

GROWING CONDITIONS AND OTHER FACTORS INFLUENCING SUGAR ACCUMULATION IN STORAGE

by
W. M. Iritani and Larry Weller

As more and more potatoes go into processing it becomes increasingly important that growers understand the quality and type of potatoes processors are demanding. On the other hand, processors should be willing to pay more for high quality potatoes and I predict that more bonuses will be paid in the future for high quality, both in terms of internal and external quality.

Over ninety percent of the potatoes which go into storage in Washington today are being processed. One of the major problems facing processors every year is the accumulation of reducing sugars in storage. What influence does reducing sugars have on processing of potatoes? First of all, it causes darkening of fried products. This is not due to frying too long as is often thought. Secondly, it causes poor texture, thirdly, sugars are responsible for off flavors and also causes off white or gray color of dehydrated mashed potatoes.

Studies have been and are being conducted to determine what influence growing and harvest conditions have on ultimate sugar accumulations in storage.

This past year there were more than normal amounts of jelly or translucent end development. Experimental results the past several years indicate that moisture stress early in the tuber development stage is implicated. It appears that many growers do not realize the importance of providing adequate moisture early in the season especially if high fertilizer rates are banded at planting time. High fertility can definitely affect germination and growth of the plant when moisture is not adequate. Stress under these conditions can cause high sugar development in the stem portion after the potatoes are harvested and stored.

Stress or growth interruption and regrowth late in the season can cause abnormally high sugars in the bud end. This condition is not very common and is due to immaturity of the bud portion. The problem can be eliminated by killing the vines and maturing out the tubers.

A factor which has considerable influence on sugar development in storage and over which some degree of control can be maintained is specific gravity. As can be seen in Fig. 1 there are considerable differences between 1.065 and 1.090 tubers on amount of sugars accumulated in storage. Cultural conditions, within limits, which produce high yields generally produce high specific gravity potatoes.

Fertilizer rate during growth as you would expect, has an influence on sugar accumulation in storage (Table 1). The vines from the 100 lb. fertility rate died prematurely. In such instances if the tubers are allowed to lie in warm soil before harvest they physiologically age and the tendency is for greater sugar accumulation in storage. This can be exemplified by the following experiment. Tubers of the same lot were divided in half. One-half was held at 50F for one month and then lowered to 42F. The other half was kept at an elevated temperature of 70F with high humidity for two weeks and then lowered to 42F. This is a simulation of conditions in which vines die prematurely and tubers are allowed to lie in a warm soil for a period of time before harvest. As can be seen in Fig. 2 much more sugar accumulated after exposure to elevated temperatures.

Over fertilization can result in immature tubers being harvested. That is tubers which have considerable amount of skinning. However, slight immaturity is desirable in comparison to over-maturity. Immature tubers accumulate more sugars in storage (depending upon degree of immaturity) than mature tubers (Table 2).

Fig. 1. The influence of specific gravity of tubers on reducing sugar accumulation at storage temperature of 42F.

