Project Title:
Identification of inoculum sources of oomycetes, a major contributor to apple replant disease, and the management thereof.

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Objectives & Rationale

The major apple replant disease (ARD) causative agents in South Africa consist of oomycetes, with plant parasitic nematodes occasionally being involved. A selected group of fungi (Cylindrocarpon-like and *Rhizoctonia* spp.) can also play a role. The aims of the study were to determine (i) whether apple nursery trees and irrigation water are external inoculum sources of ARD, (ii) whether ARD can be managed using semi-selective chemicals (phenylamides, fenamiphos, imidacloprid and phosphonates) and to compare the efficacy of fumigants differing in chloropicrin content and (iii) to increase knowledge on the translocation and efficacy of phosphonates in apple trees when used to manage Phytophthora root rot.

Methods

The methodology for the first aim consisted of quantifying ARD causative agents from nursery trees and orchard irrigation water using traditional isolation methods and qPCR analysis. The second aim was investigated through three orchard trials where various soil treatments were applied, followed by tree growth evaluations (stem dia., shoot length and yield) over a 4- to 5-year period, and the quantification of ARD causative agents in roots. For the last aim, five orchard trials were conducted; two trials to investigate phosphite (breakdown product of phosphonates in trees) translocation in trees and three trials to investigate the management of Phytophthora root rot when different phosphonate application methods (stem spray, stem paint and foliar sprays) were used. The latter five trials were evaluated by measuring phosphite concentrations and *P. cactorum* quantities, whereas tree growth and yield evaluations were conducted in three trials.

Key Results

Apple nursery trees were identified as a source of ARD causative agents, with the most prominent being *Pratylenchus* spp. and *Pythium irregulare*. ARD causative agents were rarely found in irrigation water.

In ARD orchard trials, the higher dosage chloropicrin fumigant was in general more effective than the lower dosage chloropicrin fumigant. The semi-selective chemicals combined with the low chloropicrin fumigant was also an effective treatment. These two treatments increased yields (14 to 122%) over a 3-year period. Although the independent use of semi-selective chemicals increased tree growth to a manner similar than the fumigants, yields were only significantly increased relative to the control in one of the trials.

Translocation of phosphite to roots is highly effective when phosphonates are applied as foliar sprays. In Phytophthora root rot symptomatic orchards, phosphonates increased yield meaningful (P = 0.0631) and in general irrespective of application method. Trunk diameter was increased over 2-years in two of the three trials. *P. cactorum* root DNA concentrations were significantly reduced in two of the three trials, irrespective of application method.

Conclusion and Discussion / Recommendation

The use of a higher chloropicrin containing fumigant (57% chloropicrin and 38% 1,3-di chloropropene) is recommended for fumigation of ARD trials. Due to the potential

contamination of apple nursery trees with ARD causative agents, the application of semi-selective chemicals is recommended at planting.

Phosphonates have potential for managing Phytophthora root rot in apple orchards. Data have been generated for the registration of phosphonates against Phytophthora root rot on apple, but more trials may be required for registering the product in South Africa.