Future Management Strategies in Disease Control

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Time to Reflect

Phytophthora Root Rot

The early days to the 1980s:

- “muck and magic”

“Muck and Magic”

- straw
- chicken manure
- gypsum

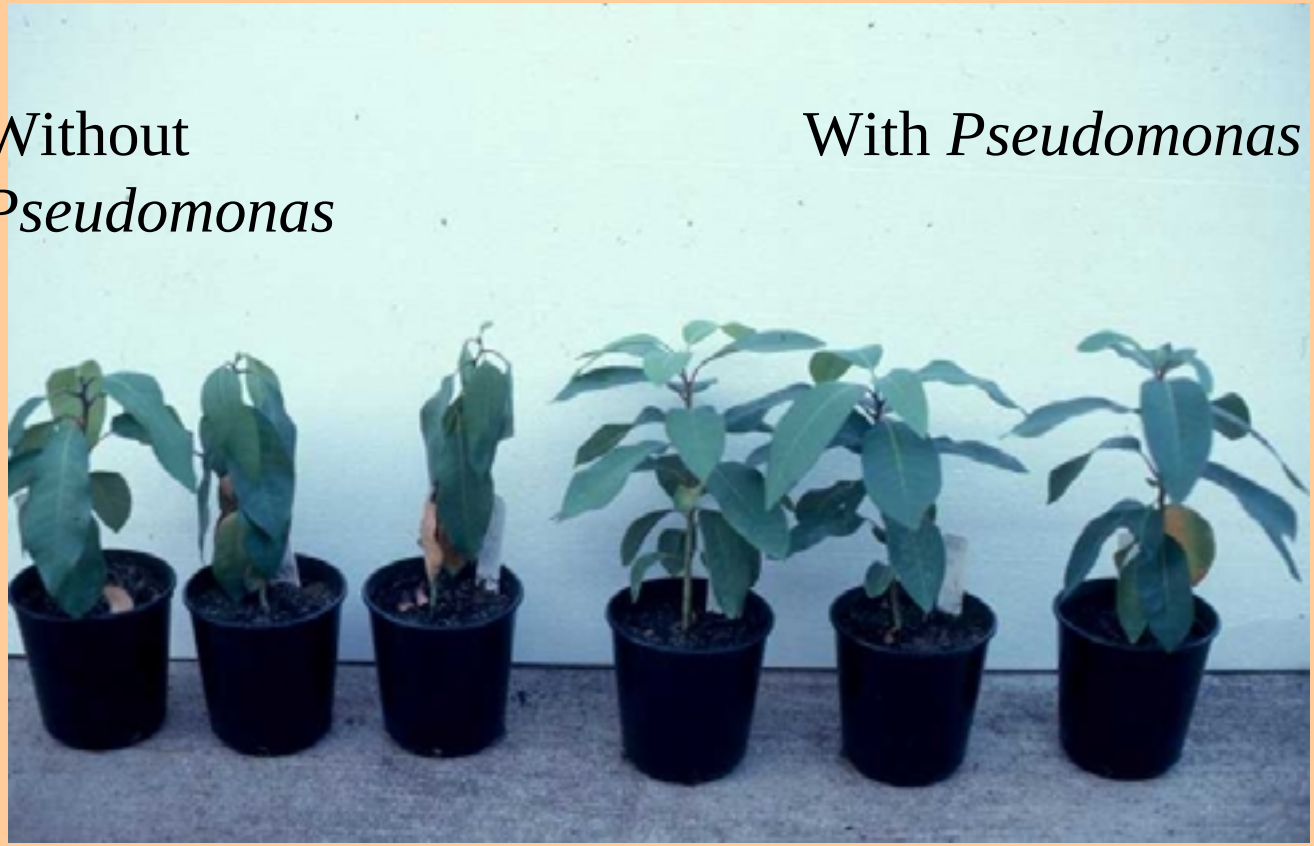
“Muck and Magic”

“Muck and Magic”

