

## Sugar ends in storage

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Sugar ends is a physiological disorder that can show up in either the bud or stem end of a tuber, and usually won't become apparent until exposure to colder temperatures (approximately 50°F or below) – either in the field or in storage. Unfortunately, if you are seeing sugar ends or jelly end rot in your stored potatoes, the stress that caused the problem actually occurred early in the growing season during tuber initiation and early tuber bulking. Potatoes don't lie and will show when they were stressed- if the sugar end symptom is expressed at the stem end of the tuber it indicates the stress happened early in the growing season. High temperatures alone or in combination with inadequate soil moisture experienced at this critical tuber development stage can cause sugar ends.

The 2013 growing season in Idaho experienced conditions favorable for sugar end development: drought conditions, initiation of hot weather coinciding with tuber initiation and early tuber bulking, and continued warm day and night temperatures for many weeks. Field differences in the incidence of sugar ends can be observed based upon planting date, field location, soil type, soil compaction, crop rotation, fertility, soil moisture, irrigation, and variety. Basically, anything that affects the timing of tuber development compared to the onset of heat or water stress, or impacts the development of the plant canopy that shades the soil and reduces soil temperature, can have an effect on incidence of sugar ends. It should also be pointed out that some varieties, such as Russet Burbank and Ranger Russet, are more susceptible to sugar end development. Unfortunately, since the stress that causes sugar ends to develop occurs several months prior to harvest, it can take a lot of detective work to identify which factors contributed to sugar end development in any given field of potatoes.

A little background on sugar end development. The carbohydrates (starch and sugars) found in a tuber originate in the leaves as sucrose formed via photosynthesis. The majority of that sucrose produced in leaves is translocated downward to developing tubers. In a tuber, most of the sucrose gets converted into starch and the remaining sucrose is used for respiration. Since this is a reversible process, starch can be converted back to sucrose. Under normal growing conditions, it is typical for a tuber to favor starch production. However, the stressful conditions of high temperature and water deficits causes starch formation not to be favored and carbohydrates stay in the form of sucrose. Sucrose can then be broken down into glucose and fructose (reducing sugars). Reducing sugars react with free amino acids in the presence of heat (frying) to form a darkened color of fried products. Once that tuber has damaged membranes due to the environmental stress, it loses the ability to compartmentalize the various biochemical constituents. Essentially, things mix together within the cell that normally would not. This allows reactions to occur that produce reducing sugars and subsequently the darkened fry color. Sugar end development is not reversible, once you have it, it will not heal itself.

What can you do in storage to manage sugar end potatoes? Preconditioning, or storing potatoes at warmer temperatures early in the storage season, will not convert that sugar back to starch or respire off the sugars that are present. Holding the crop at a warmer temperature will not decrease the level of

sugar ends in the stored crop. One common definition of sugar ends is if a predominant color of number 3 or darker, when compared with the USDA Munsell Color Chart for French Fried Potatoes, is seen on any 2 sides extending ½ inch or more from the end of the fried strip. Holding temperature will not change the 3 or darker designation of the fry strip, but rather potentially change the color of the rest of the fry strip. Instead, focus on managing the storage to limit decay due to jelly end rot and to maintain acceptable color for the potatoes not affected by sugar ends. Be aware that the general collapse of tissue associated with jelly end rot can provide an opening for other pathogens to infect the tuber, and monitor the storage regularly to spot problems before they become unmanageable.

There is an excellent scientific summary on sugar ends by Thompson et al. called 'Review of the Sugar End Disorder in Potato' published in the American Journal of Potato Research in 2008. If you are a member of the Potato Association of America you can access it electronically for free.