

CONTROL STRATEGIES FOR CITRUS POSTHARVEST DISEASES

by

ERIKA ELIZABETH AURET

SUPERVISOR : Prof. L. Korsten
CO-SUPERVISOR : Prof. F.C. Wehner
DEPARTMENT : Microbiology and Plant Pathology
DEGREE : M.Sc.



RESUMÉ

A study was undertaken to evaluate biological, warm water and integrated treatments as alternatives to fungicides for control of citrus postharvest diseases. Possible infection sites and unsanitary conditions in packhouses, and the use of surfactants/disinfectants for sanitation of fruit surfaces, packhouses and packhouse equipment were also investigated. The following transpired from the study:

1. *Bacillus subtilis* (B246) (isolated from avocado) and *B. licheniformis* (B250) (isolated from mango), effectively inhibited *in vitro* growth of citrus postharvest pathogens, *Alternaria citri*, *Colletotrichum gloeosporioides*, *Lasiodiplodia theobromae*, *Geotrichum citri-aurantii*, *Penicillium digitatum*, *P. italicum* and *Trichoderma viride*. However, *B. licheniformis* (B251) (isolated from mango) and *B. subtilis* (B248) (isolated from avocado) were the most effective antagonists against *P. digitatum* in *in vivo* experiments. *Bacillus licheniformis* (B254) (isolated from litchi) provided only moderate *in vitro* inhibition, but was more effective than B246 and B250 in postharvest experiments.
2. Antagonist treatments were neither as effective nor as consistent as full-strength chemical

treatments (guazatine-1000 ppm, thiabendazole -1000 ppm, 2,4-D - 500ppm, imazalil -500 ppm) in reducing decay. However, when integrated with quarter-strength chemical application, B246 and B254 provided the same control as full-strength chemical treatment.

3. Warm water treatment of artificially inoculated fruit was as effective as fungicide treatments in controlling citrus postharvest diseases. Optimal temperatures determined *in vivo* for warm water were 36 and 40 °C for 1, 2.5 and 5 min. This was confirmed in packhouse experiments. No decay, off-tastes or smells resulted from exposure of fruit to the temperatures.
4. *Aspergillus niger*, *P. digitatum*, *P. italicum* and *Rhizopus stolonifer* were the only citrus postharvest pathogens detected in packhouses. Crates/trailers and dip tank water were identified as the main sources of fungal accumulation.
5. Several surfactants inhibited conidial germination and growth of *P. digitatum in vitro*, the most effective ones being Multichlor and Tronic at an inoculum level 10^3 conidia ml⁻¹ and Armoblem, Ecosanitizer (Handwash + Low foam), Frigate, G49, QA5DP, Terminator and Tronic at 10^5 conidia ml⁻¹.



BEHEERSTRATEGIË VIR SITRUS NA-OESSIEKTES

deur

ERIKA ELIZABETH AURET

LEIER : Prof. L. Korsten
MEDE-LEIER : Prof. F.C. Wehner
DEPARTEMENT : Mikrobiologie en Plantpatologie
GRAAD : M.Sc.

SAMEVATTING

'n Studie is onderneem om biologiese, warmwater en geïntegreerde behandelings te evalueer as alternatief vir chemiese beheer van sitrus na-oessiektes. Moontlike infeksie-areas en onhygiëniese toestande in pakhuisse en die gebruik van oppervlakspanningsverlagings- en ontsmettingsmiddels vir ontsmetting van vrugoppervlaktes, verpakkingstoerusting en pakhuisse is ook ondersoek. Die volgende is gevind:

1. *Bacillus subtilis* (B246) (geïsoleer vanaf avokado) en *B. licheniformis* (B250) (geïsoleer vanaf mango) het *in vitro* groei van die sitrus na-oes patogene, *Alternaria citri*, *Colletotrichum gloeosporioides*, *Lasiodiplodia theobromae*, *Geotrichum citri-aurantii*, *Penicillium digitatum*, *P. italicum* and *Trichoderma viride*, effektief geïnhibeer. *Bacillus licheniformis* (B251) (geïsoleer vanaf mango) en *B. subtilis* (B248) (geïsoleer vanaf avokado) was egter die effektiefste anatagoniste teen *P. digitatum in vivo*. *Bacillus licheniformis* (B254) (geïsoleer vanaf lietsjie), wat slegs 'n mate van beheer *in vitro* gegee het, was meer doeltreffend as B246 en B250 in pakhuis eksperimente.
2. Antagonisbehandelings was nie so doeltreffend of konsekwent soos volsterkte chemies

behandelings (guasatien-1000 dpm, thiabendasool -1000 dpm, 2,4-D - 500 dpm, imasalil - 500 dpm) nie. Beide B246 en B250 het egter dieselfde mate van beheer gegee as volsterkte chemiese behandeling wanneer geïntegreer met die toediening van die chemiese middels teen kwart sterkte.

3. Warmwater-behandeling van kunsmatig-besmette vrugte het vrugbederf net so doeltreffend as chemiese behandeling beheer. Optimale temperatuur vir warmwater-behandeling is *in vivo* bepaal as 36 and 40 °C vir 1, 2.5 and 5 min, en is bevestig in pakhuiseksperimente. Geen bederf, vreemde smake of reuke is waargeneem by vrugte wat aan hierdie temperature blootgestel is nie.
4. *Aspergillus niger*, *P. digitatum*, *P. italicum* and *Rhizopus stolonifer* was die enigste sitrus na-oespatogene wat in pakhuisse aangetref is. Kratte/sleepwaens en dooptenkwater is geïdentifiseer as die hoofbronne van swamakkumulاسie.
5. Verskeie oppervlakspanningsverlaging- en ontsmettingsmiddels het konidiumontkieming en groei van *P. digitatum in vitro* beperk. Die effektiefste middels was Multichlor and Tronic by 'n inokulumvlak van 10^3 konidiums ml^{-1} en Armoblem, Ecosanitizer (Handwash + Low foam), Frigate, G49, QA5DP, Terminator and Tronic by 10^5 konidiums ml^{-1} .



I have fought the good fight,

I have finished the race,

I have kept the faith.

2 Timothy 4:7