UNIVERSITY OF IDAHO
College of Agriculture

Producing Early Gem Potatoes in Idaho

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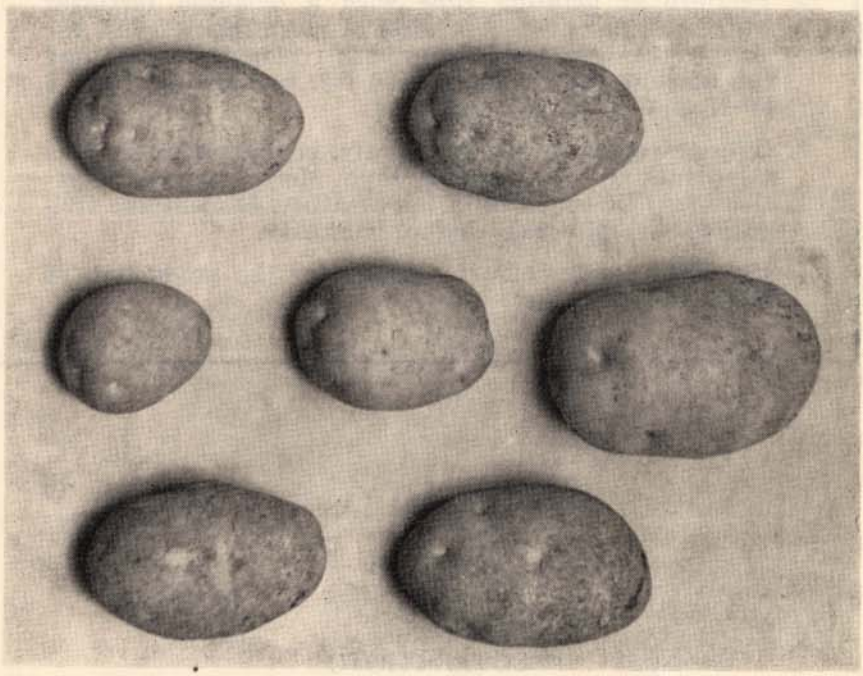

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Recommendations

1. Plant seed pieces of the Early Gem potato 9 inches or closer in the row. Each seed piece should weigh 1 to 1½ ounces or more and contain an eye.
2. Fertilize at planting time with a balanced fertilizer which will not produce a total of more than 80 lbs. per acre of nitrogen considering both residual nitrogen and the amount added; 300 to 500 lbs. per acre of 10-16-8 or 16-20-0 is recommended.
3. Irrigate regularly and frequently, beginning as soon as the plants are 4 to 6 inches high. More frequent irrigations may be required in hot weather. Discontinue irrigation several weeks before maturity.
4. Use light sandy soils if possible for the production of Early Gem potatoes.

COVER PHOTO

U. S. No. 1 tubers of Early Gem from 2 inches to 5 inches in length.

Producing Early Gem Potatoes in Idaho

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THE EARLY GEM variety of potato was developed by the National Potato Breeding Program of the United States Department of Agriculture and released jointly with the states of Idaho and North Dakota. A description of Early Gem was published in the *American Potato Journal* (3) in 1955.

Early Gem is an early variety resistant to scab but susceptible to the other common diseases of potatoes. While its russet-skin tubers are similar to Russet Burbank in appearance, they are generally shorter in length and somewhat thicker in cross-section. Under certain growing conditions some of the Early Gem tubers are nearly round. Early Gem is similar to Triumph in maturity and generally produces fewer tubers per hill than some of the later maturing varieties.

Growth cracking of the tubers is the major defect of the Early Gem variety. Investigations by members of the University of Idaho staff on the production of Early Gem potatoes in Idaho are reported in this bulletin.

Yields

The comparative yields of four varieties in four different years at three locations in Idaho are shown in Table 1. Russet Burbank and White Rose produced significantly greater yields and more U. S. No. 1 tubers (over 2 inches in diameter) than Early Gem at Parma and Lewiston in many of the tests. These varieties also produced a significantly higher total yield than Early Gem at Aberdeen in 1952 and 1953.

The average of all years and locations showed the yield of White Rose to be the highest and this variety produced the most No. 1 tubers. Russet Burbank, while second in total yield, produced relatively fewer No. 1 tubers and exceeded Early Gem by an average of only 15 sacks per acre of this grade.

