# Moving away from Chemicals for Pest, Disease and Weed Management

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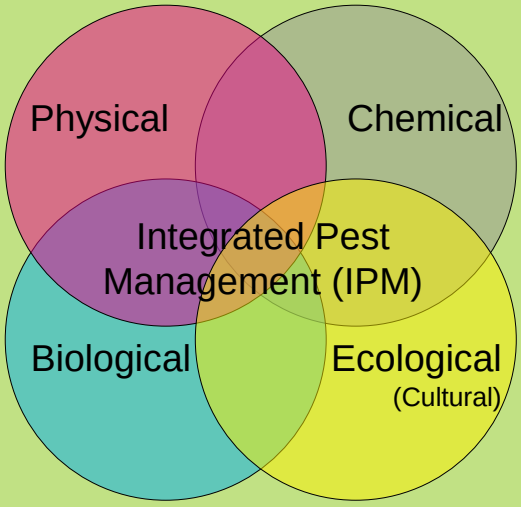
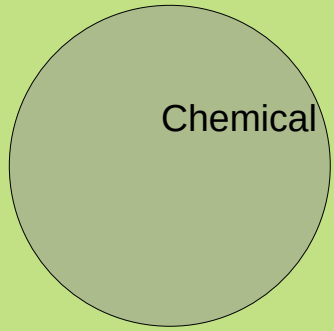
Permanent Agriculture and Horticulture
Science and Extension
www.bhu.org.nz/future-farming-centre