Biocontrol with *Pseudomonas* sp. in *Pc* infested soil

Without *Pseudomonas*

With *Pseudomonas*



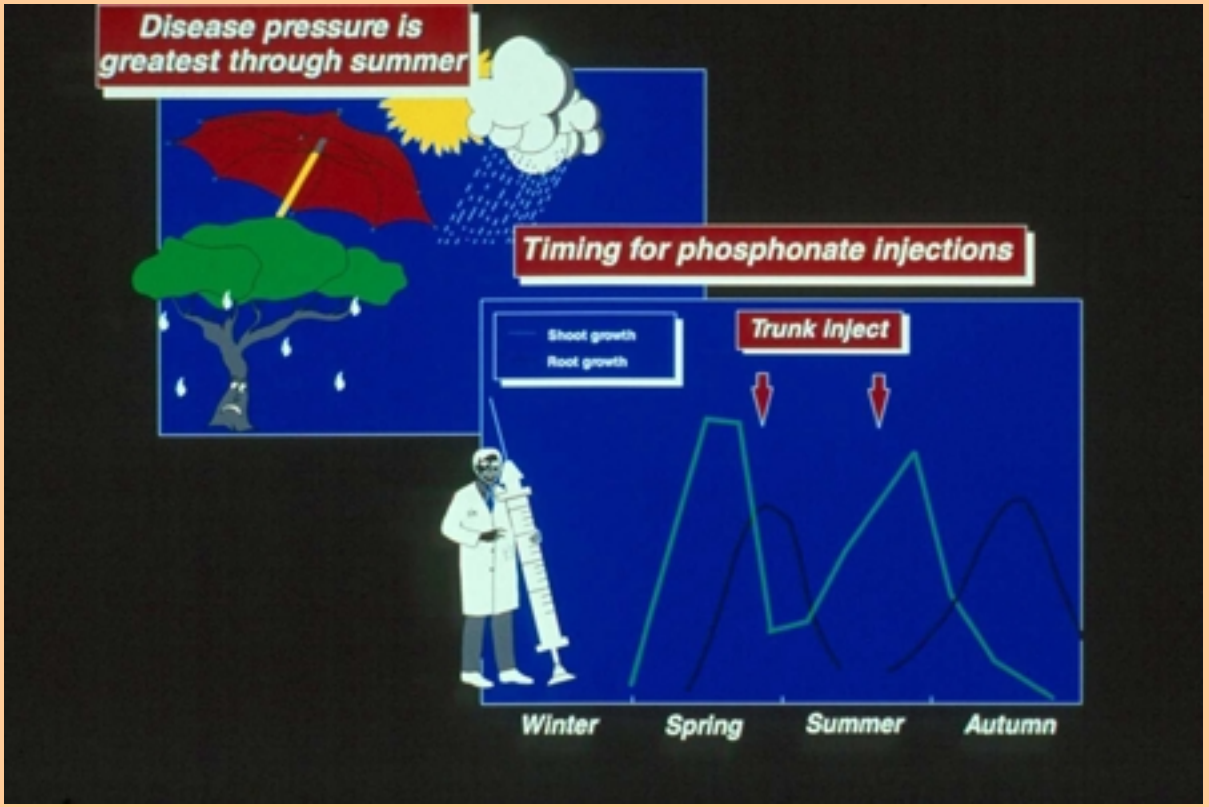
Phytophthora Root Rot

Since the early 1980s:

- trunk injections of phosphonates
- foliar applications of high concentrations of phosphonates

Trunk injection

Trunk injection



Future Management Strategies in Disease Control

Fruit Diseases

Future Management Strategies in Disease Control

Fruit Diseases

The early days to the 1980s:

- copper sprays (green skin varieties)
- prochloraz postharvest treatment
- ripening with ethylene
- ripening temperatures (17ºC)

Fruit Diseases

Since the 1980s:

- strobilurins
- antifungal compounds
- root stock effect
- influence of mineral nutrient concentrations in fruit
- biological control (yeasts & bacteria)

