Growing stronger: a Mini Conference for the greenhouse sector ·
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Resistance Management in the Protected Crop Paradox

When ideal conditions favour fungal diseases

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New Zealand Tomato Leaf Mould Industry Survey

Exploring the prevalence and molecular basis of tomato leaf mould caused by *Fulvia fulva* on disease-resistant tomato cultivars in commercial New Zealand glasshouses

SECTION 1 · RESEARCH UPDATE

Tomato leaf mould in the crop

Why this matters — and what happened next

Why this matters

Tomato leaf mould resistance is the primary defence most growers rely on. If that defence is quietly failing, cultivar and spray decisions across the industry are being made on outdated assumptions.

The result

The isolates characterised in this study lack a functional Avr9 effector — meaning *Cf-9*, long treated as a dependable resistance locus, offers no protection against them.

3

major seed companies

Turning findings into industry conversation

Since these results, I've contacted and met with three major seed companies operating in New Zealand — to share the findings directly and explore how each is approaching resistance breakdown and the wider situation in our country.

SECTION 1 · RESEARCH UPDATE

The research continues — and we need your help

- **New MSc students are starting.**

  New students at Massey University are beginning their research journey this year, continuing this line of work.

- **Their focus: more isolates, more coverage.**

  Isolating and sequencing further tomato leaf mould samples from across New Zealand, to build a fuller national picture than any single study can on its own.

Seen leaf mould symptoms in your crop?

We want to hear from you. Every sample submitted — resistant cultivar or not — strengthens this research for the whole industry, not just for one grower or one company.

BEFORE WE START

Three things to take away

1

The environment you optimise for the crop is also optimised for the pathogen.

This is structural, not a failure of management.

2

The defences we lean on are weakening.

Genetic resistance and fungicide chemistry, both.

3

You can still make good decisions on a limited budget.

If you know what question to ask before you spend.

BEFORE WE GO FURTHER

Are we sure what we're looking at?

Research observation:

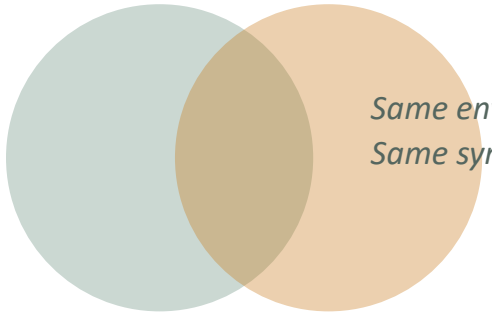
Misidentification of symptoms was more common than expected

Not a criticism of growers — an industry-wide capability gap.

Every decision downstream — spray choice, climate change, cultivar choice — inherits that first error.

Most common:

- Leaf mould
- Botrytis
- Powdery mildew
- Bacterial diseases



Same environment.
Same symptoms, to the eye.