# The four pest management toolboxes

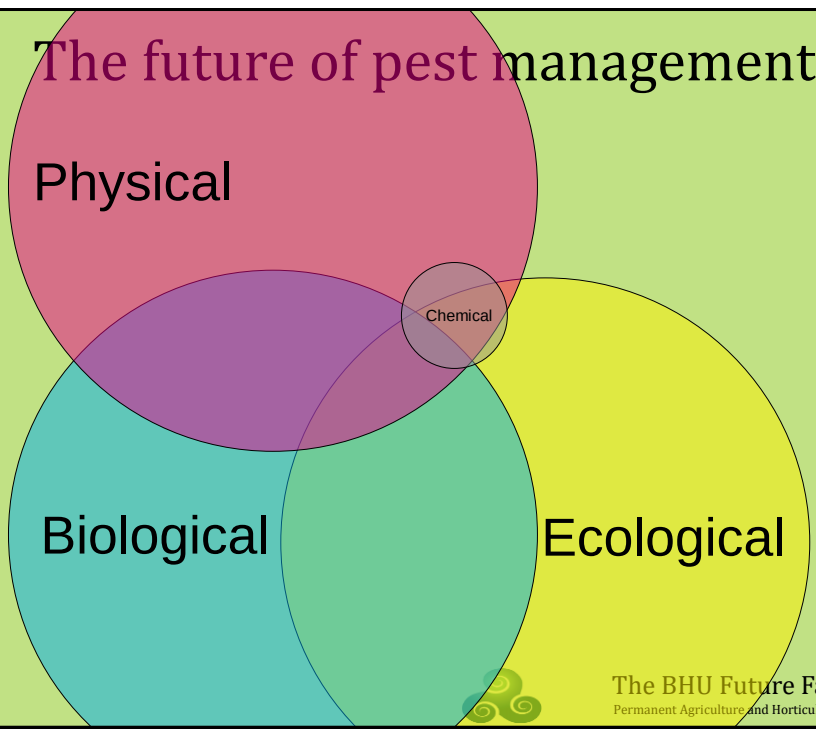


# Pest management for last 70 years






# The future of pest management



# Biology and Ecology

Steve and Alison have covered biology and ecology

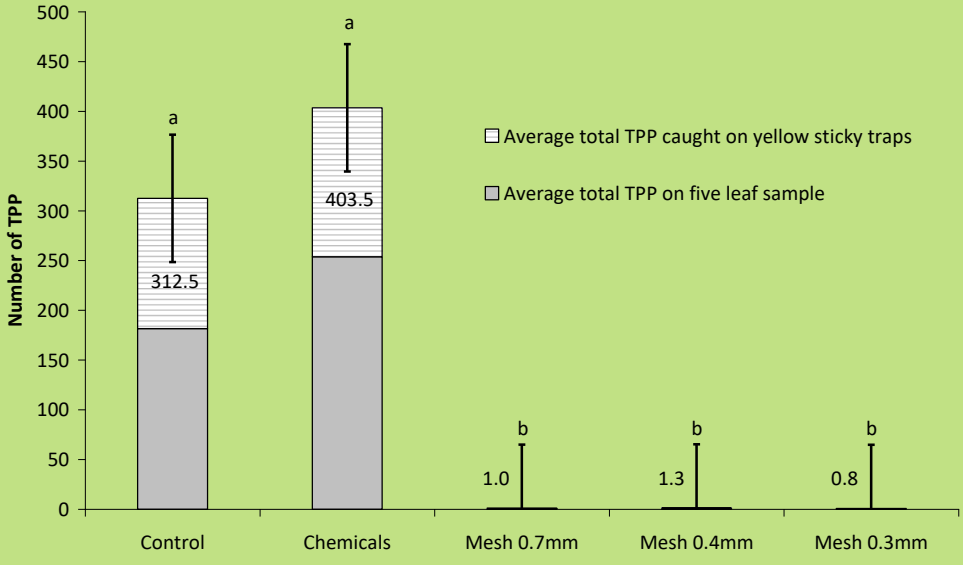
Now for some physics



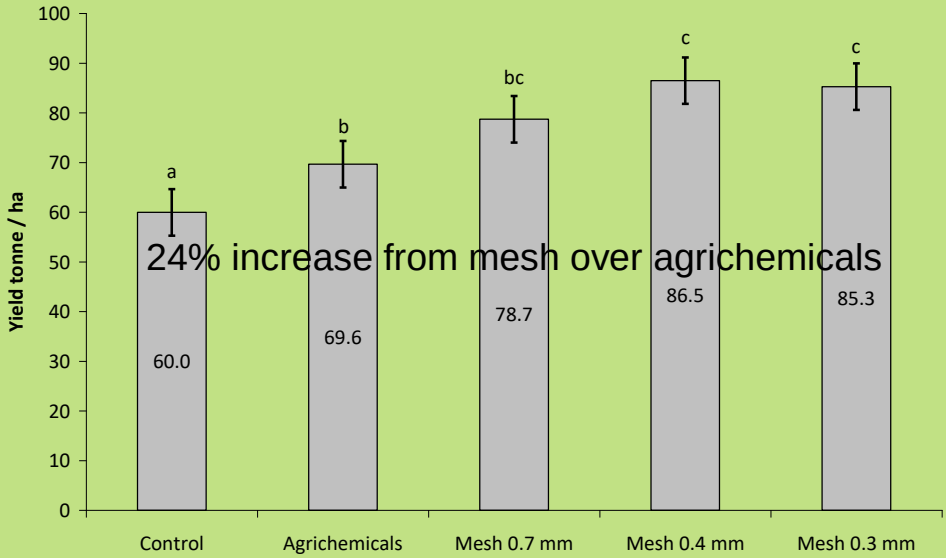
# Physics

Mesh crop covers - FFC research on mesh for tomato potato psyllid (TPP) control on potatoes

# TPP control


Number of TPP
500
450
400
350
300
250
200
150
100
50
0
a
a
b
b
b
312.5
403.5
1.0
1.3
0.8
Average total TPP caught on yellow sticky traps
Average total TPP on five leaf sample
Control
Chemicals
Mesh 0.7mm
Mesh 0.4mm
Mesh 0.3mm

# Yield of > 60 g tubers




# Nearly any pest on any crop




Impossible with chemicals





# Mesh on perennial crops


Chouinard, G., Firlej, A. & Cormier, D. (2016). Going beyond sprays and killing agents: Exclusion, sterilization and disruption for insect pest control in pome and stone fruit orchards. *Scientia Horticulturae, 208*, 13-27.

