

THE USE OF SUCROSE TO PREDICT THE VALUE OF POTATO VARIETIES FOR PROCESSING

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The sugar content of potatoes is a major factor affecting processing quality (color) of chips and French fries. One of these sugars, sucrose, is present in much higher concentration in early harvested tubers, while reducing sugars (glucose and fructose) generally remain low throughout the harvest period. The color of chips made from tubers at the time of harvest is usually good because it is the reducing sugars that react directly in the darkening of chips upon frying. Reducing sugars can rapidly accumulate in immature tubers, because sucrose is readily converted to reducing sugars after harvest. Potato varieties that inherently have low sucrose (0.25 percent or less) and maintain an equilibrium level of reducing sugars of 0.15 percent or less in storage potentially can produce light-colored potato chips after long term storage.

This research investigated relationships among sucrose levels, harvest dates, tuber sizes and chip color after storage in six varieties. Tubers were harvested at weekly intervals for 10 weeks beginning July 30 for two successive years and analyzed for sucrose. Other tubers were harvested on September 16 and 30, 1980 and placed in storage at 50°F for chipping tests on November 17, January 29 and March 23. Chip color was measured using an Agron Spectral Reflector with M 00 and M 97 calibration disks in the red mode.

Results and Discussion

The correlation between average tuber size and sucrose for the six varieties at each harvest is shown in Figure 1. The data for 1979 and 1980 were pooled since there was no measurable difference attributable to year.

Potato varieties differ markedly in their sucrose content during growth and maturation. The relationship between tuber size and sucrose content was linear for Lemhi, Crystal and Dakchip and curvilinear for Norchip, Kennebec, and Russet Burbank. Norchip, Kennebec, Russet Burbank, and Dakchip reached a sucrose

rating of 2.5 at a tuber size of about 113, 204, 184, and 275 g, respectively. These weights represented average-sized tubers of Norchip on August 15 and of Kennebec, Russet Burbank, and Dakchip between September 1 and 10. Lemhi and Crystal approached a similar sucrose level about October 1 at a size of 286 and 332 g, respectively.

The Agron values attained at three chipping intervals averaged over two harvest dates are shown in Figure 2. According to the PC/SFA¹ five-code color chart, chips of minimum color acceptability should give an Agron value of 45 or above. Norchip produced the lightest-colored chips on all chipping dates. Kennebec, Russet Burbank, and Lemhi tubers improved in chip color after storage while Dakchip and Crystal became darker. The response by Crystal, however, was not significantly different among the three chipping dates. These various trends in color are probably due to variable levels of reducing sugars among varieties in storage.

Comparison of chip color from tubers harvested at two dates averaged over three chipping dates is shown in Figure 3. The only significant difference was that Norchip produced lighter chips when harvested on September 16 versus September 30 while the reverse occurred in Russet Burbank.

To determine the value of sucrose ratings for predicting chip color, the sucrose rating at each harvest date was correlated to the color of chips on each of three chipping dates (Table 1).

Sucrose was a poor predictor of differences in chip color among varieties when chipped early (November 17) or at any of the three chipping dates when correlated to sucrose after August 27. The average of the coefficients of determination (R^2 's) between sucrose ratings taken from July 30 to August 27 and Agron values on January 29 and March 23 was .70, leaving 30 percent of the variability in chip color among varieties due to factors other than sucrose. The data suggest that sucrose levels among varieties early to midway through the growing season are more accurate for predicting relative chipping quality of various varieties from 50°F storage after four or more months than sucrose levels determined later in the season.

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¹PC/SFA = Potato Chip Snack Food Association.

