

## RESEARCH PROGRESS REPORT FOR 1982

Submitted by

David G. Holm

San Luis Valley Research Center

Research conducted in 1982 included the following:

- (a) A study to simultaneously evaluate the response of potato clones to varying levels of water stress and nitrogen fertility;
- (b) potato breeding;
- (c) seedling selection and clonal development;
- (d) a study to determine what effect water stress at the time of tuberization has on tuber set, yield, and grade of potatoes; and,
- (e) a continuing study to evaluate clonal differences in nitrogen-use efficiency.

### RESPONSE OF POTATO CLONES TO WATER STRESS AND NITROGEN

Four cultivars (Centennial Russet, Red McClure, Russet Burbank and Sangre) were evaluated for response to varying levels of water stress and nitrogen fertility. This was the second year for this study. Nitrogen was applied at the rates of 0, 70 and 140 pounds per acre. Data was collected on total tuber yield and tuber number. Average tuber weight was calculated from total yield and tuber number.

A comparison of 1981 and 1982 results indicates that in the latter year, yields were generally lower, tuber number per plant approximately the same, and average tuber weight slightly less.

No interaction was found between water stress and nitrogen levels for total yield, tuber number/plant, and average tuber weight. Yield response to applied nitrogen was greater for Centennial Russet and Red McClure. Increasing nitrogen application rate to 70 pounds per acre resulted in increases in tuber number/plant. No additional increase in tuber number was observed by applying 140 pounds of nitrogen per acre. Average tuber weight generally increased with increasing N except for Red McClure (also observed in 1981). Tuber weight for Sangre did not increase with nitrogen rates above 70 pounds per acre.

Tuber yield, tuber number, and average tuber weight decreased with increasing water stress (Table 1). Clones differed in degree of response to stress, however. The higher yielding clones (Red McClure and Sangre) were more sensitive to water stress as measured by yield response. Clones also differed in response to water stress as measured by tuber number/plant and average tuber weight.

A ranking of the four cultivars for average decrease in yield, tuber number/plant, and average tuber weight with increasing water stress was identical in 1981 and 1982.

Table 1. The influence of water stress on tuber yield, tuber number/plant, and average tuber weight of four potato clones.

Clone	Position <sup>1/</sup>									S <sup>2/</sup>
	1	2	3	4	5	6	7	8	9	
Yield (Cwt/A)										
Centennial										
Russet	311	317	309	293	255	249	196	135	99	27.7
Red McClure	540	544	511	457	359	330	250	180	110	57.7
Russet Burbank	353	394	381	354	303	276	208	173	115	34.0
Sangre	428	435	422	365	286	231	180	111	78	49.8
Tuber Number/Plant										
Centennial										
Russet	6.2	6.4	6.3	6.4	5.4	6.0	5.8	5.5	4.7	.17
Red McClure	11.4	11.4	11.0	10.3	9.3	9.7	8.3	7.7	6.7	.60
Russet Burbank	7.7	8.2	8.3	7.3	6.7	6.1	4.9	5.0	4.3	.52
Sangre	7.3	6.8	7.1	6.2	5.8	5.2	5.0	4.4	3.6	.45
Average Tuber Wt (oz)										
Centennial										
Russet	5.2	5.3	5.2	5.0	5.0	4.4	3.7	2.7	2.3	.38
Red McClure	4.9	5.0	4.9	4.9	4.5	3.8	3.2	2.6	1.9	.40
Russet Burbank	4.8	5.2	5.0	5.3	4.9	4.8	4.5	3.8	2.9	.22
Sangre	6.4	6.8	6.5	6.6	5.3	4.9	4.0	2.7	2.4	.58

<sup>1/</sup>Position 1 = minimum stress and Position 9 = maximum stress.

<sup>2/</sup>S is a measure of the average decrease in yield, tuber number/plant, and average tuber weight with a change in position.

#### POTATO BREEDING

Twenty-two parental clones were selected for crossing in 1982 and seeds from 189 crosses were obtained. Sixty-five seedling families were grown in the greenhouse, producing approximately 11,000 tubers for initial selection in 1983. Surplus tubers are being distributed to other programs.

## SEEDLING SELECTION AND CLONAL DEVELOPMENT

A total of 28,800 first-year seedlings (single-hills) were planted in the field. Of this number, 398 were selected for further observation. Another 292 clones were in various preliminary stages of testing. Forty-six of these clones were selected for continued evaluation. Eighteen advanced seedlings are being increased and evaluated. Two processing lines, WC672-2 and WC521-12, continue to show potential and are being tested in large scale out-state trials. Seed of WC672-2 was released to foundation growers. A russet selection, BC9289-1, shows fresh market potential.

Five clones were tested for chip color at harvest and after various storage regimes. Included were TC711-1, WC521-12, WC672-2, Atlantic and Norchip. All of these clones failed to produce acceptable chips in 1982.

