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CULTURAL PRACTICES FOR THE CONTROL OF BACTERIAL WILT OF POTATO

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DEPARTMENT: Plant Production and Soil Science

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ABSTRACT

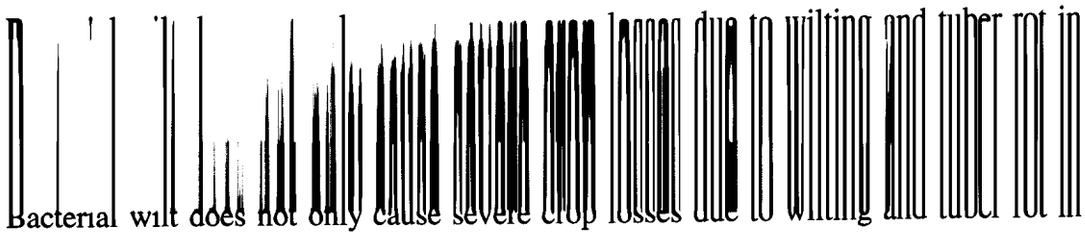
Bacterial wilt caused by *Ralstonia solanacearum* has affected the potato industry in South Africa since 1914. Control of bacterial wilt is difficult and depends greatly on integrated management strategies. Little information is available on the longevity of *R. solanacearum* in soil under South African conditions and how it is influenced by cultural practices. Information regarding local weeds which can serve as alternative hosts is limited.

Soil survival of *R. solanacearum* biovar 2 (race 3) was investigated in an artificially infested field managed by either one of four cultural practices, namely maize and potato monoculture, bare and weed-fallow. After a five-year period wilting of indicator plants was observed in all treatments with potato the highest, followed by bare-fallow, maize monoculture and lastly weed-fallow. Results demonstrated a greater ability of biovar 2 to survive in soil than generally accepted. Subsequently, the susceptibility of 22 weed and three grass species was investigated in the greenhouse. Five species were susceptible to biovar 2 and 13 to biovar 3. Preliminary *in vitro* studies conducted to determine suppressiveness of some weeds/grasses, indicate that microbial activity associated with some weeds could be involved in suppression of the wilt organism. Further studies are however required. The effect of maize on *Ralstonia solanacearum* populations was evaluated in a pot trial as well as in hydroponic culture. Results indicated that microbial populations present in the maize plant, could play a role in the susceptibility of maize to bacterial wilt infection. Antagonistic bacteria associated with some maize plants or with the maize rhizosphere could be partly responsible for suppression of wilt.

PREFACE

Bacterial wilt caused by *Ralstonia solanacearum* E.F. is a destructive disease affecting a range of economically important crops grown in temperate, subtropical and tropical climates. In South Africa it was detected for the first time in 1914 on potato, thereafter on several other crops such as tomato, pepper, brinjals, peanuts and tobacco. Various isolates of this pathogen exist which differ in their ability to affect various hosts, and in their biochemical metabolism. The term race refers to the classification according to hosts affected, whereas the biovar system is based on biochemical reactions. To date, only biovar 2 (race 3) and biovar 3 (race 1) are found in South Africa. The former strain occurring mainly in temperate regions of the country and the latter in subtropical areas.

Potato is one of South Africa's most important food crops with approximately 1.6 million tons being produced annually. More than 50,000 ha are under production in 14 regions situated throughout the country. Potatoes are not only produced for local fresh consumption, but also for export and for the processing industry. The South African processing industry has increased by more than 100% over the last five years. To satisfy the increased demand, it is essential that production factors be manipulated to optimize crop environment and minimize the effects of pests and diseases. One of the diseases that has affected the South African potato industry since 1914 is bacterial wilt or brown rot of potatoes. The disease occurred sporadically in plantings but in the 1980's, serious outbreaks of bacterial wilt were reported. Although both biovar 2 and biovar 3 were isolated from diseased potato plants, the former was prevalent in the potato production regions of South Africa. Control of bacterial wilt became essential for the survival of the potato industry in South Africa. World-wide bacterial wilt is regarded as difficult to control or eradicate and therefore an integrated disease management approach is followed. In order to implement effective control strategies that are suitable for the region and for the specific race of the pathogen involved, it is essential to gain a good understanding of the disease and the pathogen that causes it. Chapter 1 represents a literature study in which some of the findings regarding the etiology, epidemiology and control of the bacterial wilt pathogen are summarised.



storage, but it also renders the soil unsuitable for subsequent potato cultivation. When the role of infected seed tubers in the transmission of the disease was realized, compulsory testing of all registered seed tuber plantings was implemented. Confirmation of bacterial wilt in a planting would result in the withdrawal of registration. Availability of healthy seed, good sanitary practices and disease avoidance strategies have helped in reducing new infections, but uncertainty still exists on the management of infected fields and for how long these fields could sustain the organism. Chapter 2 reports on the investigation into the longevity of bacterial wilt (biovar 2) in artificially infested soils under different cultural practices. Maize and potato monoculture, and bare- and weed-fallow treatments were applied over a period of five years. To monitor *Ralstonia* populations, potato plants were planted in a designated region across all treatment plots after a three- and five-year cropping sequence.

Several weeds serve as alternative host to the bacterial wilt pathogen and thus play an important role in its survival in the absence of cultivated hosts. Consequently, weed control is regarded as an essential aspect of bacterial wilt management. Susceptibility of some weed species to bacterial wilt varies even if the same race or biovar of the pathogen is involved. In South Africa, little work has been done to identify the host range for both biovars. The study into the impact of cultural practices on the longevity of bacterial wilt suggested that the weed-fallowed plots are suppressive to *R. solanacearum*. An investigation was undertaken to determine the host status of a range of weeds for biovar 2 and biovar 3 and to probe the hypothesis of suppressive interaction between certain weeds and the pathogen. The findings are reported in Chapter 3.

Maize has been included in rotation programs for may years, either as a single rotation crop or in combination with other non-host crops. The level of disease control achieved with maize rotation however, varies. In some instances *R. solanacearum* is capable of infecting maize, albeit at lower infection rates. In other instances, bacteria antagonistic to the wilt organism have been isolated from the maize rhizosphere. Maize monoculture in the above mentioned field study was slightly more efficient in

reducing wilt than bare fallow but was less efficient than weed-fallow. Chapter 4 reports on the investigation into maize as a carrier of the local biovar 2 strain and whether maize cultivation could have a suppressive effect on the pathogen.