SUMMARY RESEARCH PROGRESS REPORT FOR 2001 AND RESEARCH PROPOSAL FOR 2002

Submitted to : SLV Research Center Committee and the
Colorado Potato Administrative Committee (Area II)

TITLE: Dormancy in potatoes

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PROJECT JUSTIFICATION: This project is based on the continuing need to: (1) develop storage performance profiles of new introductions, (2) determine mechanisms that impart postharvest dormancy in potato minitubers and to develop well defined protocols to overcome dormancy.

PROJECT STATUS: (a) Field tuber storage profiles. Seven cultivars and selections (Cherry Red, Chipeta, CO86218-2, Keystone R., Norkotah #3, Norkotah #8, and R. Nugget) were stored for 204 days at 34, 36, 38, 40 and 44 °F. The 36 °F cooler malfunctioned and froze the tubers thus we have data only for 120 days. Data were collected on bud break, chilling injury symptoms and electrolyte leakage. Soluble sugar analyses are underway on freeze dried samples.

(b) Minituber dormancy. Minitubers of six cultivars (Desiree, Nooksak, R. Norkotah, R. Norkotah #3, Sangree and Silverton R.) were produced at the SLV research center greenhouse by Dave Holm during late 2001, (harvested 11-30-01 to 12-28-01) to ensure we had a good record of dormancy status. These 4500 minitubers presently comprise five experiments designed to test hormone and chemical treatments, soluble sugar composition, exposure to electrical fields, and alpha galactosidase activity as components of understanding dormancy mechanisms. Laboratory and field plot data from these experiments comprise part of a PhD dissertation and are anticipated to be the final phase of this research to be reported next year.

SIGNIFICANT ACCOMPLISHMENTS FOR 2001:

(a) Field tuber storage profiles

(1) After examining data from two years storage experiments (2000 and 2001), it appears that the most effective temperature to extend storage life without application of a dormancy inhibitor for all cultivars was 34 °F. At this temperature storage without bud break was longest, and dry matter content was highest for all cultivars. We detected no visual evidence of chilling injury, nor any increase in electrolyte leakage that would typically be indicative of membrane disruption from chilling injury. An electron microscopy scan was not effective in detecting membrane injury. Sugar analyses are being conducted to determine if there are differences among storage temperatures in extent of starch hydrolysis to soluble sugars.

(2) Based upon first sign of bud break (10%), R. Norkotah #8 and Cherry red had the best profiles followed in order by Chipeta, Durango Red, Russet Nugget, Russet Norkotah #3, and Keystone.

(3) Under our conditions, tubers stored from the 1999 harvest generally stored better than those harvested in 2000. This may be due to an environmental effect or some other unknown variable. It was unlikely due to storage conditions since separate chambers were used and the effect seems apparent for all cultivars.

(4) Alpha galactosidase enzyme breaks down complex carbohydrates to simple sugars. We thus monitored its activity to determine if it could be used to predict the onset of dormancy release in potato tuber buds. Alpha galactosidase activity is strongly related to the end of dormancy (r^2 = 0.8993 (P =0.05), but only for tubers stored at 34 °F. This may reflect the fact that raffinose sugars increase in plant tissues upon exposure to low temperatures, and this enzyme then breaks them down as they emerge from

dormancy.

It appears that two storage seasons are required, and may be sufficient to develop reasonable cultivar storage profiles as a guide to assessing longevity when no sprout inhibitors have been used. **These profiles should benefit producers by providing information that could be used to assess storage longevity expectations, especially if commercial sprout inhibitors are made unavailable, or as a component of an organic marketing program.**

(b) Minituber dormancy

(1) Progibb at recommended rates, and Progibb plus Etheral at 250 ppm, were the most effective growth regulators in breaking minituber dormancy with RNK -3 and Silverton.

(2) Dormancy release occurred 10 days after application in Silverton and after 28 days in RNK -3.

