

## Best Management Practices of Bacterial Ring Rot (BRR) of Potatoes



Bacterial ring rot (caused by *Clavibacter michiganensis* subsp. *sepedonicus*) is one of the most serious diseases of potatoes in Canada. It is highly infectious and is readily spread by potato cutters, planters, harvesters and even containers. There is zero tolerance for this disease in seed potatoes.

The bacteria overwinter in slightly to moderately infected tubers which may not exhibit symptoms. In Atlantic Canada, the bacteria do not overwinter in field soil but may survive in volunteers. Bacteria can persist for years in dried slime on potato bags, bins, machinery, and storage walls and floors. Ring rot symptoms may first appear 60-70 days after planting, but disease expression is dependent on climate and potato cultivar. Under warm growing conditions, all of the plant symptoms may be detected, while under cooler conditions, few or none of the symptoms may be seen. The first symptoms generally appear in the lower leaves. The leaves become pale-yellow with mottling and may display signs of wilting. As the disease progresses and moves upward, this leaf yellowing can intensify producing a bar of bright yellow tissue between the veins. The leaf margins often curl upward, roll inward and eventually a dead brown area develops. This can be limited to a single stem at first. With severe infection, the whole plant will eventually wilt and die. Tuber symptoms may be visible at harvest or during storage, but for some cultivars and under certain growing conditions, infected tubers may not show symptoms and require serological detection methods. Tuber infections usually begin at the stem end, and when cut, creamy yellow to tan areas of infection are found in the vascular tissue. Often when the cut tuber is squeezed a sticky, cheesy bacterial ooze can be forced from the vascular ring causing tissue separation. As the disease progresses, the tissue surrounding the ring becomes infected and often the entire center of the tuber disintegrates, leaving only the outer shell of the potato. Externally, the tubers from diseased plants may appear normal. If badly affected, the skin may have pale reddish-brown patches which gradually darken and become slightly sunken. Often irregularly shaped cracks appear in these areas. At this stage the tuber may become infected with the common soft rot bacteria, becomes slimy, and gives off an offensive odor.

Currently there are no effective methods available to control BRR. In addition, none of the potato cultivars currently available are immune or resistant to the disease. A single tuber can therefore lead to significant economic loss in several ways which include:

- a. Direct crop loss during growth and storage.
- b. Rejection of infected seed lots.
- c. Destruction of infected crops and restricted marketing of associated crops.
- d. Extra cost for safe disposal and disinfection.
- e. Restriction on further cropping, etc.
- f. Loss of export markets and restrictions to new markets.

## Employee Protocol

1. **Educate employees** about BRR and the proper precautionary measures required to avoid spreading the disease.
2. **Be aware of employees who may work for more than one employer**, especially if they are working for another grower or a processing facility.
3. **Ensure employees/visitors properly disinfect their footwear prior to entering the farm operation.**
4. **Supply clean gloves for all workers.**
5. **Adhere to all phytosanitary protocols for all agricultural equipment and apparel** (boots, pants/coveralls, knives, etc.). Change gloves regularly.

## Spring Preparation

1. **Regularly clean and disinfect** all machinery, equipment, containers, vehicles, and storage facilities used. Thoroughly wash all soil and debris from machinery and equipment prior to disinfecting. Disinfectants are rapidly absorbed/neutralized by soil particles and organic material significantly reducing their effectiveness.
2. **Maintain a minimum temperature of 82°C (179.6°F) for 5 minutes** (required for complete inactivation of the bacterium).
3. **Disinfect all equipment between varieties/certification numbers** when cutting seed, planting, working in the field, harvesting, and storing.
4. **Mix disinfectants at the recommended label rate.** More chemical does not mean better control (refer to publication #1300 A for a list of recommended disinfectants).  
**Note:** Disinfectants must come in contact with all surfaces and remain moist for a minimum of 10 minutes after treatment (always refer to label recommendations).
5. **Replace “open cell” foam rubber rollers which can carry inoculum with “closed cell” rollers.**
6. **Ensure careful handling and grading practices to minimize tuber damage.** Cross infection of stock occurs most commonly via superficial damage of tubers coming in direct contact with infected tubers, contaminated machinery, or wash water.  
**Note:** There is clear evidence that contaminated wash water from infected tuber lots can transmit the pathogen to subsequent lots washed in the same water during packing (up to 48 hours after washing). Disinfect and change the water between lots from different origins. Change your solution often to ensure and maintain the proper strength to effectively kill the bacteria.
7. **Properly dispose of surplus stock and monitor cull piles frequently for plant growth.** Plants growing from cull piles should be killed with herbicides as a safeguard against becoming a possible inoculum source.