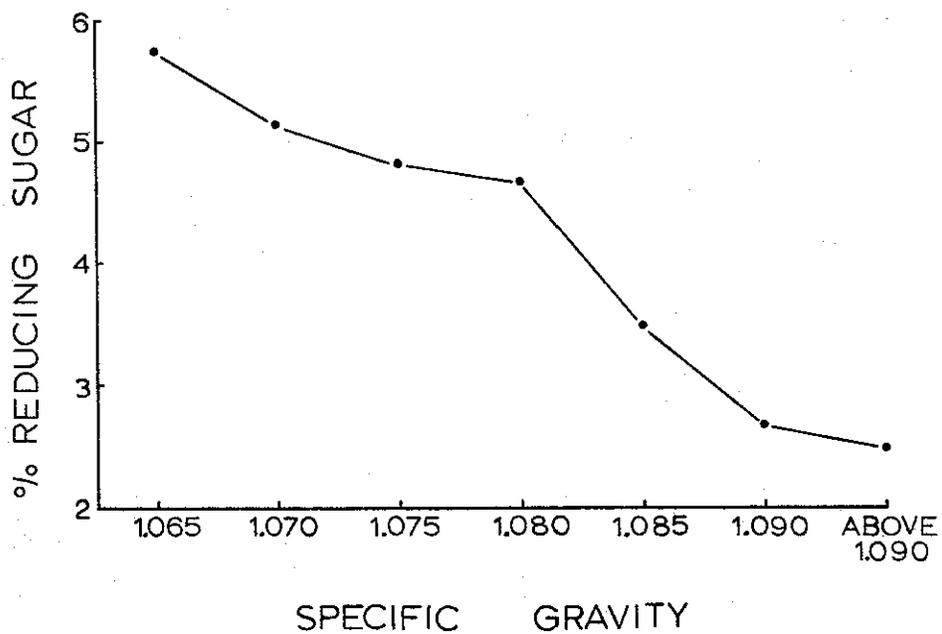


Table 1. Effect of fertilizer rate during growth on sugar accumulation in storage.

Variety	Fert. Rate lbs/A of N	% Reducing Sugar
Kennebec	100	2.06
	400	1.61
Russet Burbank	100	3.02
	400	1.32

Fig. 2. The effect of elevated temperatures previous to storage on ultimate reducing sugar accumulation in storage.

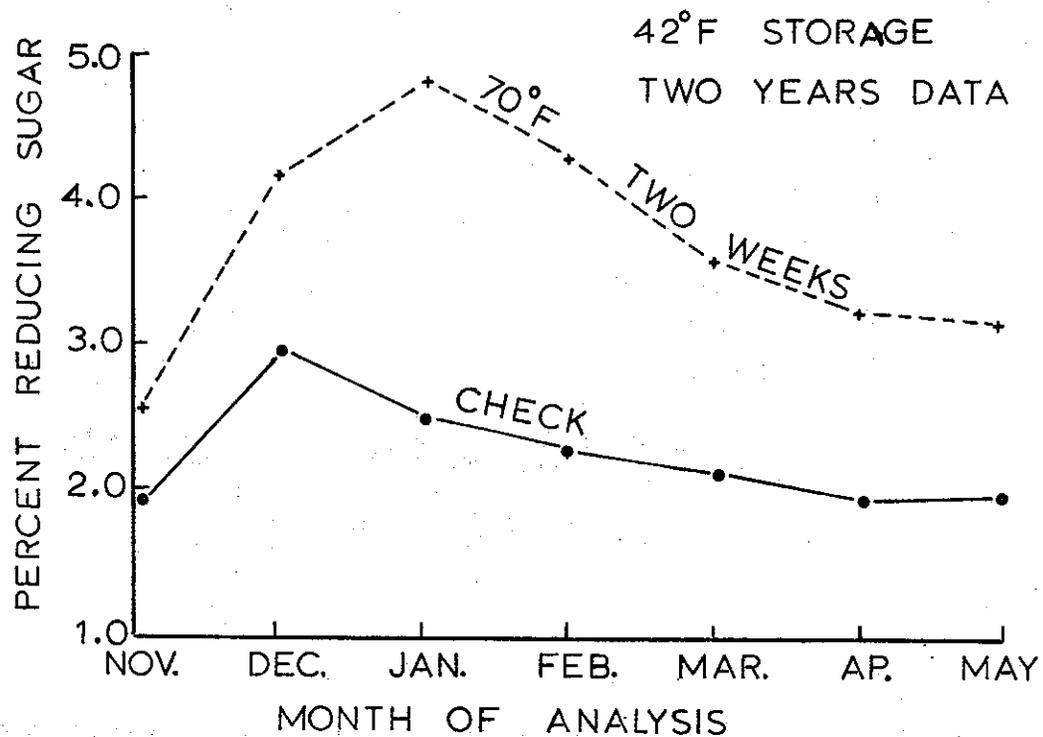


Table 2. Effect of relative maturity on sugar accumulation in storage.