Sun Blotch

Future Management Strategies in Disease Control

Sun Blotch

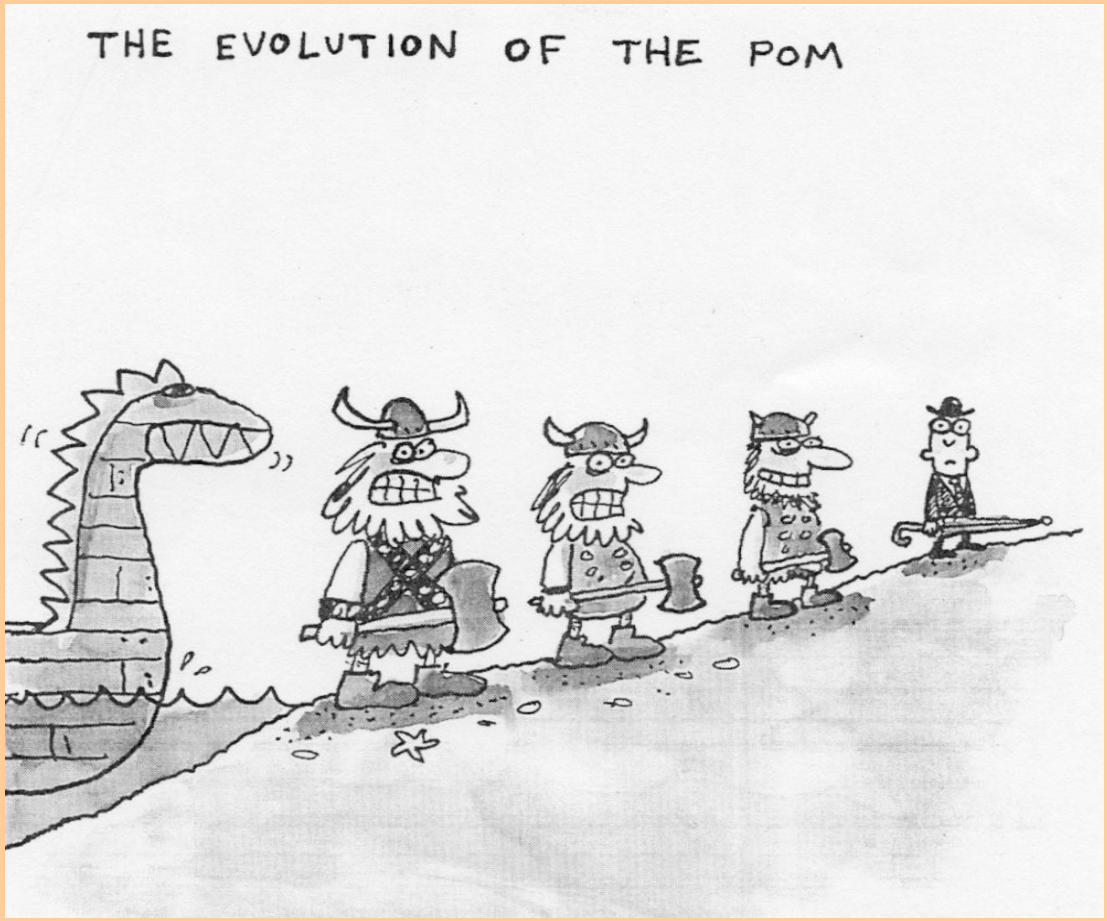
The early days to the 1980s:

- viroid - single stranded RNA containing 247 nucleotides

Since the 1980s:

- variants (246-251 nucleotides) detected in trees showing no symptoms

The Future
- Designing the Way Ahead



Future Management Strategies in Disease Control

Phosphonates

- The only reliable & cost affective tool until a resistant root stock is found
- Spraying is fraught with pitfalls:
  - more contaminating & ecologically damaging
  - relationship between crop phenology & partitioning & persistence of foliar applied phosphonates?
  - fruit may accumulate excessive phosphonate

The Solution

- Reduce phosphonates by exploiting defence inducers
- Systemic Acquired Resistance
  - uses genes already present in plants
  - plants are resistant to most pathogens
  - defence genes present
  - speed of gene activation

