

- Disease-free areas can become infected through infected planting materials, contaminated run-off water, contaminated farm tools such as knives and hoes used for cutting tubers, and through contaminated soil sticking to farm tools and shoes.
- Wash tools, shoes and boots with 0.5% household bleach or peroxygen products while moving from one field to another. Metal tools can also be disinfected in fire while farmers are preparing their meal.
- Avoid run-off from infected fields. The best way is to produce seed potato on the top of hills or on the slopes above ware potato production and other Solanaceous crops. Making ridges or contours also limits runoff.

Negative selection

- Negative selection means roguing out plants with symptoms of bacterial wilt, suffering from poor vigor, disorders or other serious problems from a relatively clean seed potato plot.
- Remove all atypical plants and weeds from the seed plots (Fig. 3). This is done by digging out the whole infected plant with its root system, tubers, stolons and the soil around it should be collected and buried at least one-meter underground. The five neighboring plants should also be rogued out and burnt or buried as well.
- Infected and symptomatic plants should be removed with its root system, tubers, stolons the soil in the holes where the plants are rogued from is mixed with ash (2 hands-full) or lime (1 hand-full). Ashes and lime work as disinfectant and are known to kill the bacteria by increasing the soil pH.

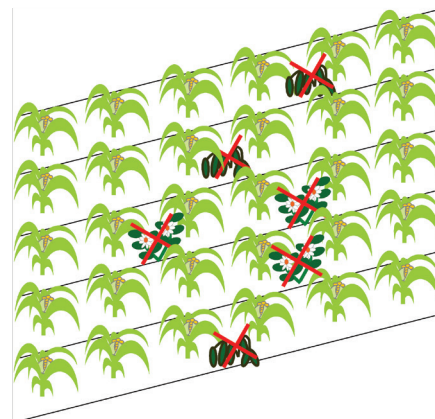


Figure 3. Removal of a typical plants and weeds crops from potato field



Figure 4. Farmers harvesting 'Select the Best' trial

Positive selection

- Positive selection means selecting healthy looking plants as mother plants for the next generation of seed potato. Bacterial wilt is a vascular disease and moves from plant to the tubers. If these tubers are planted again, they will produce a sick plant. Most of the farmers select seed from their own potato crop, thereby mixing sick and healthy tubers.

By pegging plants without disease symptoms for seed selection, the number of sick plants in the next crop can be reduced (Fig. 4).

- Positive selection involves pegging the healthy looking plants at the flowering stage and checking the health of pegged plants 2 weeks later and removing the pegs from plants that have developed disease symptoms. Harvest the pegged plants one by one before the rest of the field, and select the small tubers of 30–60-mm diameter and store them separately in clean disinfected containers (Fig. 4). These seed tubers could be then used for subsequent seed multiplication or for ware potato production.
- Avoid positive selection in a field with more than a few wilting plants (more than 2% of all plants wilting). If positive selection is carried out in a field with few wilting plants, avoid all plants closer than 1 meter to a wilting plant.

Crop rotation and intercropping

- Follow crop rotation with the non-host crops such as beans, barley, wheat, onion, shallot, carrot for minimum one season if there is no bacterial wilt, two seasons if less than 5% of plants are in the fields are wilting, and three to five seasons if more than 5% of plants are wilting.
- Intercropping or relay cropping of potato into cereal and legume cropping systems also helps to reduce the buildup of pathogen in the field.
- Flushing of seed potato field with new seed stocks after five generations of the same seed source is very important. While producing same seed source for several generations, seed producers are required to start over again with new seed stocks to prevent the buildup of soil borne pathogens in the soil.

Photo credit: CIP-CPAD

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The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change and the preservation of our Earth's fragile biodiversity and natural resources.

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Strategies for Bacterial Wilt (*Ralstonia solanacearum*) Management in Potato Field: Farmers' Guide

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Introduction

Bacterial wilt, caused by *Ralstonia solanacearum* is a serious disease of potato in temperate and subtropical climates. It primarily infects host plants through the roots by penetrating the host through microscopic wounds caused by the emergence of lateral roots. Other common causes of root wounding are transplanting, nematodes, insects and agricultural equipment that allow the bacterium to enter the plant. Once infection has occurred in the roots, the bacterium colonizes the cortex and makes its way towards the xylem vessel, from where it rapidly spreads in the plant. Bacterial masses prevent water-flow from roots to the leaves, resulting in plant wilting.



