BRUISING WHOLE AND CUT SEED TUBERS - *IMPACT ON YIELD, QUALITY AND POTENTIAL GROWER RETURN*

(Jacques Lavoie, P. Ag., Seed Potato Specialist, NBDAAF, Wicklow, email: jacques.lavoie@gnb.ca**)**
(Janet McLaughlin, Potato Research Technician, NBDAAF, Wicklow, email: janet.mclaughlin@gnb.ca)

Of all the aspects in potato production, it is the reduction of physical damage to whole and cut seed that offers the most significant improvement at minimal cost. This includes both harvest and post-harvest handling, beginning with the seed grower and ending with the commercial grower.

This can be accomplished by a combination of management practices:

1. Uniform plant stands and proper application of nutrients during the growing season.
    - Helps ensure a uniform crop with minimum off type and knobby tubers that can be easily damaged.
2. Timely vine kill to allow adequate skin set.
    - Protects the tuber during harvest and subsequent handling.
3. Timely harvest of varieties susceptible to bruising.
    - Harvesting after a good rain when soils are damp allows for more soil to be carried in the bed and damaging clods to be softened.
4. Proper tuber temperature during harvest to prevent the tuber from getting too dry.
    - Tuber temperatures below 50°F (10 °C) can lead to severe and unacceptable shatter bruise during harvest.
5. Proper adjustment and operation of the harvester.
    - Essential for a bruise free harvest.

Research indicates a yield increase of 20% and more is possible with “proper management practices”. A third of total yield reduction is the result of handling injuries occurring before the seed reaches the commercial growers’ storage. The balance of the yield loss (67%) is due to bruising after cutting.

It is widely accepted that large tubers are very difficult to handle without significant levels of bruising. Large tubers are more likely to bruise than smaller whole seed due to the weight/impact energy difference and the amount of cell tissues that absorb the impact energy. These bruises occur before the seed is cut.

Healthy tissue below the blackspot bruise (Fig. 1 a & b) cannot heal due to lack of oxygen. Each injury site is an open door for decay pathogens to become established.

Fig. 1 (a)

Fig. 1 (b) *Potatogrower.com*

Intact potato skin is an excellent barrier to most decay-causing pathogens but when bruised the decay organisms can easily enter through the skin (Fig. 2(a, b)). Essentially, the potato loses its defense. The more favorable the conditions, the faster the tissue break down will occur (Fig. 2(c)).

Ruptured Skin
Fig. 2 (a)

Seed Piece Decay
(b)

Tissue Breakdown
(c)

"Controlling seed potato decay organisms is difficult."
Preventing conditions that favor infection through skin openings is the first order of defense!

When an infected tuber (Fig. 3 (a)) is cut into seed pieces (Fig. 3 (b)), the disease further spreads to each subsequent seed piece (Fig. 3 (c)). Once the fusarium fungus spreads and begins to attach itself, it makes the seed piece vulnerable to other serious diseases such as blackleg and soft rot (Fig. 3(d)).

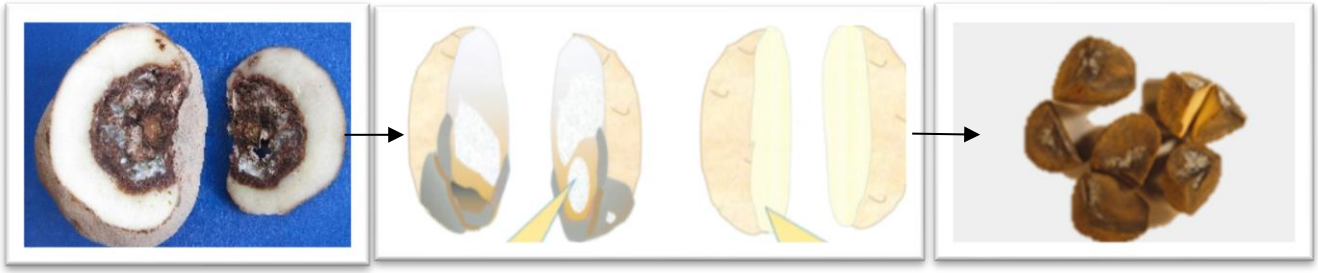


Fig. 3 (a) **(b)** **(c)** **(d)**

Seed piece treatment cannot be expected to stop this cycle. In fact, when applied at high rates, seed piece treatment becomes like wet plaster and reduces the amount of oxygen reaching the

cut surface of the seed. This may actually promote bacterial seed piece decay. Seed piece treatment offers no protection against bacterial soft rot!

Seed piece decay can cause significant stand reduction and crop losses of up to 25% (Fig. 4 & 5).

Fig. 4

Fig. 5

Over 90% of seed decay that becomes established in the seed piece after planting enters through a bruised site. This decay consumes part of the energy contained in the seed piece leaving less for the developing plant. The result is a decaying seed piece that behaves like smaller seed, producing a less profitable crop (Fig. 6, 7 & 8).

Fig. 6

Fig. 7

Fig. 8

Remember:

- No seed treatment will compensate for poor quality seed!
- There is no return for a missing plant, yet it still receives the same input as a healthy plant.

Keep in Mind:

Planting diseased seed almost always guarantees there will be consequences to deal with later! Some pathogens act alone in the crop, but many interact and cause greater damage. **There are few, if any, disease cures** so the best course of action is prevention!

Buy clean seed!
"It's a great investment!"