The variety-test plantings were generally made on a 12-inch spacing within the rows and irrigated in a manner which favored the later maturing varieties. Growth cracking was the main defect which reduced the yield of marketable tubers of Early Gem. While the average total yields of Early Gem and Triumph were approximately the same, Triumph produced an average of 21 sacks more per acre of No. 1 tubers under the same conditions.

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Table 1. — Yields of Early Gem and three other varieties of potatoes for four years at three locations in Idaho.

Variety and Year	LEWISTON Total Cwt./A.	LEWISTON U. S. No. 1 Cwt./A.	PARMA Total Cwt./A.	PARMA U. S. No. 1 Cwt./A.	ABERDEEN Total Cwt./A.	ABERDEEN U. S. No. 1 Cwt./A.	AVERAGE Total Cwt./A.	AVERAGE U. S. No. 1 Cwt./A.
Early Gem								
1951	191.4	126.9	177.4	159.3	256.2	153.8	208.3	146.7
1952	205.4	183.9	158.8	51.3	167.0	123.0	177.1	119.3
1953	276.0	208.0	239.0	195.0	243.0	144.0	252.7	182.3
1955	240.0	203.0	260.4	131.4	307.0	124.0	269.1	152.8
Average	228.2	180.5	208.9	134.2	243.3	136.2	226.8	150.3
Russet Burbank								
1951	235.4[1]	162.2[1]	169.6	76.5[2]	231.8	92.5[2]	212.3	110.4
1952	294.7[1]	256.3[1]	222.2[1]	69.1	194.3[1]	125.3	237.1	150.2
1953	409.0[1]	293.0	313.0[1]	224.0[1]	280.0[1]	143.0	334.0	220.0
1955	285.0[1]	221.0[1]	354.6[1]	229.8[1]	239.9	88.0	293.2	179.6
Average	306.0	233.1	264.9	149.9	236.5	112.2	269.1	165.1
Triumph								
1951	183.3	165.0	180.9	174.0			182.1	169.5
1952	257.0	189.0	147.2	75.8			202.1	132.4
1953	260.0	137.0	209.2[2]	164.0[2]	180.2[2]	113.0[2]	216.5	138.0
1955	317.1[1]	282.0[1]	287.4	214.8[1]	246.3	216.3[1]	283.6	237.7
Average	254.3	193.3	206.2	157.2	213.3	164.7	224.6	171.7
White Rose								
1951	248.1[1]	171.5[1]	231.5[1]	138.2	287.3	94.7[2]	255.6	134.8
1952	425.9[1]	382.1[1]	282.9[1]	80.4[1]	250.0[1]	175.0[1]	319.6	212.5
1953	548.0[1]	442.0[1]	446.0[1]	347.0[1]	310.0[1]	183.0[1]	434.7	324.0
1955	399.0[1]	308.0[1]	291.0	200.4[1]	303.5	120.5	331.2	209.6
Average	405.3	325.9	312.9	191.5	287.7	143.3	335.3	220.2

1. Significantly greater yield than Early Gem for location and year.
2. Significantly less than Early Gem for location and year.

Quality

Specific gravity, or the percentage of total solids, has been generally used as an indication of cooking or processing quality of potatoes. Numerous varieties when grown in Idaho are relatively high in total solids (2). The percentage of total solids was determined from the specific gravities of four varieties (Table 2). Early Gem and Triumph were generally lower in total solids than Russet Burbank and White Rose. If the value of 19.7 per cent total solids (specific gravity of 1.080) was used as a criterion for a superior baking or processing potato, Early Gem would not always be accepted. The average total solids content of 19.0 per cent (specific gravity of 1.077), however, would favor Early Gem over numerous varieties grown in other localities (2) for use as an early, fresh-market potato.

Table 2—Quality of tubers of Early Gem and three other varieties in four years at three locations in Idaho as measured by total solids content.