Colorado participated in the WRCC-27 for a fifth year. This program was established to promote regional cooperation in the uniform testing of potato selections and development of new cultivars. Eleven advanced selections and three standard cultivars were included in the 1982 test. Results for the trial are presented in Tables 2 and 3. Table 2 summarizes data on yield, grade, specific gravity, stand, vine maturity, tuber shape, and skin type. This table also includes the merit rating of the best selections in the trial. The merit rating is a subjective composite index indicating overall potential as a new cultivar. Table 3 summarizes information collected on external grade defects and hollow heart.

A russet selection, A74212-1, from Idaho was rated as the overall best clone because of a high yield potential, high percentage of No. 1 potatoes, a low amount of external grade defects, and no hollow heart. Another Idaho russet cross selected in California, AD74135-1, was similar to A74212-1 in all characteristics measured. However, because of a greater percentage of external grade defects, it was rated number two. Clone A72685-2 received a merit rating of three. This Idaho selection had a relatively poor stand, but yielded very well. It also had a high specific gravity and was one of the few clones evaluated with no observed hollow heart.

Clones WC285-18 and A74133-1 received merit ratings of four and five, respectively. Both of these clones are russet selections. WC285-18 and A74133-1 were selected in Colorado and Idaho, respectively. These clones are similar in many characteristics. WC285-18 had a slightly greater specific gravity, significantly better stand, and slightly less external defects.

Fifteen protoplast-derived clones of Russet Burbank were tested for adaptability and variability in the San Luis Valley. This test was conducted in cooperation with Dr. James Shepard, Kansas State University. Considerable variability existed among clones for yield, grade and stand. None of the protocloned clones performed significantly better than the mother clone, Number 342 (Table 4). Clone 322 had a higher percentage of U. S. No. 1 potatoes, however.

TABLE 2. Yield (total and U.S. No. 1), percent U.S. No. 1, specific gravity, stand, maturity, tuber shape and skin type, and merit rating for the 1982 Western Regional Trial entries grown at the San Luis Valley Research Center, Center, Colorado.

Clone	Total Yield	Yield US No.1	U.S. No.1	Spec. Grav.	Stand	Vine <sup>1/</sup> Maturity	Tuber <sup>2/</sup> Shape & Skin Type	Merit <sup>3/</sup> Rating
	Cwt/A	Cwt/A	%		%			
A72685-2	413	344	82.9	1.092	89	3.5	Ob,R	3
A74133-1	355	294	82.7	1.086	91	4.5	Ob-L,R	5
A74212-1	418	388	92.8	1.086	97	3.3	L-Ob,R	1
A7596-1	392	331	85.0	1.092	99	4.0	L-Ob,R	-
AD74135-1	465	375	80.3	1.088	97	4.8	L,R	2
BC9289-1	299	222	74.2	1.080	96	3.3	Ob-Ov,R	-
ND9474-6	189	134	70.5	1.075	79	1.3	R-Ov,R	-
WC285-18	338	279	82.4	1.088	99	4.5	Ob,R	4
WC567-1	268	223	82.1	1.076	94	2.0	L-Ob,R	-
WC630-2	276	242	87.5	1.085	93	3.8	Ob,R	-
WC708-6	224	191	84.7	1.084	94	1.3	Ob,R	-
Norchip	244	195	80.0	1.080	95	1.0	R-Ov,W	-
Lemhi Russet	391	315	80.4	1.090	91	2.3	Ob-L,R	-
Russet Burbank	361	271	75.1	1.088	99	3.5	L, R	-
Mean	331	272	81.5	1.085	94	3.1	-	-
LSD (0.05)	59	65	9.7	-	7	.6	-	-

<sup>1/</sup>Vine maturity is based on amount of dead foliage on August 31:

1 = Very Early; 2 = Early; 3 = Medium; 4 = Late; 5 = Very Late.

<sup>2/</sup>Tuber Shape: R = Round; Ov = Oval; Ob = Oblong; L = Long

Skin Type: R = Russet; W = White

<sup>3/</sup>Merit Rating: 1 = Best

TABLE 3. Summary of external grade defects and hollow heart for the 1982 Western Regional Trial entries grown at the San Luis Valley Research Center, Center, Colorado.

Clone	External <sup>1/</sup>	Type External <sup>2/</sup>	Hollow <sup>3/</sup>
	Defects	Defect(s) Observed	Heart
	— % —		— % —
A72685-2	3.2	GC, SG*, SB	-
A74133-1	4.1	SG*, SB, MS*	-
A74212-1	1.5	MS*	-
A7596-1	9.0	GC*, MS	4.2
AD74135-1	7.3	GC, SG*, MS*	0.3
BC9289-1	4.5	GC, SB, MS*	1.3
ND9474-6	0.9	SG, MS*	11.6
WC285-18	3.0	AH*	1.3
WC567-1	4.4	GC*, MS*, AH	0.5
WC630-2	1.8	SB, MS*	13.1
WC708-6	3.5	GC*, MS*	1.9
Norchip	6.3	GC*, MS	1.9
Lemhi Russet	6.4	CG, SG, MS*	8.7
Russet Burbank	13.3	GC, SG*, MS	3.0

<sup>1/</sup> Percent External Defects based on the proportion of the total sample weight with significant defects.