## Seed Pick Up by Growers

1. **Ensure trucks from commercial potato farms have been cleaned and disinfected prior to entering** a seed storage or seed handling area. Always suspect equipment used for hauling potatoes to starch factories, processing facilities, or commercial packing plants to be carrying BRR and treat accordingly.
2. **Control/limit access of people and other equipment (trucks) entering your seed potato storage.** Storages should always be locked, and a logbook kept recording those who enter the storage facility.
3. **Never allow seed potatoes that have left your operation to be returned.**

## Obtaining Seed from Other Growers

1. **Always carry disinfectant bottles with you.**
2. **Limit visits** to other potato operations and always disinfect yourself when finished.
3. **Only load seed on a clean and disinfected trailer.** Trailers can be a major source of contamination, spreading BRR.

4. **Frequently inspect tubers at the pick-up point.**

### Planting/Growing Season

1. **Plant seed fields first.**
2. **Use only certified seed produced under a system with zero tolerance for BRR.** All certified seed potatoes produced in Canada must be derived from material found free from the disease. Although this does not guarantee complete total freedom from BRR, it is the best assurance that growers can have.
3. **Utilize a limited field generation production system** (flush-through).
4. **Plant whole or single drop seed.** This helps to greatly reduce the spread of BRR.
5. **Prohibit visitors from entering fields.**
6. **Spray, cultivate and hill seed fields first.**
7. **Do not share equipment** between seed and commercial farms.
8. **Rotate crops.** Do not plant potatoes in the same field two years in a row. BRR free seed, planted in a field with potential ring rot the previous season, may become infected.
9. **Destroy volunteers** growing in a previously infected field. Infected volunteer potatoes can remain infectious over several generations. Spreading may occur through contact of infected volunteers during harvesting and handling of a subsequent field crop.
10. **Control insects**, especially Colorado Potato Beetles (CPB). CPB adults and larvae feed heavily on foliage, consuming nearly all the leaves during times of heavy infestation, increasing the risk of infection. This pest also spreads several potato diseases including brown rot and spindle tuber. Aphids, leafhoppers and other potato plant insects also can transmit the bacteria.
11. **Closely monitor fields.** Be aware of the symptoms of BRR and check thoroughly for typical symptoms of stunting (particularly late in the season).
12. **If found immediately process or dispose of the potato lot** from which BRR was detected. These should not be placed in storage. Good seed trace back on BRR occurrences in commercial potato production is a must.
13. **If shipping, contact the necessary processors and packers** to explain your BRR situation. Allows proper measures to be enacted to reduce the possibility of spreading the disease.

### Harvest

1. **Harvest seed fields first.**
2. **Keep all seed lots separate.**
3. **Check harvested tubers for signs of the disease shortly after harvest.**
4. **Laboratory test.** The bacterium causing BRR may be latent in a seed lot and not exhibit symptoms for up to two years. This may cause it to go undetected during visual inspections. Laboratory testing of seed tuber samples for latent infection is an essential component for managing the disease. However, it is important to remember that potatoes cannot be guaranteed free of BRR based on visual inspections or laboratory testing.
5. **Collect samples according to protocol.** BRR test results of seed stock are only as accurate as the sampling procedure. Low incidence may not be detected if inaccurate sampling occurs. This could lead to infected tubers bringing bacteria onto a clean seed farm, resulting in cross contamination during the seed cutting operation. Dollars spent on testing are wasted unless a representative sample is provided.
6. **Ensure an adequate supply of seed is kept for planting next season's crop.** This helps avoid the temptation of purchasing seed from another source.

### BRR Found in Storage

1. **Immediately process or dispose** of the potato lot from which BRR was detected. Good seed trace back on BRR occurrences in commercial potato production is a must. Detection of low levels of BRR on a commercial seed farm, as well as good record keeping and segregation of crops from different seed sources, can help to identify the source of infected seed.

2. **Thoroughly clean storage and equipment** to reduce the chance of remaining bacteria to contaminate incoming certified seed lots and consequently next year's potato crop.
3. **Contact the necessary processors and packers** to explain your BRR situation. This allows proper measures to be enacted to reduce the possibility of spreading the disease.
4. **Discard all potatoes that have been handled by anyone other than yourself or your regular employees.**
5. **Do not dump discarded potatoes and waste from potato processing back onto fields.** These can harbor the disease.
6. **Burn and properly dispose contaminated bags.** Used potato bags for handling seed is a primary way for ring rot to spread. It is very difficult to kill ring rot bacteria in contaminated bags.

**Contacts:**

Dr. Khalil Al-Mughrabi: khalil.al-mughrabi@gnb.ca  
Jacques Lavoie: jacques.lavoie@gnb.ca

Potato Development Centre, New Brunswick Department of Agriculture, Aquaculture and Fisheries, 39  
Barker Lane, Wicklow, New Brunswick E7L 3S4, Canada. Tel: (506) 392-5199