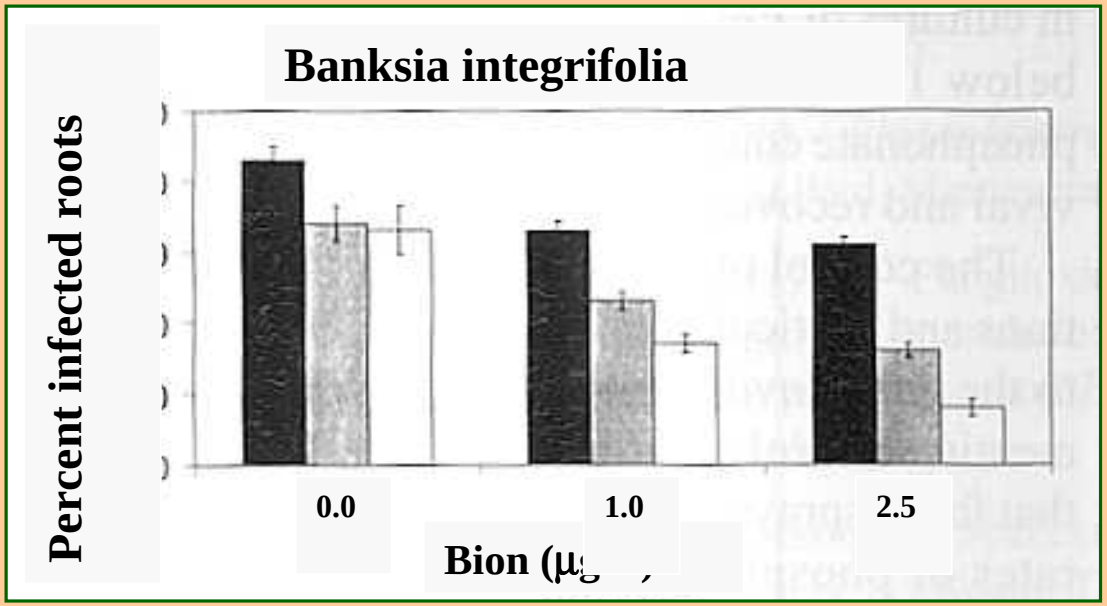
Bion (0.05g/L)
- *Cladosporium oxysporum (Co)*, passionfruit

Treatment	Scab Severity (1-5)
1. Untreated control	1.0[c]
2. Inoculate with *Co*	4.8[a]
3. Inoculate with *Co* Bion 4 days later	5.0[a]
4. *Co* + Bion	2.4[b]
5. Bion then inoculate *Co* 4 days later	2.0[b]

Field control of scab in passionfruit

Treatment	Fruit Scab (%)
1. Untreated control	70.8[a]
2. Industry standard	45.0[b]
3. Industry standard blocked with Amistar	28.3[b,c]
4. Industry standard block with Amistar + Bion	9.2[d]

Effect of potassium phosphonate & Bion on *Phytophthora cinnamomi*



(From Ali *et al.* 2000 APP 29:59-63)

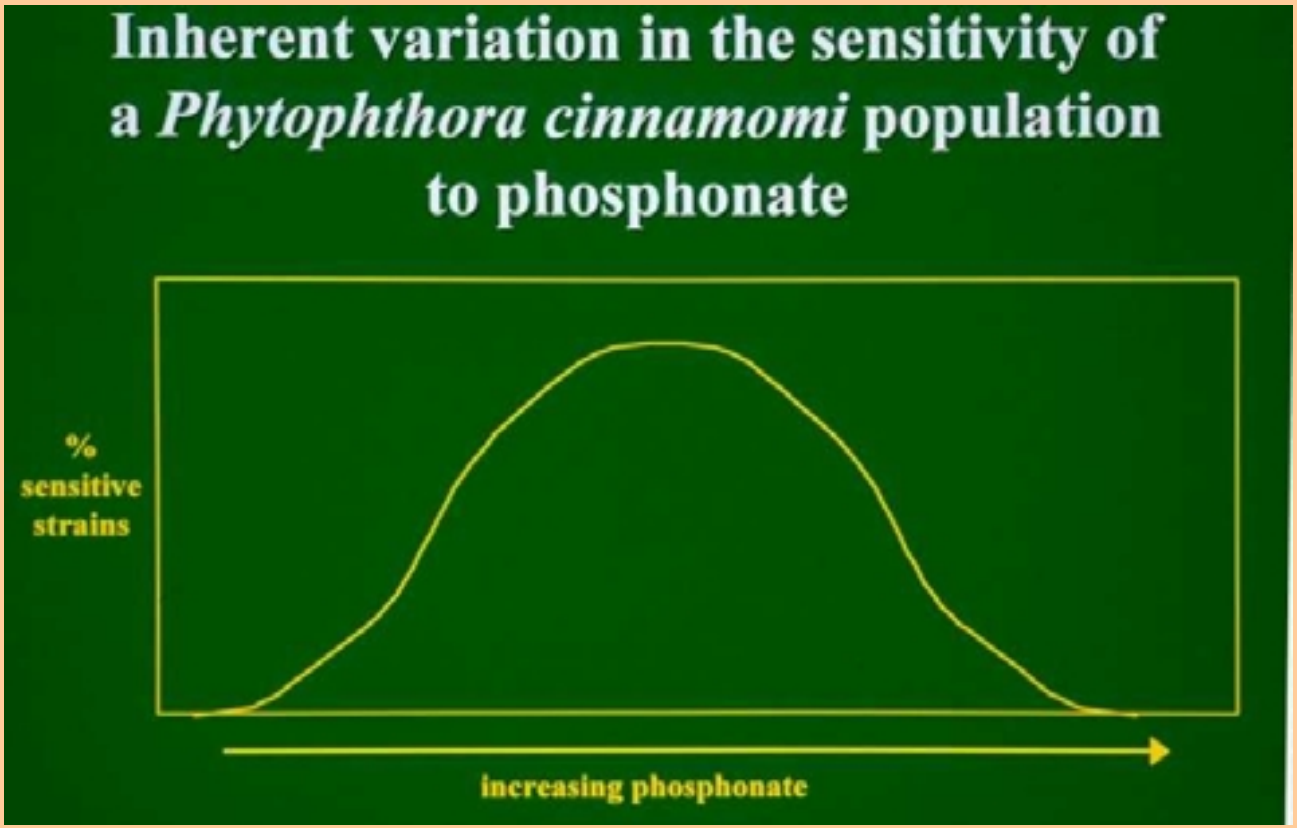
- Both chemicals when used alone reduced disease
- Plants sprayed with both chemicals had significantly lower levels of root rot