SECTION 2 - THE CORE OF THE TALK

Understand the problem

Disease

VPD

RH

Dew Point

IPM

Condensation

Fungicide

Biosecurity

Scouting

Symptoms

Sensors

Pest

ROI

Spraying

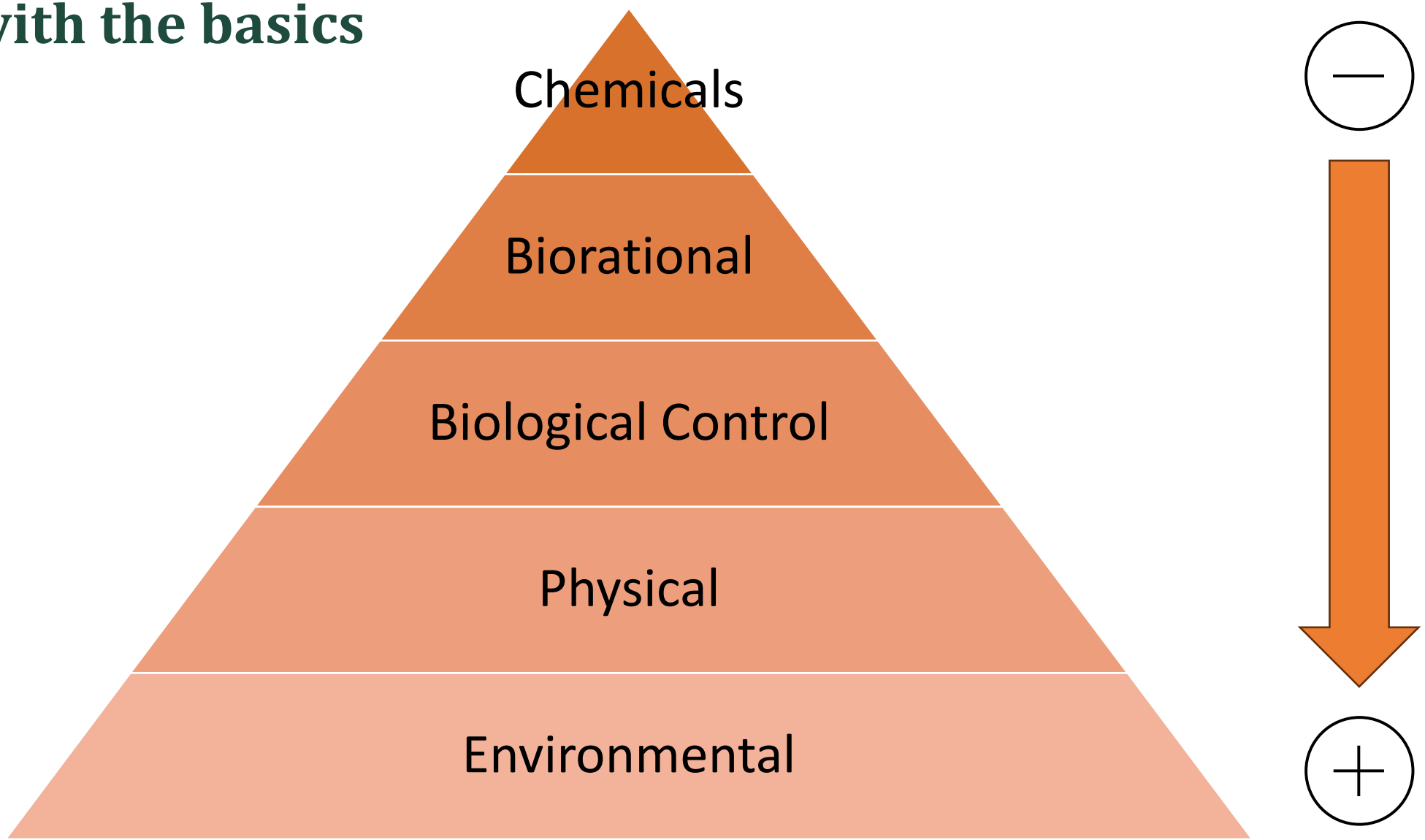
Physiological Disorder

Nutrient Deficiency

Labour

Good Hygiene Practices

Start with the basics



SECTION 2 · THE CORE OF THE TALK

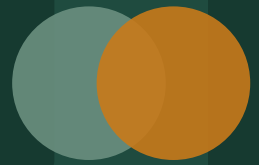
The paradox, made physical

What the crop needs

- ✓ Warmth
- ✓ High humidity
- ✓ Stomata open for gas exchange
- ✓ Dense, productive canopy
- ✓ Long season, no break (production-driven)

What the pathogen wants

- ✓ Warmth
- ✓ High humidity
- ✓ Stomata open for entry
- ✓ Dense, sheltered canopy
- ✓ Continuous host, no break



These are the same list.

You may want to look at VPD if you can

DANGER ZONE

≤ 0.4

kPa

Air close to saturated — condensation risk climbs.

~0.8–1.2

kPa

Ideal range.

≥ 1.5

kPa

Too high.

Two parameters, one number

VPD tells you how far the air is from saturation — temperature and humidity combined into a single measurement of how hard the air is pulling water out of the leaf.