Seed cutter performance is the next cause of good quality seed not reaching the fields. Why? It all comes down to the many drops (not to mention the height of the drops) that cause bruising, and the dull knives that cause torn flesh damage and seed piece decay.

Seed tubers are sized on the cutter by adjusting the spacing of the sizing rollers. The separation occurs as a result of a gravity-induced free fall, often exceeding 24 inches (61 cm), onto steel slopes and hard rollers. Energy impacts of this magnitude cause bruise damage at an unacceptable level! (Fig. 9 & 10)

Fig. 9

Fig. 10

The situation is further compounded as the cut seed drops from the cutter onto the conveyor. Cut seed will not remain bruise free even with free fall drops as minimal as 6 inches. The larger tubers stay on the upper level of the cutter and once cut are allowed (forced) to free fall up to 4 feet (1.2 m) onto a belt, chip trolley, or other seed pieces.

Additionally, the seed treatment equipment increases the damage while completing its task. (Fig. 11)

Fig. 11

"The majority of the seed pieces that drop this far will bruise no matter what!"

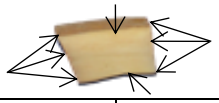
Current mechanical seed-cutting equipment produces a cut seed profile that varies considerably with changes in whole seed size.

Whole and minimum cut seed (1 cut surface) offers many disease and cost effective advantages over multi-cut seed.

- Ideally, all seed less than 3.5 oz (99 g) should not be cut.
- Seed from 3.5 to 6 oz (99 to 170 g) should be cut only once through the center of the tuber.

Cut seed is extremely fragile compared to whole seed. Drops of only 3 to 6 inches (7.6 to 15 cm) will cause tissue to crush (bruise when impact occurs on the edge and corners of the cut seed piece). These crushed cells are dead and therefore unable to heal and suberize properly. Healing each cut surface requires an amount of stored energy equal to that contained in ¼ to ½ oz (7 to 14 g) of the seed tissue. The remaining energy is what the new plant uses for its early season growth. "Productivity" of seed pieces equal in weight is dependent on the number of cut surfaces (Table 1). By comparison, cut seed is extremely fragile. Corners and edges along the cut surface are more susceptible.

Table 1. Consequence of the level of bruises 3" (7.6 cm) drop and 6" (15 cm) drop 2 ¼ oz (64 g) seed bruise susceptibility of Russet Burbank @ 55°F (13°C)

Treatment	Whole 	90 Center Edge 	90 Skin Edge 	Edges and Corners 	
3"	0%	82%	88%	89%	93%
6"	6%	97%	100%	100%	100%

From Steve Holland

Remember:

- 95% of bruising that occurs after the seed is cut is located on the edges and corners.
- Seed cut from small tubers have considerably smaller linear edge dimensions and no corners compared to seed pieces cut from larger tubers.
- As seed tuber size increases, the more cut surfaces and greater cut surface area per seed piece is realized.

Bruise and decay incidence increase rapidly as the number of edges and corners of cut seed increases. Strong correlations exist between elevated seed piece bruise and a failure to emerge, weak plant numbers, and increased stem numbers. Missing plants can have a negative impact on yield and quality, while increased stem numbers may result in elevated tuber sets. For the seed grower, elevated tuber sets are fine but for the processing grower, it can mean a smaller tuber size profile!

"Without optimal mother tuber seed size (<9 oz (<255 g), ideally <6 oz (<170 g)), an uphill battle will be fought from the very start!"

In addition to limiting and lessening the drops during seed preparation, the continual checking and re-sharpening of knives, to ensure clean cut surfaces, is required. Dull knives cause considerable amounts of torn and compressed tissue damage below the cut surface. Torn tissue ultimately heals without excessive decay loss, but the tissue deteriorates and discolors (1/16 to 1/8"). If this damaged tissue is trimmed, 10% of the seed piece weight could be removed. Less healthy flesh planted equates to less energy for the seed piece to get established!

Consider for a moment the drops going from the cutter to the planter. How many drop heights of less than 12 inches exist (30 cm) (if any) and how many are greater than 12 inches (30 cm)? Loading the planter produces more free fall drops ranging from 2.6 to 7.6 feet (0.8 to 2.3 m), the difference being due to the diverse range of equipment available today. Some equipment

allows the boom of the conveyor to be lowered into the empty hopper while others do not! The average operation drops seed 5 feet (1.5 m) or more into the empty planter, a distance that can inflict considerable damage on the first seed pieces loaded. **The use of a conveyor with hydraulic height adjustment and a vertical extension into the planter box greatly increases the ability to load the planter hopper with minimum damage to the seed!**

Remember:

The goal is to eliminate or at least reduce the cause of seed injury. Each and every seed handling process needs to be examined and refined! Seed severely abused generally performs well below desired expectations.

"Maintaining <u>sound seed</u> is a great investment!"

Important facts to remember:

- University of Idaho surveys have found seed samples that were up to 70% bruised. Some pieces revealed 2 or 3 severe bruises.
- Some losses can run over $300/acre as a result of improper seed handling leading to bruising.
- As many as 15 bruise sites on a single cut seed piece of a 2 ¼ oz (64 g) size range can be reached.
- An overall average of 8 bruises per seed piece can be realized by the time the seed is planted.
- 75% of the bruise sites develop some level of decay infection, severely impacting the yield potential.

HANDLE ME CAREFULLY – NO DROPS OVER 6 INCHES

Remember…
Bruise and "You" Lose!!