Potassium Phosphonate and Bion

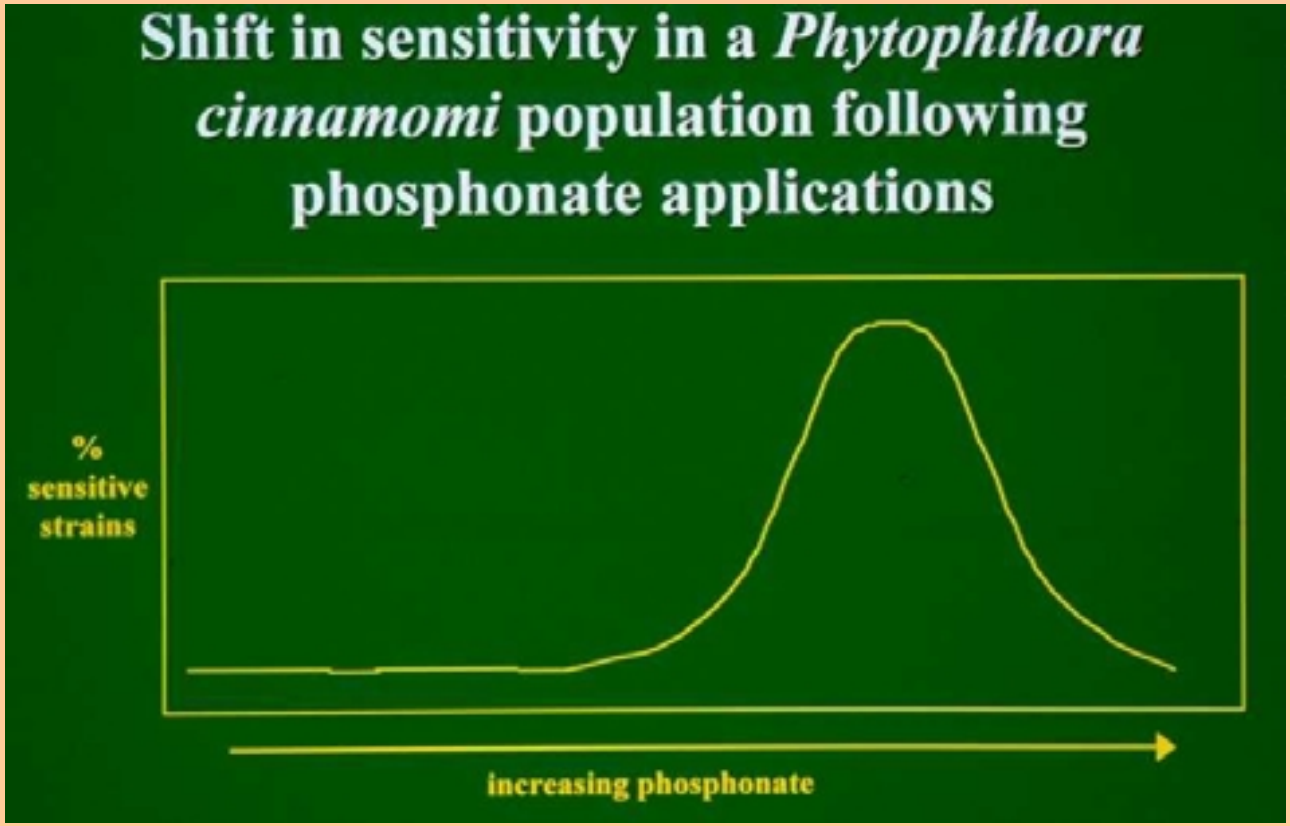
Combination sprays may reduce selection pressure on *Phytophthora cinnamomi* in roots and soil, thus preventing a shift in sensitivity with the population becoming dominated by less sensitive isolates