Variety & year	Lewiston %	Parma %	Aberdeen %	Average %
Early Gem				
1951	18.6	20.4	16.3	18.4
1952	19.9	19.0	17.4	18.8
1953	21.5	21.8	18.6	20.7
1955	19.1	18.4	16.2	17.9
Average	19.8	20.0	17.1	19.0
Russet Burbank				
1951		21.6	19.5°	20.5
1952	22.7°	20.4	19.9°	21.0
1953	20.4	25.2°	23.0°	22.9
1955	23.2°	21.2°	19.7°	21.4
Average	22.1	22.1	20.5	21.5
Triumph				
1951	19.3	20.4		19.9
1952	22.7°	20.1		21.4
1953	20.9	21.6	18.1	20.2
1955	20.8°	18.4	17.8	19.0
Average	20.9	20.1	18.0	20.0
White Rose				
1951			19.2°	
1952	23.2		19.3	23.2
1953	23.0°	25.2	19.4	22.5
1955	22.1°	21.2°	17.9°	20.4
Average	22.8	23.2	19.0	21.7

° Significantly higher than Early Gem for location and year at the 5% level.

Spacing

It was believed that growth cracking could be controlled in Early Gem by close spacing of the plants in the row. Since Early Gem sets few tubers per plant and develops them rapidly, the competition offered by more plants in the row might help prevent the rapid fluctuations in growth and result in less growth cracking.

The results from three planting distances are shown in Table 3. The sprockets used on the planters in an attempt to obtain 6-, 9-, and 12-inch spacings resulted in plants averaging 8.2, 10.7 and 13 inches apart at Parma and 8.3, 10.4 and 16.5 inches apart at Aberdeen. Closer spacing within the rows resulted in more plants per acre. The three planting distances produced averages of 21,250, 16,285 and 11,980 plants per

acre when the rows were 36 inches apart. The differences in yield due to the greater number of plants at the closer spacings resulted in average yields of 273.3, 259.8 and 224.7 sacks per acre, or a difference of 48.6 sacks per acre between the 6- and 12-inch planting. Use of rows 30 inches apart increased the number of plants per acre to 1.2 times the number where the rows were 36 inches apart.

Significant increases in total yield and amount of U.S. No. 1 tubers were obtained in some tests, where plants were spaced less than 11 inches apart. A significant reduction in growth cracking was also found in some instances at the closer spacings. The average size of the tubers, however, was reduced when there was less than 11 inches between the plants.

The general trend in the spacing tests is illustrated by the averages at the bottom of Table 3. As the distance between plants was increased, the yields per acre and yields of U.S. No. 1 tubers were decreased and growth cracking was increased but the average size of the tubers was decreased with the closer spacings.

Different spacings of the plants had no appreciable effect on total solids content.

Table 3—Effect of spacings on yield, growth cracking and size of Early Gem.

Location and distance between rows	Proposed distances between plants	YIELD		Growth cracked		Size of U.S. No. 1 tubers
		Total Cwt./A.	U.S. No. 1 Cwt./A.	Cwt./A.	%	
Parma, 1954						
36 inches	6 inches	276.0	204.0°°	40.8	15	
	9 inches	242.4	175.2	41.4	17	
	12 inches	218.4	153.0	45.0	20	
Parma, 1955						
36 inches	6 inches	327.6	213.6	64.8	20	
	9 inches	307.8	192.0	66.8	22	
	12 inches	282.0	180.6	58.8	21	
Aberdeen, 1953						
						Ave. Oz.
36 inches	6 inches	260.2	160.0°°	34.3	13	9.2
	9 inches	244.2	142.9°°	37.2	15	9.2
	12 inches	192.2	105.7	32.2	17	10.1
30 inches	6 inches	319.1	186.1°°	57.3°°	18	7.8
	9 inches	293.2	172.3°°	62.3°	21	7.9
	12 inches	247.6	120.9	70.7	29	8.3
Aberdeen, 1954						
						Pct. over 10 oz.
36 inches	6 inches	176.4	127.4	14.9	8	4.3
	9 inches	179.3	126.6	12.1	7	10.0
	12 inches	145.9	109.9	16.4	11	16.5
30 inches	6 inches	214.1	149.4	28.3	13	3.1
	9 inches	214.3	149.4	27.2	13	6.6
	12 inches	165.7	120.5	21.8	13	19.9
Aberdeen, 1955						
36 inches	6 inches	283.6°°	173.7°°	76.4°	27	18.4°°
	9 inches	273.3°	156.0	89.8	33	27.5°°
	12 inches	247.8	139.6	87.2	35	39.5
30 inches	6 inches	329.6°°	208.4°°	58.5°°	17	21.0°°
	9 inches	324.2°°	200.4°	89.0	25	24.3°°
	12 inches	298.0	168.3	95.3	32	33.2
Average all tests:						
	6 inches	273.3	177.8	46.9	17	11.8
	9 inches	259.8	164.4	53.2	21	17.1
	12 inches	224.7	137.3	53.4	24	27.3

° Significantly different from 12-inch spacing at 5% level.
°° Significantly different from 12-inch spacing at 1% level.

