Agrobacterium tumefaciens©

Jan van Schoor
23 Suikerbos street, Blomtuin, Belville 7530, Cape Town, South Africa
Email: science@agricscience.com

BACKGROUND

Agrobacterium tumefaciens is a ubiquitous soilborne pathogen responsible for crown gall disease affecting over 600 types of plants, mainly monocotyledonous species, such as woody and herbaceous plants.

Agrobacterium tumefaciens enters the host through wounds or through the emergence of lateral roots. The bacterium migrates to the point of initial infection through the process of chemotaxis. Chemotaxis is the migration of a pathogen towards sugars and amino acids which accumulate around plant roots in the rhizosphere or to specific plant compounds released from wounds, such as acetosyringone and opines.

Propagating techniques facilitate the infection process through wounding.

Crown gall transfers plasmid DNA into the nuclear genome of the plant cells after infection. *Agrobacterium tumefaciens*, and its related species *A. rhizogenes* and *A. vitris,* are the only known bacterial pathogens that invade plants by transferring their DNA to the plant.

Normal plant cells are transformed into tumor cells. Once integrated into the plant genome, the auxin and cytokinin biosynthetic genes are expressed, resulting in uncontrolled proliferation and growth of the gall. Opine biosynthetic genes are also expressed, and these opines are used only by the gall as its sole carbon source, making it almost independent of the plant. Abnormal proliferation continues even in the absence of the bacterium.

Galls of varying size and shape on the lower stem, crown region, and main roots of the plant appear within 2 to 4 weeks after infection on condition that the average temperatures are 20 °C or above. Temperatures below 15 °C or above 32 °C delay symptom development.

Initially these galls are white, soft, but when older and larger the surface appears dark brown due to the death and decay of the outer peripheral cells. Irregular overgrowths distort the vascular system, disrupting water, nutrient, and hormone flow throughout the plant. The average tumour size is about 5 cm, depending on the host, but galls of up to 30 cm have been witnessed.

Infected plants may become stunted, produce small chlorotic leaves, fewer blossoms and are more susceptible to extreme environmental conditions such as winter, cold, and wind or periods of drought, low humidity, and heat during summer.

Crown gall influences the vigour of nursery stock, the rooting of cuttings, and crop development and if the aim is fruit or flowers, these will be of poor quality.

The formation of hairy roots is another symptom seen in the field.

Infected plants will also be extremely vulnerable to infections by other pathogens. *Agrobacterium tumefaciens* can live saprophytically for many years in soil and as result proved very difficult to eradicate.

Trials all over the world confirmed the effectiveness of *A. radiobacter* in limiting the effect of *A. tumefaciens* on a wide range of plants.

DISEASE CONTROL

The key is prevention. Cultural methods include:

- The use of uninfected planting medium.
- Lift seedling trays from the ground. The flow of water beneath open drainage holes on the bottom of the seedling trays will expose the roots and medium to contamination and infection.
- Some literature suggests planting resistant cultivars or crops or leaving the infected field to rest for at least 2 years.
- All plant material must be inspected before planting to reduce risk of pathogen introduction.
- Resistant cultivars may still be carriers.
- All infected plant material must be destroyed.
- Trials proved that its not enough to cut off the galls, for this pathogen is present in healthy roots from the same plant as well.
- Sterilized pruning equipment is essential.

Only uninfected plant material can be inoculated with *Agrobacterium radiobacter*.

Agrobacterium radiobacter, strain K84, produces the antibiotic agrocin which are used as a biocontrol agent against certain strains of *A. tumefaciens*.

Crown gall can also be eradicated using creosote-based chemical compounds, copper-based solutions, and strong oxidants such as sodium hypochlorite.

Chemical treatments, as well as biocontrol treatments, are not always consistent in effectiveness.