(3) Progibb plus Etheral produced more sprouts two weeks after treatment in Atlantic and Sangree. Calcium nitrate and calcium chloride at very high concentration (100, 000 ppm) also enhanced sprout number, but significance compared to a water aeration treatment was mixed.

(4) With the addition of a final year's experimentation (2002) and data collection presently underway, we should be in a position to make recommendations that can serve to shorten the dormancy of several cultivars of minituber seed stock under defined storage and handling conditions.

OBJECTIVES FOR 2002

1. Continue storage profile experiments with ten cultivars and advanced selections initiated with the 2001 harvest.

2. Work on carbohydrate analyses of stored freeze dried samples. We were unable to complete this work with resources and help available during the past year.

3. Prepare a research paper and present the results orally at an invited symposium on potatoes at the International Society for Horticultural Science Congress, August, 2002, Toronto, Canada.

4. Complete a series of experiments on minituber dormancy to confirm previous findings and assist a PhD graduate student to complete his dissertation.

Table 1.Days in storage to attain 10% tuber bud break for 1999/00 and 2000/01 storage.						
	Storage temperature (°F)					
Cultivar/storage year	44	40	38	36	34	Rank
Cherry Red 1999/00	<50	<50	<50	<50	>79	2
2000/01	<50	<50	<50	<50	95	
Chipeta 1999/00	<50	<50	<50	55	90	3
2000/01	<50	<50	<50	<50	<50	
Durango Red 1999/00	<50	<50	<50	<50	85	4
2000/01	<50	<50	<50	<50	52	
Keystone 1999/00	<50	<50	<50	<50	<50	7
2000/01	<50	<50	<50	<50	<50	
R. Norkotah #3 1999/00	52	<50	<50	65	60	6
2000/01	<50	50	52	66	68	
R. Norkotah #8 1999/00	<50	<50	<50	63	>79	1
2000/01	<50	<50	<50	60	110	
R. Nugget 1999/00	<50	<50	<50	52	70	5
2000/01	<50	<50	<50	53	65	

Table 2.Days in storage to attain 50% tuber bud break for 1999/00 and 2000/01 storage.						
	Storage temperature (°F)					
Cultivar	44	40	38	36	34	Rank
Cherry Red 1999/00	<50	<50	<50	>150	>150	5
2000/01	<50	<50	<50	90	125	
Chipeta 1999/00	<50	<50	<50	100	>200	4
2000/01	<50	<50	<50	70	85	
Durango Red 1999/00	<50	<50	<50	>150	>200	3
2000/01	<50	<50	<50	90	85	
Keystone 1999/00	<50	<50	<50	<50	<50	7
2000/01	<50	<50	<50	<50	<50	
R. Norkotah #3 1999/00	68	65	50	>100	>200	1
2000/01	65	67	85	90	127	
R. Norkotah #8 1999/00	60	55	50	>100	>200	2
2000/01	50	55	58	90	127	
R. Nugget 1999/00	<50	<50	<50	70	>100	6
2000/01	<50	<50	<50	65	100	

Table 3. Analysis of variance for dry matter content after 204 days of storage at four temperatures.

Source	Df	% of total variation	P value	Mean square	F value
Storage temp.	3	59	<0.0001	940	330
Cultivars	6	19	<0.0001	150	52
Interaction	18	3.08	0.0001	8.1	2.8
Residual	301			2.9	

Table 4. Treatment and cultivar means for % dry matter after 204 days storage

	Storage Temperature (°F)				
Cultivar	34	38	40	44	Mean
Cherry Red	28.4	29.3	22.9	22.4	25.8
Chipeta	26.7	28.0	21.9	20.7	24.4
Durango Red	26.0	27.6	21.5	21.6	24.2
Keystone	22.9	23.0	17.8	18.1	20.5
R. Norkotah#3	24.0	26.6	20.3	21.4	23.1
R. Norkotah#8	26.9	28.2	21.7	21.5	24.6
R. Nugget	28.9	29.8	22.8	20.4	25.5