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# Physical weed control

Physics is the main non-chemical weed toolbox


# Electrothermal weeders

Uses high voltage electricity to boil the water inside the plant

Cells explode from the inside

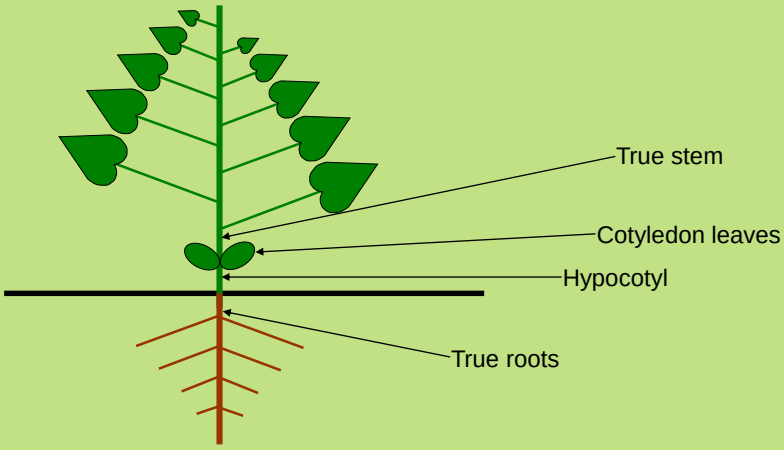
Biochemistry completely destroyed

Catastrophic tissue failure - zero chance of recovery

Thermal effect - impossible to evolve resistance



# Electrothermal mode of action

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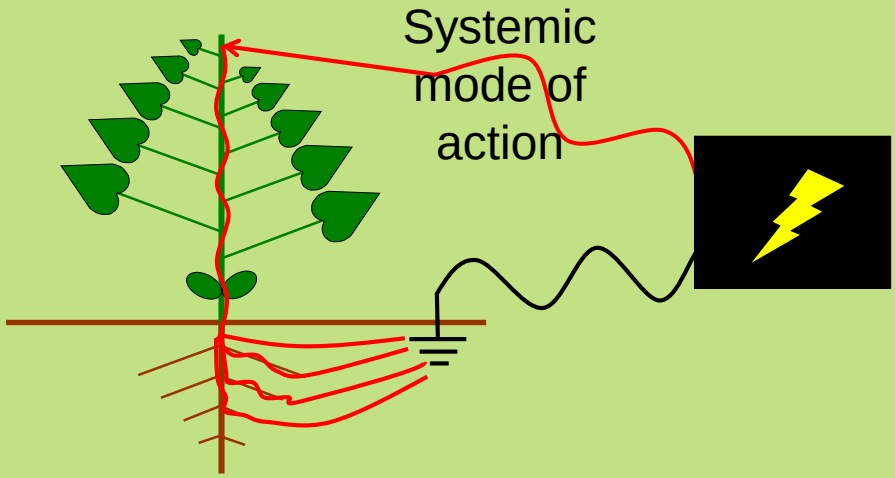
# Electrothermal mode of action