Signs and Symptoms

Above-ground symptoms include wilting of 1-2 leaves on young plants during the heat of the day (Fig.1. A). Such plants tend to recover at night. In a severe case, the plant will eventually fail to recover and die (Fig. 1. B). Unlike the fungal wilts, the leaves remain green in bacterial wilt.

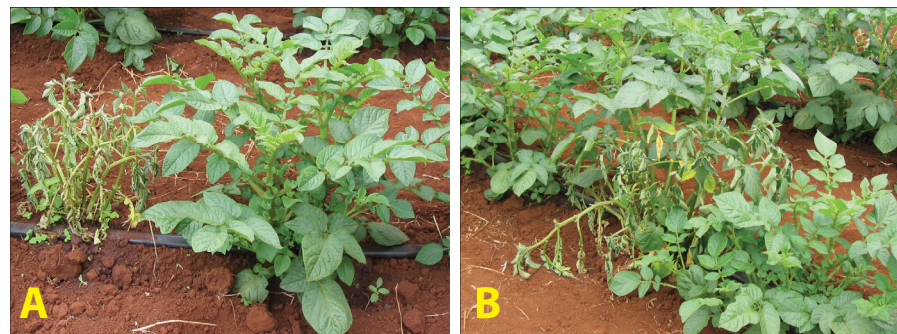


Figure 1. (A) whole potato plant wilting and (B) partial wilting,

When an infected stem is cut across and the cut ends held together for a few seconds, a thin thread of ooze can be seen as the cut ends are slowly separated. If one of the cut ends is suspended in clear water, a white and milky stream of bacterial cells and slime will flow from vascular system of the infected stem into the water in 3-5 min (Fig 2).

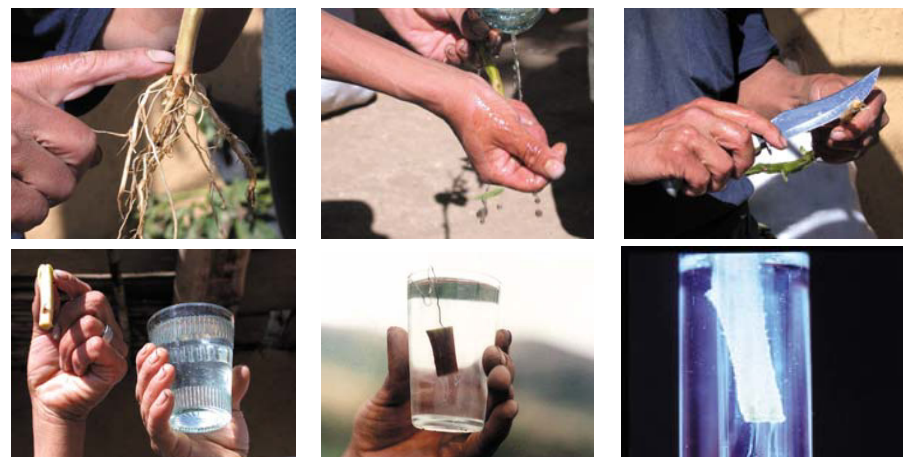


Figure 2. Steps in vascular flow test

Tubers may rot and a brownish discoloration of the vascular ring could be seen in the cross-section of the tuber (Fig. 3 A). Slimy, sticky pus may exude from the ring when the tuber is squeezed (Fig. 3 B, D). Pale ooze may exude from eyes and heel end of potato tubers (Fig. 3 C). Soil will adhere to the oozing eyes (Fig. 3 C).