- may require higher levels of phosphonate in roots for effective control

Phosphonate sensitivity



Phosphonate sensitivity



Aerial Spraying

- technology is well - developed for natural ecosystems in WA
- will require the use of adjuvants

Improving Fruit Disease Control

- solve with good pathology & physiology
- influence of rootstocks on antifungal compounds & mineral nutrients in fruit
- plant activators to boost levels of pre-formed & induced antifungal compounds
- develop prediction systems to avoid heavy use of chemicals

Biotechnology

What has biotechnology delivered?

- molecular marker technology
- molecular diagnostics
- transgenic plants

Biotechnology

Molecular Diagnostics

- technology invaluable to nursery industry
- PCR method for the rapid detection & identification of *Phytophthora* species
- highly sensitive RT-PCR assay for detection of sunblotch viroid

Phytophthora Diagnostics

Baiting from soil

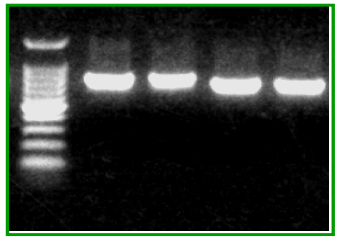
Infected plant material

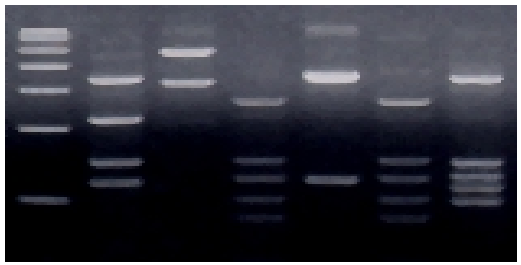
DNA Extraction

PCR - Genus Specific Primers

Restriction Digest for Species ID

Genus ID





Biotechnology

Transgenic Plants

- Roundup™ tolerance
- corn, cotton, canola, soybean protected by the Bt gene
- virus resistant plants (potato, papaw) by the introduction of virus coat protein genes
- for avocado, conceptually intriguing but will require much more work before it becomes a reality

Biotechnology

- Look upon biotechnology as an important tool to value add but not displace traditional methods used in horticulture

Biological Control

- “muck & magic” to modify soils
- spray trees with nutrients (urea, yeast extract, molasses)
- innundative biocontrol - apply effective biocontrol agents at specific times

Biological Control

No biological control then *Colletotrichum gloeospirioides* (*Cg*)

With biological control agent and then *Cg*

Biological Control

Major constraints

- cost of commercialisation
- inconsistent disease control in the field

Biological Control Products

- some 30 products (mostly *Trichoderma* & *Bacillus*) available for root diseases
- must overcome biological buffering capacity of soil (initial success due to high inoculum levels)
- cope with changes in abiotic environment
- not as effective as chemical control
- incorporate into integrated disease management practices

For the future...

- combine plant activators with phosphonate
- aerial application of phosphonates
- select rootstocks for *Pc* resistance & ability to reduce fruit rots
- plant activators to reduce fruit diseases
- computer-based prediction system to reduce heavy chemical usage
- use molecular technology to assist nursery industry
- develop biocontrol to form an integral component of disease management