DimLuxLighting.com

Recommended Leaf VPD

Leaf cooler than room temp by: 5 °F ≈ 2.8 °C

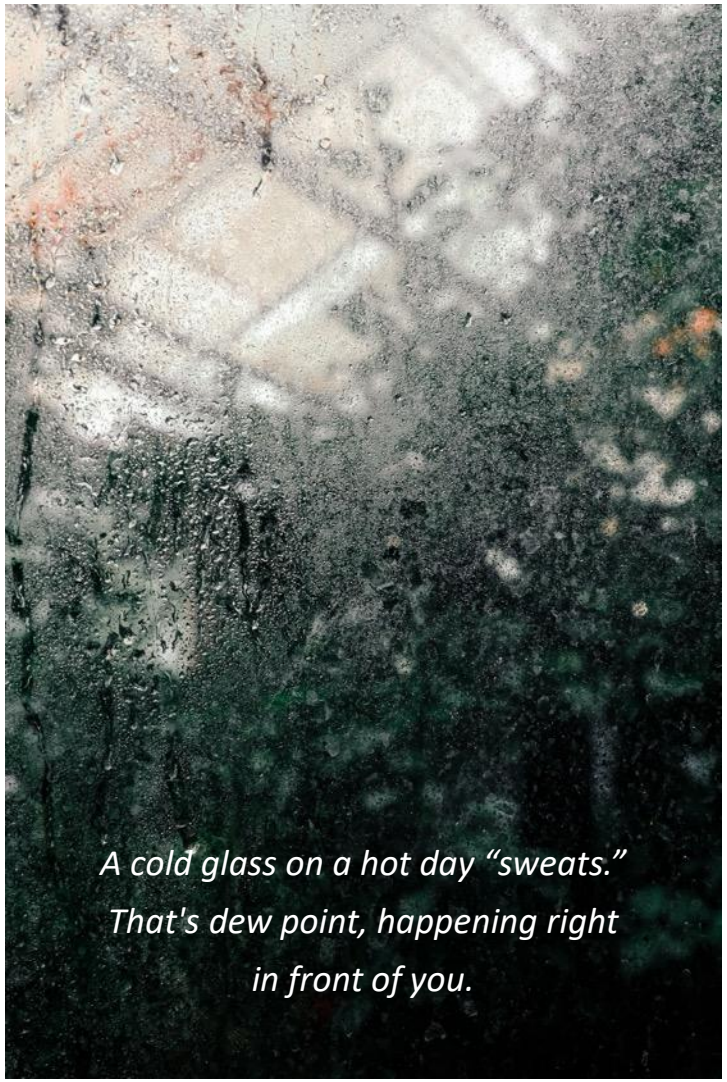
Propagation / Early Veg Stage 0.4 - 0.8 kPa
Late Veg / Early Flower Stage 0.8 - 1.2 kPa
Mid / Late Flower Stage 1.2 - 1.6 kPa
Danger Zone Below 0.4 / Over 1.6