# Electrothermal mode of action

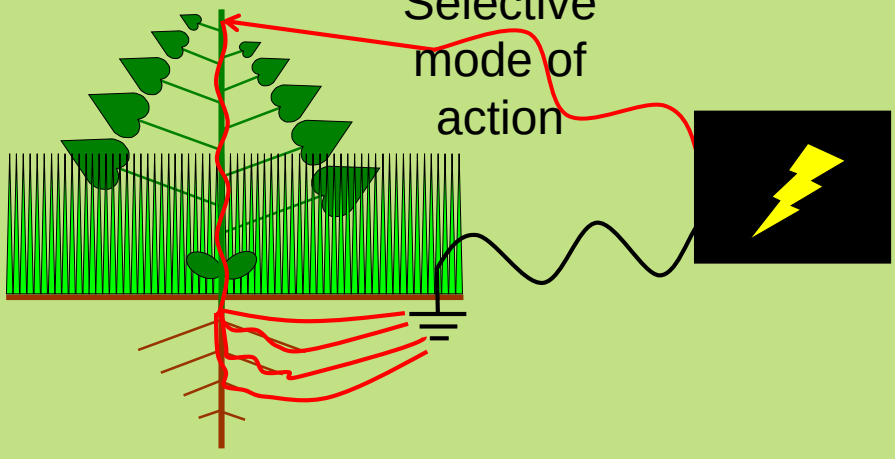


Photo Dr Mike Diprose

# Electrothermal mode of action

## Broad acre

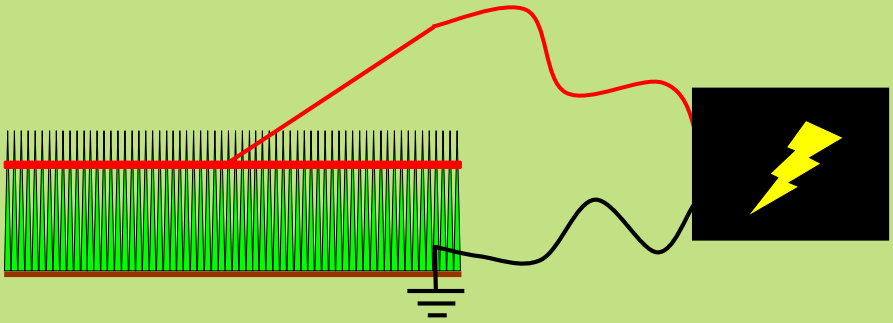


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Photo Dr Mike Diprose

Photo Dr Mike Diprose

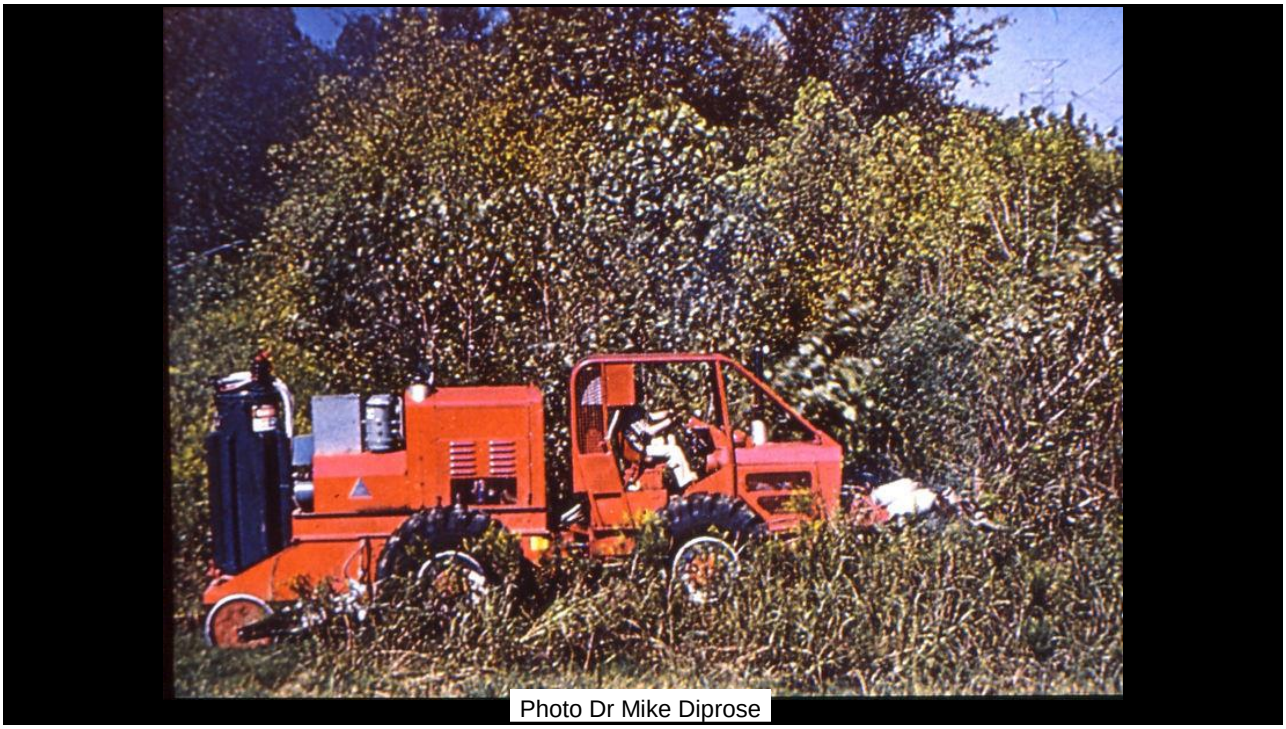


Photo Dr Mike Diprose

# Light - spectral filters

Many insects and diseases use / need specific wavelengths of light

- Aphids - yellow and UV bands to detect plants and orientate to the sky
- Fungal diseases, e.g., *Botrytis cinerea* and *Alternaria solani* need UV light to sporulate



