Agriculture Research and Extension Center were provided with samples to cook in their own homes over a period of several weeks.