Fertilizers

The dates of planting, altitude, temperatures, and other growing conditions were different at Parma, in western Idaho, and Aberdeen in the eastern part of the State. Plantings in Parma were made in early April and the crop was harvested in late July or early August. At Aberdeen the potatoes for the trials were planted from May 10 to May 15 and harvested in early September. The average July temperature for Parma was listed as 75.0° F. while at Aberdeen the July temperature averaged 69.9° F.

The fertilizer trials showed different results at the two locations (Tables 4, 5 and 7). The effects of different amounts of nitrogen, phosphorus and potassium on the yield and quality of Early Gem at Parma are shown in Table 4. In 1954, all fertilizers containing nitrogen produced significantly higher total yields, more U.S. No. 1 tubers and more growth-cracked tubers than no fertilizer or phosphorus alone. The total solids of the tubers was reduced when higher increments of nitrogen were applied. In 1955, a similar trend was found for nitrogen applications but the differences were not as great. The field used at Parma for the 1955 trials was high in fertility previous to the addition of fertilizers and it was believed that the high total nitrogen content of the soil affected the fertilizer results (Table 4) as well as the results of spacing (Table 3) and a higher proportion of growth-cracked tubers resulted in both tests.

The results of the fertilizer trials at Aberdeen in 1953 and 1955 are shown in Table 5. When the nitrogen application was increased from 40 to 160 lbs. per acre the total yield and the yield of U.S. No. 1 tubers were decreased and the amount and percentage of growth-cracked tubers were increased.

While nearly significant increases in yield and U.S. No. 1 grade tubers were found at Parma when 40 lbs. per acre of potash was added to the fertilizer, no consistent difference was shown at Aberdeen from potassium applications.

Table 4—Effects of various fertilizers on the yields, growth cracking and quality of Early Gem potatoes at Parma, Idaho.

Fertilizer in lbs./acre N-P-K	YIELD Total Cwt./A.	U.S. No. 1 Cwt./A.	U.S. No. 1 %	Growth cracked Cwt./A.	Growth cracked %	Total solids %
1954						
120-80-40	282.0°°	201.6°°	71	52.2°°	18.5	18.4°°
120-80-0	264.6°°	182.4°	69	52.8°°	20.0	18.4°°
40-80-0	253.2°°	180.0°°	71	48.6°°	19.2	19.1°°
0-80-0	212.4	163.2	77	26.4	12.4	19.4°°
0-0-0	215.4	160.2	74	31.2	14.5	19.6
1955						
160-80-40	354.0°°	187.2	53	104.4°°	29.5	17.9°
160-80-0	351.6°°	182.4	52	108.6°°	30.9	17.9°
160-0-0	310.8	182.4	59	76.8	24.7	17.9°
80-80-0	329.4°	186.0	56	96.6	29.3	18.6
80-0-0	313.8	190.2	60	73.8	23.5	18.9
0-80-0	282.6	174.0	62	68.4	24.2	19.1
0-0-0	291.6	181.2	62	80.4	27.6	19.1

° Significantly different from the unfertilized control at the 5% level.
°° Significantly different from the unfertilized control at the 1% level.

Table 5—Effects of various fertilizer applications on the yield and quality of Early Gem potatoes at Aberdeen, Idaho in 1953 and 1955.

Fertilizer in lbs./acre	1953 YIELD				1955 YIELD			
	Total Cwt./A.	U.S. No. 1 Cwt./A.	Growth cracked Cwt./A.	%	Total Cwt./A.	U.S. No. 1 Cwt./A.	Growth cracked Cwt./A.	%
0-0-0					215	150	41	19
40-80-0	210	110	54	26	220	145	47	21
160-80-0	198	90	65	33	204	116	55	27
40-160-0	211	112	49	23	245°	164°	45	20
160-160-0	210	82	78	37	220	135	54	25
40-80-40	217	118	51	24	238°	167°	46	20
160-80-40	202	87	70	35	220	138	55	25
40-160-40	224	117	62	28	225	161	43	19
160-160-40	218	94	80	37	208	135	54	26

° Significantly higher than the unfertilized treatment at the 5% level.

