The battle against *ERWINIA*

How can we win this disease in South Africa?

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The most common bacterial diseases on potatoes are caused by pectolytic *Erwinias* namely, *Erwinia carotovora subsp. atroseptica* (Eca), *E.carotovora subsp. carotovora* (Ecc) and *Erwinia chrysanthemi* (Ech). Direct and indirect crop losses due to these pathogens are considerable, especially in certain production areas.

***Erwinia* soft rot on potato tubers**

The seed and table producers seem to struggle with the same problem especially in warmer seasons. However, the table potato market seems to be worse off due to soft rot occurrence in stored pro-

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***Erwinia* wilting on potato plants.**

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duce. Conditions that predispose potatoes to infection include: warm, humid weather conditions; dipping of tubers before planting; cutting of tubers, washing of harvested produce and treatment with fungicide. The fungicide treatment disposes of all the competition for the pathogen and creates a biological 'vacuum' that *Erwinia spp*. takes advantage of. Another invisible culprit - and sometimes the most devastating - is the latent infection of tubers with *Erwinia spp*. There are no visible symptoms that can give lead to suspicions and because of a lack of suitable detection methods, the problem persists. The *Erwinia spp.* population on the tuber surface also plays an important role in disease development. When deciding on a suitable pre- or post-harvest treatment of tubers, the amount of water used and the inoculum density on the tuber surface are the two main factors to consider.

Soft rot

Symptoms of soft rot include rotted tissues that are wet, cream to tan in colour, and soft. Rot begins on the tuber surface and progresses inward. Infected tissues are sharply delineated from healthy tissue by dark brown or black margins. Rotting tissue is usually odorless in the early stages of decay, but develops a foul odor as secondary organisms invade infected tissue. Soft rot can also infect wounded stems and roots. In areas where soft rot is particularly prevalent it is important to plant cultivars that show resistance to the disease.

Blackleg

Plants with blackleg are stunted and have a stiff, strained growth habit. Foliage becomes chlorotic and the leaflets tend to roll upward at the margins.

Stems of infected plants exhibit an inky black decay. The base of the stem is often completely rotten. Tuber symptoms for blackleg are similar to those of soft rot.

The soft rot *Erwinia spp*. may cause symptoms similar to blackleg but lack the characteristic inky black decay. Blackleg, which is initiated by the pathogen from the rotting mother tuber, is often confused with aerial stem rot which originates in wounds on the aerial stems and is caused by air- or water (irrigation)-borne *erwinias*. The range of symptoms expressed varies and is strongly modified by environmental conditions, e.g. a soft rot tends to occur under wet conditions while wilting and desiccation predominates under dry conditions.

Survival of *erwinias* in soil is limited and less than the time lapse (three to five years) from one potato crop to another in an average crop rotation system. In potatoes the infection site is usually the lenticel, but decay can be initiated wherever the pathogen has entered the tuber, e.g. at the stolon

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end or through wounds and bruises. In storage, rotting usually starts in small pockets and then spreads rapidly, resulting in massive decay of the tubers. Potato tubers have a higher potential risk of forming bacterial soft rot immediately after major handling processes such as harvest, washing and cutting seed pieces.

It is now known that seed from blackleg-free crops can produce blackleg plants and vice versa. Nevertheless, tubers with stolon end rot from affected plants can be an important source of the bacteria in post-harvest operations. When contaminated mother tubers rot, large numbers of the pathogen present are transmitted by soil water to the lenticels of progeny tubers where they can persist throughout the storage period to planting time.

Moisture and temperature are the two critical factors in initiation and development of soft-rot diseases. High soil temperatures and bruising of seed tubers favour seed-piece decay and pre-emergence blackleg. Blackleg in growing plants is favoured by cool, wet soils at planting followed by high temperatures after emergence. Dense plant canopies and long periods of leaf wetness favour infection of aerial plant parts. Oxygen depletion in tubers also favours soft rot. When seed pieces in soil or tubers in storage become covered with a film of water, the tissues rapidly become depleted of oxygen. This also may be induced by soil flooding or improper drying of washed tubers. Once it starts, tuber soft rot can proceed rapidly in storage. "Wet" areas may develop in the piled tubers that flow onto ones below, spreading the bacteria. Heat, coupled with condensation on tuber surfaces, can further adversely affect storage conditions, resulting in accelerated "melt" of the pile.

Control

Tuber contamination can be avoided by reducing bulking time of stocks; early harvesting before extensive rotting of mother tubers occurs and bacteria spread to the progeny; and harvesting and grading seed under conditions which avoid excessive wounding and contamination from rotting tubers. Alternative methods that reduce seed contamination level can he used, e.g. dry storage in well-ventilated stores. However, there is no guarantee that any of the above measures will consistently produce healthier seed as they are dependent on environmental and other variables. Fungicides do not directly affect these bacterial pathogens, but seed piece treatments with fungicides can reduce invasion by other fungi and therefore reduce opportunistic infection by *Erwinia spp*. The use of disinfectants to control *Erwinia* also show promising results. The use of disinfectants during tuber washing is particularly important due to the fast spread of *Erwinia spp*. in wash water as well as during cutting of tubers.

In the long term, only resistance to infection will achieve consistent control, but previous attempts to breed for resistance have failed because this character is absent in conventional potato breeding lines in which only varying degrees of susceptibility are expressed. Long term disease control clearly lies in increasing the level of disease resistance expressed in current cultivars. There is no easy answer to address the *Erwinia* problem in the South African Potato industry, but in managing the disease a positive outcome can be achieved.

Although the use of certified seed does not guarantee the absence of *Erwinia*, it does imply that the seed crop was evaluated for the presence of *Erwinia* as well as for visual symptoms of soft rot during tuber inspections.