Room Temp		Relative Humidity																			
C	F	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%	15%	10%	5%	0%
15	59	-0.11	-0.03	0.06	0.14	0.23	0.31	0.40	0.48	0.57	0.65	0.74	0.82	0.91	0.99	1.08	1.17	1.25	1.34	1.42
16	61	-0.12	-0.03	0.06	0.15	0.24	0.34	0.43	0.52	0.61	0.70	0.79	0.88	0.97	1.06	1.15	1.24	1.34	1.43	1.52
17	63	-0.12	-0.03	0.07	0.17	0.26	0.36	0.46	0.55	0.65	0.75	0.84	0.94	1.04	1.13	1.23	1.33	1.43	1.52	1.62
18	64	-0.13	-0.03	0.08	0.18	0.28	0.39	0.49	0.59	0.70	0.80	0.90	1.00	1.11	1.21	1.31	1.42	1.52	1.62	1.73
19	66	-0.14	-0.03	0.08	0.19	0.30	0.41	0.52	0.63	0.74	0.85	0.96	1.07	1.18	1.29	1.40	1.51	1.62	1.73	1.84
20	68	-0.14	-0.03	0.09	0.21	0.33	0.44	0.56	0.68	0.79	0.91	1.03	1.14	1.26	1.38	1.49	1.61	1.73	1.85	1.96
21	70	-0.15	-0.02	0.10	0.22	0.35	0.47	0.60	0.72	0.85	0.97	1.10	1.22	1.34	1.47	1.59	1.72	1.84	1.97	2.09
22	72	-0.15	-0.02	0.11	0.24	0.37	0.51	0.64	0.77	0.90	1.04	1.17	1.30	1.43	1.56	1.70	1.83	1.96	2.09	2.22
23	73	-0.16	-0.02	0.12	0.26	0.40	0.54	0.68	0.82	0.96	1.10	1.24	1.38	1.52	1.66	1.81	1.95	2.09	2.23	2.37
24	75	-0.17	-0.02	0.13	0.28	0.43	0.58	0.73	0.88	1.03	1.17	1.32	1.47	1.62	1.77	1.92	2.07	2.22	2.37	2.52
25	77	-0.17	-0.02	0.14	0.30	0.46	0.62	0.78	0.93	1.09	1.25	1.41	1.57	1.73	1.88	2.04	2.20	2.36	2.52	2.68
26	79	-0.18	-0.01	0.15	0.32	0.49	0.66	0.83	0.99	1.16	1.33	1.50	1.67	1.84	2.00	2.17	2.34	2.51	2.68	2.84
27	81	-0.19	-0.01	0.17	0.35	0.52	0.70	0.88	1.06	1.24	1.42	1.59	1.77	1.95	2.13	2.31	2.48	2.66	2.84	3.02
28	82	-0.20	-0.01	0.18	0.37	0.56	0.75	0.94	1.13	1.32	1.50	1.69	1.88	2.07	2.26	2.45	2.64	2.83	3.02	3.21
29	84	-0.20	0.00	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40
30	86	-0.21	0.00	0.21	0.43	0.64	0.85	1.06	1.27	1.49	1.70	1.91	2.12	2.33	2.55	2.76	2.97	3.18	3.39	3.61
31	88	-0.22	0.01	0.23	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.48	2.70	2.93	3.15	3.37	3.60	3.82
32	90	-0.23	0.01	0.25	0.49	0.72	0.96	1.20	1.44	1.67	1.91	2.15	2.39	2.63	2.86	3.10	3.34	3.58	3.81	4.05
33	91	-0.24	0.02	0.27	0.52	0.77	1.02	1.27	1.53	1.78	2.03	2.28	2.53	2.78	3.03	3.29	3.54	3.79	4.04	4.29
34	93	-0.24	0.02	0.29	0.55	0.82	1.09	1.35	1.62	1.88	2.15	2.42	2.68	2.95	3.21	3.48	3.75	4.01	4.28	4.54
35	95	-0.25	0.03	0.31	0.59	0.87	1.15	1.44	1.72	2.00	2.28	2.56	2.84	3.12	3.40	3.68	3.96	4.25	4.53	4.81

*Pressure has many different measurements!
1 hPa = 1 mb = 0.1 kPa = 2.09 lb/ft2 = 0.03 inHg = 0.001 bar

QUICK EXPLAINER

Dew point, explained simply



A cold glass on a hot day “sweats.” That's dew point, happening right in front of you.

What's actually happening

Air is always carrying invisible water. Warm air can carry a lot; cold air can't carry much. When air touches something cold — like your glass — it cools down right at that surface. If it cools enough, it can't hold its water anymore, and the extra water appears as droplets.

Dew point is just a number for that: **the temperature at which water starts appearing.**

Try it yourself

1. Fill a shiny metal cup with water.
2. Add ice, a little at a time, stirring gently.
3. Watch the outside. The moment droplets appear, that water's temperature is the dew point.

No VPD? Use temperature, RH and dew point instead

1

Check your controller

Many climate computers already calculate dew point, even where VPD isn't shown.

2

No dew point shown?

Temperature + RH gets you there via a chart or a free grower app — a once-off lookup.

3

Compare to crop surface temp

The closer leaf/fruit temperature is to dew point, the higher the condensation risk.

4

Measure it directly

An IR thermometer gives actual surface temperature, not just air temperature.

Same physics, different number. Dew point tells you when water starts forming; VPD tells you how far you are from that point. Keep leaf and fruit temperature a few degrees clear of dew point, especially overnight and at sunrise.

The cheapest things that actually work

~$100

IR thermometer

Leaf & fruit surface temp vs dew point — find your cold spots at sunrise.

~$50–150

Distributed T/RH loggers

Real conditions where you suspect a problem, not one house average.

Varies

Leaf wetness sensors

Direct measurement of the condition that matters most.

Good hygiene practices

The gap between your climate computer's average and the coldest square metre in your house costs about NZ$300 to measure.