Irrigation

The effects of three irrigation levels on Early Gem are shown in Table 6. To obtain the heavy irrigation treatment, water was applied to the furrows when the available soil moisture was 30 to 35 per cent depleted. An average of 11 irrigations were required during the season. In the plots receiving moderate irrigation, water was applied when the soil moisture was 50 to 55 per cent depleted, receiving six irrigations. The plots at the low level received three irrigations during the growing season when the plants showed visible stress.

Heavy irrigation generally increased the total yield and the yield of U.S. No. 1 tubers and decreased growth cracking. In 1955, however, the percentage of growth-cracked tubers was the same at all irrigation levels. In 1953, heavy irrigation or low irrigation reduced growth cracking as compared with moderate irrigation. This data indicated that an alternating or interrupted moisture supply was more conducive to the production of growth cracks than either a high or low level of soil moisture.

The effects of fertilizers, spacing and irrigation in various combinations were studied at Parma in 1954 (Table 7). Irrigation water was applied to the low-irrigation plots at 10-day intervals while the high-irrigation plots received water every five days during the growing season. As the space between plants was decreased the total yield and U.S.

Table 6—Effects of three irrigation levels on yield and growth cracking of Early Gem at Aberdeen, Idaho, 1953 and 1955.

Irrigation	1953 YIELD				1955 YIELD			
	Total Cwt./A.	U.S. No. 1 Cwt./A.	Growth cracked Cwt./A.	%	Total Cwt./A.	U.S. No. 1 Cwt./A.	Growth cracked Cwt./A.	%
Heavy	223°°	119°°	52	23	247°°	157°°	54	22
Moderate	219	87	78	37	222	142	48	22
Low	192	89	56	30	195	125	41	22

°° Significantly higher than low treatment at the 1% level.

Table 7—Effects of five rates of fertilization at two irrigation levels and three spacings on yield and growth cracking of Early Gem potatoes at Parma, Idaho, in 1954.

Fertilizer applied in lbs./acre N-P-K	12-inch spacing				9-inch spacing				6-inch spacing			
	Total yield Cwt./A.	U.S. No. 1 Cwt./A.	Growth cracked Cwt.	%	Total yield Cwt./A.	U.S. No. 1 Cwt./A.	Growth cracked Cwt.	%	Total yield Cwt./A.	U.S. No. 1 Cwt./A.	Growth cracked Cwt.	%
Low Irrigation												
120-80-40	262°	179	65°°	25	264°°	187°°	46°°	17	313°°	233°°	46°°	15
120-80-0	241	162	62°°	26	276°°	197°°	56°°	20	306°°	192	72°°	24
40-80-0	230	148	61°°	26	264°°	194°°	50°°	19	299°°	210	59°°	20
0-80-0	200	161	23°°	11	196	143	32	16	220	173	19°°	9
0-0-0	221	155	44	20	208	147	35	17	251	194	31	12
High Irrigation												
120-80-40	257°°	166°°	63°°	24	276°°	200°°	52°°	19	320°°	247°°	44°°	13
120-80-0	211°°	136	45°°	21	252°°	184	37°°	15	299°°	222°°	46°°	15
40-80-0	217°°	161	39°°	18	249°°	162	56°°	23	260°°	206°°	28	11
0-80-0	170	127	22	13	228	179	26	11	262	197	37	14
0-0-0	176	137	20	11	208	162	27	13	229	167	29	13

° Significantly different from the unfertilized control at the 5% level.
°° Significantly different from the unfertilized control at the 1% level.

No. 1 tubers increased and the percentage of growth cracks decreased. The more frequent irrigations generally resulted in decreased growth cracking and increased total yield and U.S. No. 1 tubers.

The use of 120 lbs. of nitrogen per acre was not consistently better than 40 lbs. in the production of No. 1 tubers when 120-80-0 fertilizer was compared with 40-80-0. Improved production of No. 1 tubers and total yield was generally found where potassium (120-80-40 versus 120-80-0) was used at Parma.