Potatoes grown under UV blocking mesh - very little blight

Control - no mesh - lots of blight

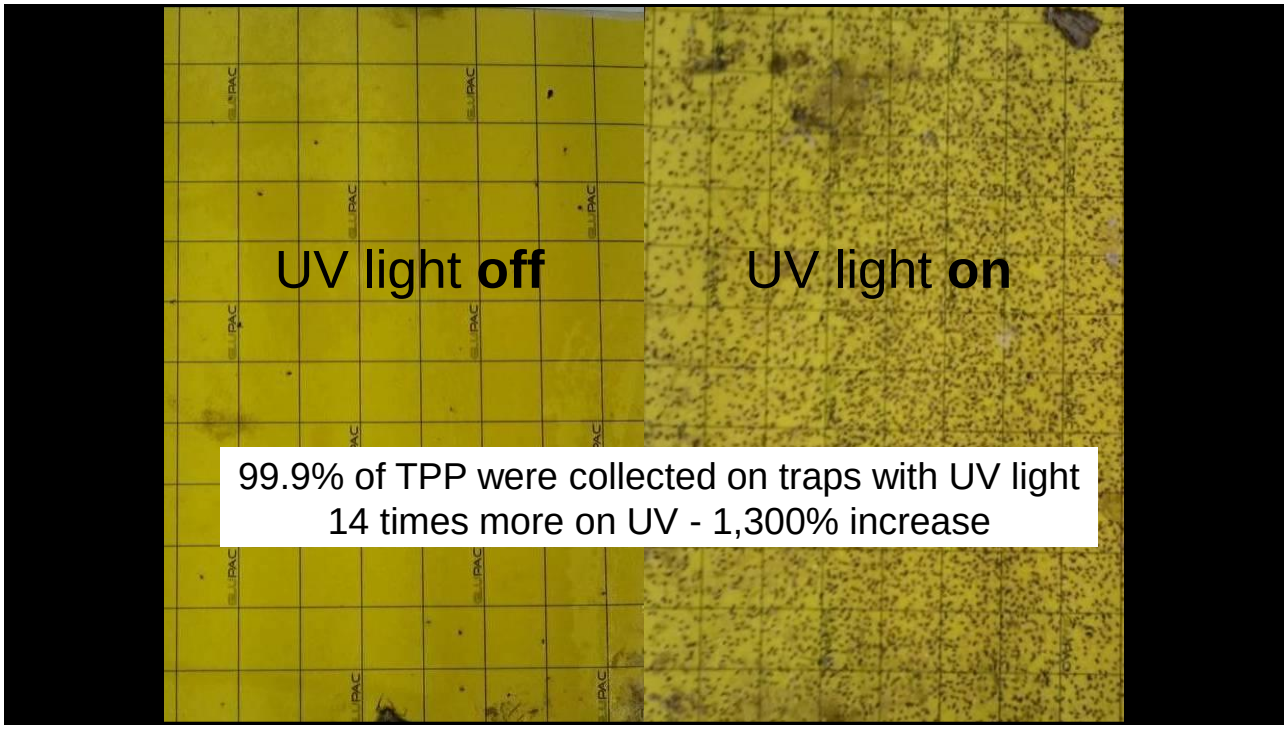
| ECONET 0.15 × 0.35 mm hole mesh | No mesh |
|---|---|
| 54 tonne ha - 40 kg / 10 m row | 8 tonne ha - 6 kg / 10 m row |

# TPP, mesh and UV light

When TPP gets under mesh it sulks - mesh blocks UV…..

When we really dial down UV light, psyllid yellows almost stops

What happens when we dial up the UV?


UV light **off**
UV light **on**
99.9% of TPP were collected on traps with UV light
14 times more on UV - 1,300% increase

# Conclusions

A smorgasbord of physical pest, disease and weed management techniques

The chemical toolbox is loosing tools and very few new ones are being found

The physics, biology and ecology toolboxes are having new tools added at an exponential rate

You need to understand and start using the new tools ASAP.