SUMMARY – Barbara Nel

Management of Fusarium wilt of banana, one of the most important diseases of agricultural crops, is complicated and involves the consideration of factors such as the biology, epidemiology and population structure of the pathogen, and genetic resources and production practices of the crop. The development of an integrated disease management programme, therefore, is of great importance in countries where the Fusarium wilt pathogen, *Fusarium oxysporum* f.sp. *cubense* (*Foc*), has been introduced into banana fields, and where resistant cultivars are not acceptable to local markets. To achieve this, it is important to investigate new management strategies and to review methods that have been less successful in the past. These management practices need to be practical and affordable. Since certain cultural practices have proven to be effective, management practices that could compliment them should be considered. This thesis has attempted to investigate such practices in order to develop an integrated disease management programme for Fusarium wilt of banana.

One of the most important findings of this study, was that the surface sterilant previously used to prevent the introduction of the Fusarium wilt into uninfected areas in South Africa, are not effective. The sterilants Sporekill and Prazin proved to be highly effective, and are now recommended to replace the sterilants previously used. Several fungicides reduced mycelial growth of *Foc in vitro*, with the DMI fungicides and Benomyl found to be the most effective. The same fungicides reduced the disease severity of Fusarium wilt in the greenhouse significantly, especially when they were applied as root dip treatments. None of the fungicides found effective against *Foc* have been evaluated in the field against *Foc* before. The next step, therefore, would be to evaluate root dip treatments combined with drench treatment in the field. Although it is expected that these fungicides might have a negative effect on the microbial populations in the soil, this has yet to be investigated. Fungicides may even weaken or stress the pathogen, making it more vulnerable for the action of an effective biocontrol agent or agents.

Chemical activators are probably one of the most attractive strategies to combat Fusarium wilt of banana, since it stimulate the plants' own defence system. Banana plantlets were found to be quite sensitive to the amount and method whereby chemical activators were applied. The activator benzo-(1,2,3)thiadiazole-7-carbothioic acid S-methyl ester induced resistance against *Foc* on the susceptible Williams cultivar in the greenhouse, but not in the field. In field studies, environmental conditions were much more variable than in the greenhouse, which made it difficult to evaluate the effectiveness of chemical activators.

Sodium nitroprusside and a product containing the harpin protein showed promising results on the Williams and DRS1 cultivars, respectively. These activators need to be considered as part of an integrated disease management programme. Since they are not directly applied to the soil, they will not have a negative effect on the microbial populations in the soil.

Several *Fusarium* isolates had been collected from banana fields with disease suppressive soils in Kiepersol, South Africa. Most of these isolates were *F. oxysporum*, and with the exception of one isolate, proved to be non-pathogenic to banana plants. A PCR-based restriction fragment length polymorphism (RFLP) analysis of the intergenic spacer region of the ribosomal RNA operon grouped the non-pathogenic *F. oxyporum* isolates into 12 distinct genotypes. A great diversity could be seen among the non-pathogenic isolates compared to the pathogenic *Foc* isolates. The known-biological control agent Fo47 grouped with three of the South African isolates, while the one pathogenic isolate grouped with the pathogenic *Foc* from diseased Cavendish bananas in South Africa. By using PCR-RFLPs, we were able to rapidly characterize the structure of non-pathogenic isolates of *F. oxysporum* in disease suppressive soils in Kiepersol. This could assist us in our search for potential biological control agents for Fusarium wilt of banana.

Representative isolates from the 12 genotype groups were selected for evaluation of Fusarium wilt suppressive properties in banana. These non-pathogenic *F. oxyporum* isolates appeared to be good biological control candidates and was compared to known biological control agents and commercial biological control products. Fourteen of the non-pathogenic isolates, the combination of two *Trichoderma* strains form suppressive soils in South Africa, and two *Pseudomonas fluorescens* isolates were found to significantly reduce Fusarium wilt development in the greenhouse. The commercial products Patostop, B-rus and a mixture of arbuscular mycorrhizae were also found to suppress the disease severity of *Foc* significantly. The well-know biological control agent Fo47 proved to be not effective. Results concluded that two of the non-pathogenic *F. oxysporum* isolates and the two *P. fluorescens* isolates, one of which was the well-known WCS 417, were the most effective of all the agents evaluated. Since combinations of biocontrol agents may provide even more consistent and effective control than a single agent, future research will include the combination of biocontrol agents found effective in this study. It would also be of great value to determine the mode of action of these isolates, so that isolates with different modes of action could be combined to enhance the suppression effect. Biological control can be a very useful component of an integrated disease management programme, since the effective agent or agents can easily be established on tissue culture banana plantlets before they are planted in the field.