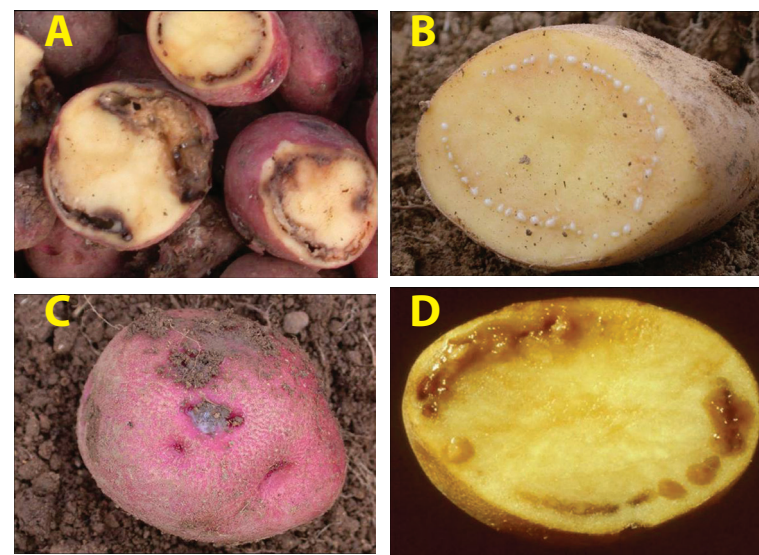


Figure 3. Oozing symptoms, (A), rotting of the tubers, (B) ooze coming from the vascular ring, (C) oozing eyes and soil sticking to the eyes and (D) vascular browning.

Host range

The pathogen has wide host range, and can infect more than 200 plant species in 33 different plant families including tomato, tobacco, eggplant, chilli, peppers, jute and geranium. A few ornamentals and some common solanaceous weed species, including bittersweet (*Celastrus orbiculatus*), nightshade (*Solanum nigrum*), jimsonweed (*Datura stramonium*) and stinging nettle (*Urtica dioica*) are also hosts, and are commonly found in Ethiopian environment.

Survival

Ralstonia solanacearum can survive for various periods of time (few months to years) in infested soil or water, forming a reservoir for source of inoculum for the pathogen. It can survive during the winter in semi-aquatic weeds, in plant debris or in the rhizosphere of non-host plants that act as reservoirs for the pathogen and release bacteria when conditions become favorable for the bacterium.

Dissemination

It is disseminated by contaminated soil, water, equipment, and farmers and/or by transplanting infected plants, tubers, or cuttings. Infected seed potatoes are an important factor in the distribution of the disease from one field to another. Dissemination of the bacterium in potato occurs from plant to plant when bacteria move from the roots of infected plants or weeds to roots of nearby healthy plants in the soil, usually by water movement. It can also spread from infested to healthy fields by soil transfer on machinery and surface runoff water after irrigation or rainfall. It also can be disseminated from infected ponds or rivers to healthy fields through waterways. In cool conditions, infected potato plants may harbor the bacterium without exhibiting symptoms and transmit the disease to progeny tubers, resulting in severe outbreaks if grown under warmer conditions.

Management

Bacterial wilt is difficult to control (or eradicate) because of its soil-borne nature and persistence in the soil for a long time. No single management strategy effectively prevents losses caused by bacterial wilt. There is no cure once a potato plant or tuber is infected with bacterial wilt. This means that control measures should be applied to prevent initial infection. When infection has already occurred, then measures are needed to contain the disease. Therefore, the containment strategy for bacterial wilt should follow the system approach that incorporates specific operational practices to reduce the likelihood of incursion, establishment and growth of *R. solanacearum* in potato crops. Farmers and extension agents should follow below strategy to contain and manage bacterial wilt in potato field.

Educate farmers for safe production practices

- Training farmers in safe production practices such as sanitation and cultivation practices, removal of potato haulms and rotted tubers, weeding, rouging volunteer and wilted potato plants, farm tools decontamination, use of uncontaminated water etc. which can prevent the introduction and establishment of the pathogen in the field.

Learn to recognize problem, symptoms and signs

- Proper disease control tactics cannot be implemented unless the correct disease problems are identified. Accurate diagnosis results in using the right management tactic at the right time and place. Therefore, accurate and early diagnosis is necessary for employing a successful management program for bacterial wilt.

Use disease free seed potato and plant them in BW-free areas

- Always use BW free seed potato and plant them in disease free areas or in a plot where potato or crops from *Solanaceae* family has not been grown before.