<sup>2/</sup> GC = Growth Crack; SG = Second Growth; SB = Shatter Bruise; MS = Misshapen; AH = Alligator Hide. Major defects for each clone are asterisked.

<sup>3/</sup> Percent hollow heart based on the proportion of the sample weight of tubers greater than 10 ounces with defect.

Table 4. Yield (total and U.S. No. 1), percent U.S. No. 1, and percent stand for 16 Russet Burbank clones grown at the San Luis Valley Research Center, Center, Colorado, in 1982.

Clone	Total	Yield	U.S. No. 1	Stand
	Yield	U.S. No.1	U.S. No. 1	
	Cwt/A	- Cwt/A -	---- % ----	- % -
70	316	217	68.7	100
83	300	208	67.8	98
88	280	221	79.0	98
98	277	165	59.4	97
113	287	202	70.5	100
117	200	126	64.5	84
130	264	173	65.5	97
140	259	202	76.6	64
141	231	128	54.8	93
213	298	216	72.5	99
261	136	85	66.4	66
287	307	218	71.4	99
322	311	251	80.5	97
327	258	175	67.3	95
335	269	198	73.4	94
342*	391	277	71.1	100
Mean	283	198	69.5	94
LSD (0.05)	50	50	10.7	8

\*Mother clone

#### WATER STRESS X TUBERIZATION

A study was initiated to see what effect water stress at the time of tuber initiation has on tuber set, yield, and grade of Russet Burbank and Centennial Russet. Results are summarized in Table 5. Centennial Russet was less sensitive to water stress during tuber initiation. Water stress at tuberization resulted in a seven and 43 Cwt/A yield decrease, respectively, for Centennial Russet and Russet Burbank. Similar decreases in yield of U. S. No. 1 potatoes was observed for both clones. Average tuber weight and tuber number/plant for both clones was not significantly affected by stress. However, Russet Burbank tended to have fewer tubers per plant when subjected to stress at the time of tuberization.

Table 5. Influence of water stress at the time of tuber initiation on yield, grade and tuber characteristics.

Cultivar	Water Regime	
	Nonstressed	Stressed
	----- Yield (Cwt/A) -----	
Centennial Russet	319	312
Russet Burbank	389	346
	----- Yield U.S. No.1 (%) -----	
Centennial Russet	283 (88.8)	253 (81.0)
Russet Burbank	260 (66.5)	232 (67.1)
	----- Average Tuber Wt. (Oz) -----	
Centennial Russet	5.8	5.4
Russet Burbank	5.5	5.9
	----- Tuber Number/Plant -----	
Centennial Russet	5.8	6.1
Russet Burbank	7.4	6.1

#### CLONAL NITROGEN-USE EFFICIENCY

The objective of this study was to determine the physiological basis for nitrogen-use efficiency differences among potato clones. However, due to some Sencor damage, this study was discarded. This resulted in a seed shortage for some clones this year. This study will be conducted again in 1984 when a sufficient seed supply is available.

RESEARCH PROPOSAL FOR 1983

David G. Holm

1. The study to evaluate the effect of water stress at the time of tuberization on tuber set, yield, and grade of two potato cultivars, Centennial Russet and Russet Burbank, will be continued to verify 1982 results.
2. Cytex will be evaluated for potential usefulness in potato production. Reputable reports have indicated increased yields resulting from the use of Cytex.
3. The potato breeding and clonal development program will be continued. Advanced clones will be tested in yield trials. Development of virus-tested seed stocks of the most promising clones will be initiated.
4. The Colorado Western Regional Trial will be conducted again in 1983.
5. New protoclones of Russet Burbank will be tested for adaptability in the San Luis Valley.
6. Initial studies have shown that there are differences in the binding ability between Erwinia carotovora var. carotovora and Erwinia carotovora var. atrosep-tica and among Erwinia carotovora strains to potato tuber tissue. Because of this, there is a possibility that there may be differences between Erwinia varieties and potato cultivars. This may also provide a potential disease rating index for diverse potato cultivars against blackleg. Work will be performed to verify these differences as well as attempting to work this index into the potato breeding program. (In cooperation with Rob Davidson).

BUDGET REQUEST

POTATO BREEDING AND CLONAL DEVELOPMENT

Labor	\$2,200.00
Travel	200.00
Equipment and Supplies	<u>600.00</u>
TOTAL	\$3,000.00

CULTURAL AND PHYSIOLOGICAL STUDIES

Labor	\$2,000.00
Travel	600.00
Equipment and Supplies	<u>1,300.00</u>
TOTAL	\$3,900.00

GRAND TOTAL \$6,900.00