Season	% Reducing Sugar		
	Mature	Immature	Over
1968-69	3.0	4.3	3.6
1969-70	3.2	4.2	---
1970-71	2.6	3.5	---
1971-72	3.6	4.2	---
1972-73	2.9	4.1	---

Fig. 3. Effect of malformed tubers on sugar accumulation at storage temperatures of 42F.

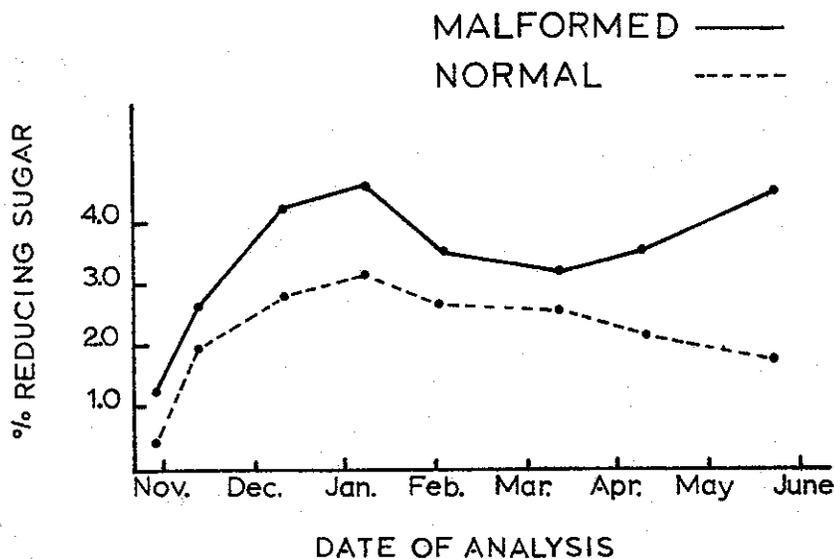


Table 3. Influence of early storage temperatures on ultimate sugar accumulation in storage.

Season	Percent Reducing Sugar							
	Constant 42F		Nov. 48-42F		Jan. 48-42F		Constant 48F	
	S*	B	S	B	S	B	S	B
1970-71	3.9	1.3	-	-	2.7	1.0	1.7	0.0
1971-72	4.8	1.9	4.0	1.7	3.0	0.8	1.7	0.0
1972-73	3.5	1.3	3.0	0.6	1.9	0.0	1.3	0.0
AVE.	4.1	1.5	3.5	1.1	2.5	0.6	1.6	0.0

*Stem portion as opposed to (B) bud portion of tuber.

The present recommendation is to cool potatoes to 50F as rapidly as possible after placing in storage. Research results (Table 3) indicate that the longer potatoes are kept at 48 to 50F, less accumulation of sugars occur when temperatures are finally lowered to 42F or the desired holding temperature. Generally, temperatures of 48 to 50F are a good compromise temperature which keeps progression of rot to a minimum while not allowing sugar accumulation. There is a linear relationship between low temperatures and sugar accumulation. With lower temperatures more sugars accumulate.

On the average, malformed tubers accumulate more sugars than normally shaped tubers primarily because the shape is an indication that stress has occurred (Fig. 3). It is important that potatoes are allowed to grow at an even rate. Any condition which allows stoppage or slow down and rapid regrowth would cause misshapen tubers.

Harvest and storage late in the fall after tuber exposure in the field to temperatures of 40 to 45F is highly undesirable because of the danger of field accumulation of sugars. Also the tubers do not get properly suberized because they are generally never warmed to suberizing temperatures.

We have discussed some of the factors during growth and harvest which cause sugar accumulation in storage. Most of the factors can be controlled, however there are some over which only a degree of control can be achieved. Nevertheless I hope that grower understanding has increased to the extent that decisions which have to be constantly made in regard to growing and harvesting a crop can be on a basis of understanding rather than guesses.