The use of nitrogen in the fertilizer significantly increased growth cracking in most instances but also increased the yield of marketable tubers. The use of phosphorus alone (0-80-0) generally resulted in a significant decrease in growth cracking as compared with the untreated control at the low irrigation level. With frequent irrigation, however, there was little difference between the application of phosphorus and the control.

Discussion

Growth cracking of the tubers is the major defect of Early Gem and one of the chief hazards in the production of this variety. In some of the trials herein reported, Early Gem was grown, for the most part, under conditions suitable for the production of Russet Burbank and other later maturing varieties. Planting distances, except where indicated, were usually 12 inches or over, relatively high levels of total nitrogen were used and irrigation was too infrequent and continued too long for the Early Gem variety. These conditions probably accounted for the high amount of growth cracking and relatively low proportion of No. 1 tubers in some instances. Spacing over 11 inches in the row, high total nitrogen, and infrequent irrigation appeared to be the main factors which contributed to growth cracked tubers.

Increased nitrogen applications resulted in higher yields and more U.S. No. 1 potatoes at Parma, but generally decreased the total and No. 1 yields at Aberdeen. Growth cracking was increased at both locations when the amount of nitrogen was increased. Nitrogen applications at Parma decreased the total solids of the tubers.

A high level of soil moisture was necessary to reduce growth cracking when nitrogen was applied at Parma. The authors' observations of dryland plantings of Early Gem have indicated that a uniform low supply of soil moisture will adequately control growth cracking. Even when no rainfall or supplimental moisture was received during the growing season, Early Gem produced many 4- to 8-ounce tubers on dry land, thereby exceeding Russet Burbank by double the amount of No. 1 tubers produced.

Hoyman, Schultz and Johansen (1) reported that heavy clays in North Dakota were unsuited for Early Gem production because of the high proportion of growth-cracked tubers. On the lighter soils a high percentage of No. 1 grade was produced.

In general, the producers in western Idaho agreed that even a small amount of growth-cracked tubers gave a bad appearance. The pack-out

from Early Gem was good, however, and frequently exceeded that of other varieties because of uniform size and lack of other defects such as off-shape, second-growth and sunburn. Growers and shippers in western Idaho who had successfully produced and handled Early Gem were contacted for information on their experiences with the variety. The consensus of the growers' opinions was as follows:

Soil Type—Light or sandy soils were generally best for Early Gem, but some growers had produced 250 cwt. per acre of No. 1 tubers on heavy soils.

Fertilizers—Application of 300 to 500 lbs. per acre of 10-16-8 was recommended following onions or beets where residual fertilizer remained from the previous crop. On alfalfa ground or second-year potatoes, 500 lbs. per acre of 10-16-8 or 16-20-0 fertilizer was generally used. Eighty lbs. per acre or less of total nitrogen was believed best for growing Early Gem and adequately controlling growth cracking.

Spacing—It was generally agreed that the distances between plants should be nine inches or less. Some growers were contemplating a five-inch spacing. The use of small seed pieces of Early Gem accounted for unevenly spaced plants in the fields. Because Early Gem has relatively fewer eyes toward the stem-end than Russet Burbank, very small seed pieces were without eyes. The uneven stands which resulted produced more growth-cracked tubers.

Irrigation—Early irrigation was believed necessary on Early Gem to prevent the large, early growth cracks. Irrigation water was applied when the plants were four to six inches tall and applications were made at five- to seven-day intervals. It was felt that withdrawing irrigation water several weeks before harvest would reduce the amount of small, late growth cracks. In western Idaho, irrigation should be discontinued about July 15.

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Other University of Idaho Publications On Production, Handling and Marketing of Potatoes

Effects of Mechanical Injury Upon the Storage Losses of Russet Burbank Potatoes. Experiment Station Bulletin No. 220.

Fertilizer Recommendations for Idaho Soils. Extension Circular No. 120.

Consumer Preference for Sized Idaho Russet Burbank Potatoes. Experiment Station Bulletin No. 208.

An Analysis of Potato Packing Costs in Idaho, 1950-1951 Season. Experiment Station Bulletin No. 208.

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Injury to Russet Burbank Potatoes by Different Harvesting Machines. Experiment Station Bulletin No. 218.

Selecting and Breeding Potatoes for Resistance to Verticillium Wilt in Idaho. Research Bulletin No. 30.

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