The gold standard, priced honestly

PLANT-BASED BIOSENSING

Detects biotic stress signatures — some cases indicating powdery mildew pathogenesis weeks before visible symptoms.

~$10,000

per year

Also requires a working baseline in plant physiology and comfort reading the plots.

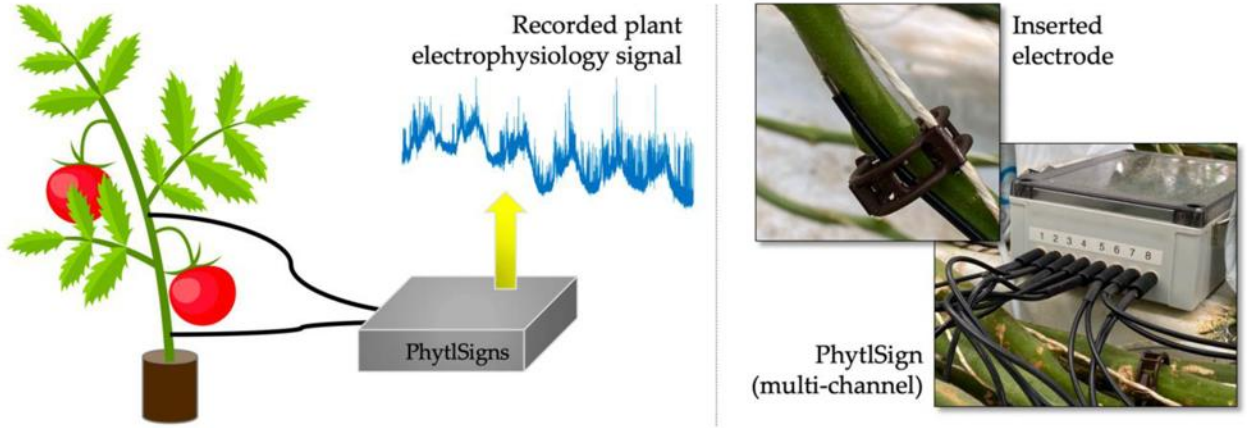


Figure 1. Setup for recording tomato plant electrophysiological signals. Adapted from "Classification of Plant Electrophysiology Signals for Detection of Spider Mites Infestation in Tomatoes," by E. Najdenovska et al., 2021, *Applied Sciences*, *11*(4), Article 1414 (https://doi.org/10.3390/app11041414). CC BY 4.0.

What that buys you

Time. Adjust climate, change husbandry, target a preventative spray — before the first lesion.

Evidence status

Real technology, real signal — independent validation in commercial protected crops is still limited.

This is the ceiling — not the recommendation. Everything next is a cheaper way of buying some fraction of the same thing: earlier information.

Five questions before you buy anything

1. What exactly does it measure or do — not what does it promise?
2. How does it change a decision I make?
3. How does that decision affect my production goal?
4. Is the ROI justified at my scale?
5. Is there a cheaper, simpler, or already-available way?

And the one that comes first: **is my identification right?**

If you're going to ask an AI, ask it properly

1. Give it the environment, not just the symptom — crop, stage, week, VPD/RH regime, recent climate events, spray history, distribution in the house.

2. Ask for differentials and what would distinguish them — not for an identification.

3. Ask what it would need to see to be confident — that becomes your checklist.

4. Ask it to argue against its own answer.

Rule: never let it close a decision that costs money or changes a spray. Triage and structure — then confirm.

What that means if you buy seed

- A resistance designation is a claim about specific genes, against specific pathogen races, at a specific point in time.
- It is not a permanent property of the cultivar.
- Ask your seed supplier: which genes, tested against which races, and when.

Treat resistance as one layer among several — not as the reason you can relax the others.

New Zealand Tomato Leaf Mould Industry Survey

Questions

Francisco Ferrada-Hartley · Massey University – Bioeconomy Science Institute

TO CLOSE

Three things to take away

1. The environment you optimise for the crop is also optimised for the pathogen. Structural, not a failure.

2. The defences we lean on — genetic and chemical — are both eroding.

3. You can still decide well on a limited budget, if you ask the right question before you spend.

Handout: trusted sources · tool-evaluation questions · symptom comparison card · cheap-intervention list