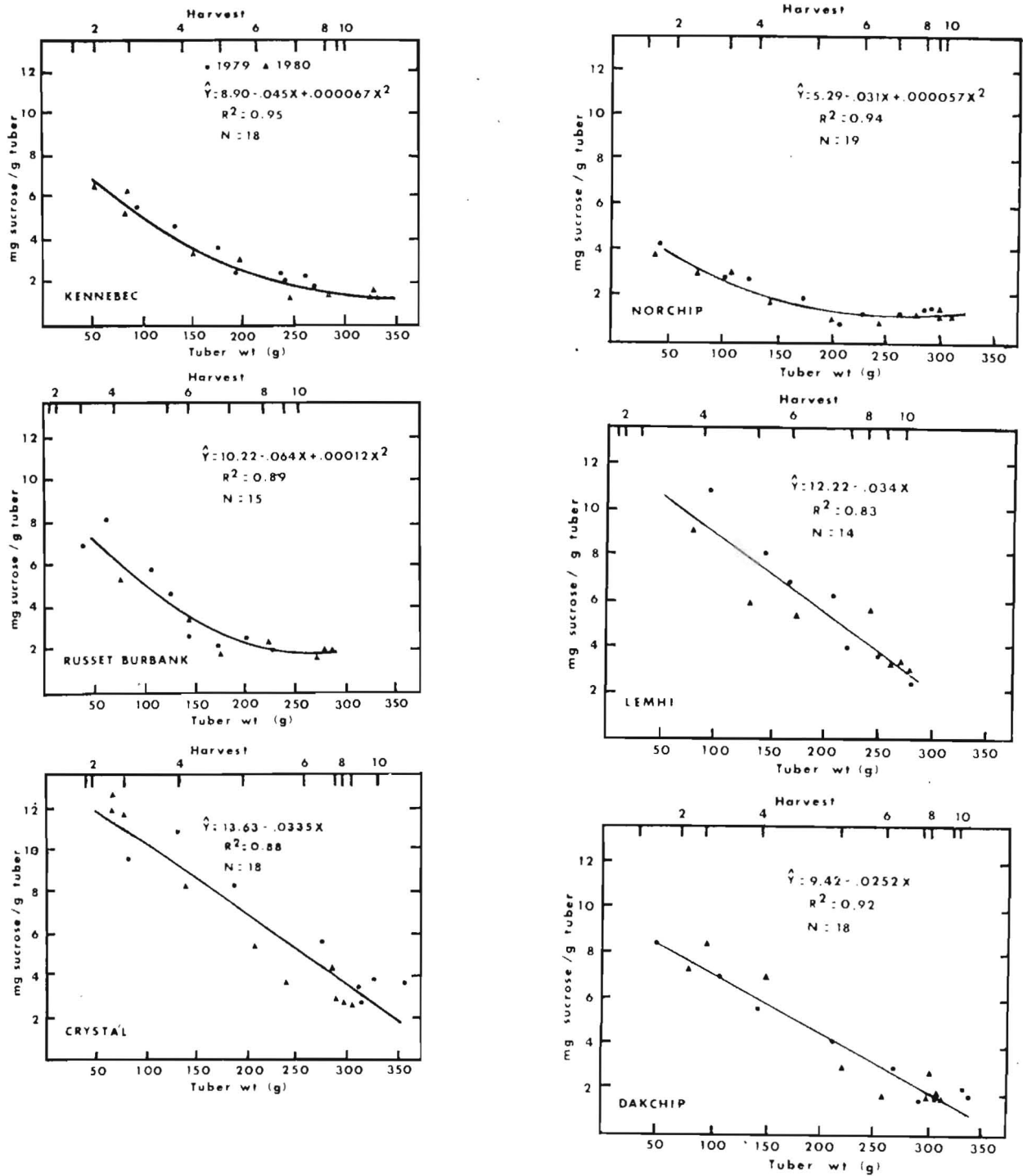


Figure 1. Regressions of tuber sucrose on tuber weight in six cultivars. All R^2 s are significant at $P = .0001$.

The results of this study indicate sucrose content could be used to predict the relative chipping potential of selections from breeding programs or varieties after moderate to long-term storage. However, sucrose levels should be measured relatively early during tuber development when sucrose differences are greatest among selections or varieties under comparison.

Of the varieties included in this study, Norchip was superior in chip color. Dakchip had better color after short than after long-term storage while the opposite was true for Kennebec. Crystal, Lemhi, and Russet Burbank were marginal to poor for chipping in this study.

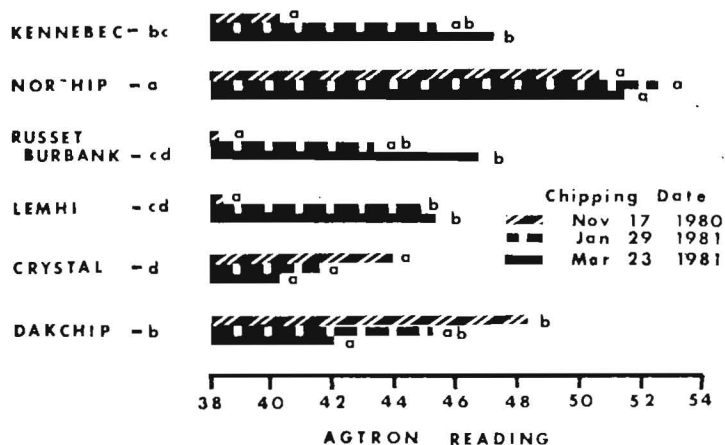


Figure 2. Color of potato chips fried at three dates averaged over two harvests. Chipping dates within cultivars or cultivars averaged over chipping dates with the same letter are not different at $p = .05$ using Duncan's Multiple Range Test.

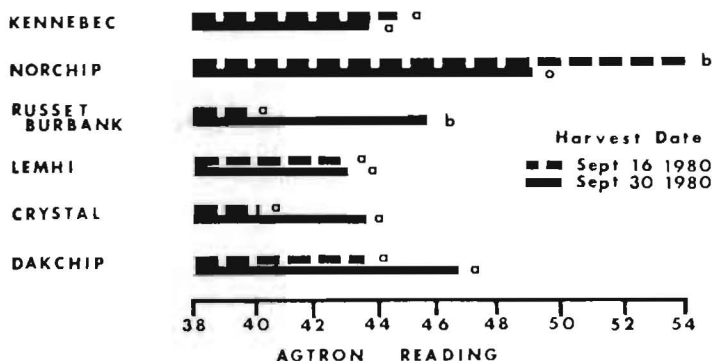


Figure 3. Color of potato chips from tubers harvested at two dates averaged over three chipping dates. Harvest dates within cultivars with the same letter are not different at $p = .05$.

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Continued on page 31

Table 1. Coefficients of determination (r^2 's) between tuber sucrose ratings on various dates and chip color from stored tubers of six cultivars; 1980-81.¹

Date of chipping	Sucrose sampling sequence									
	1 (Jul 30)	2 (Aug 6)	3 (Aug 13)	4 (Aug 20)	5 (Aug 27)	6 (Sept 3)	7 (Sept 10)	8 (Sept 17)	9 (Sept 24)	10 (Oct 1)
Nov. 17	.430	.195	.240	.206	.510	.228	.130	.185	.150	.213
Jan. 29	.671*	.803**	.866**	.684*	.802**	.486	.472	.390	.378	.408
Mar 23	.415	.783**	.782**	.691*	.403	.454	.565	.421	.472	.423
Average	.767**	.790**	.856**	.717*	.918**	.572*	.519	.484	.467	.514

¹Potatoes used for chipping were harvested Sept 17 and Oct 1. The regression equation was a power curve: $y = ab^x$; $y = SR$, $x = \text{Agtron value}$.

*Significant at $p = .05$ **Significant at $p = .01$.

Continued from page 13

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Continued from page 19

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