The New Zealand Institute for Plant & Food Research Limited

Insights into the latest New Zealand viticultural innovations

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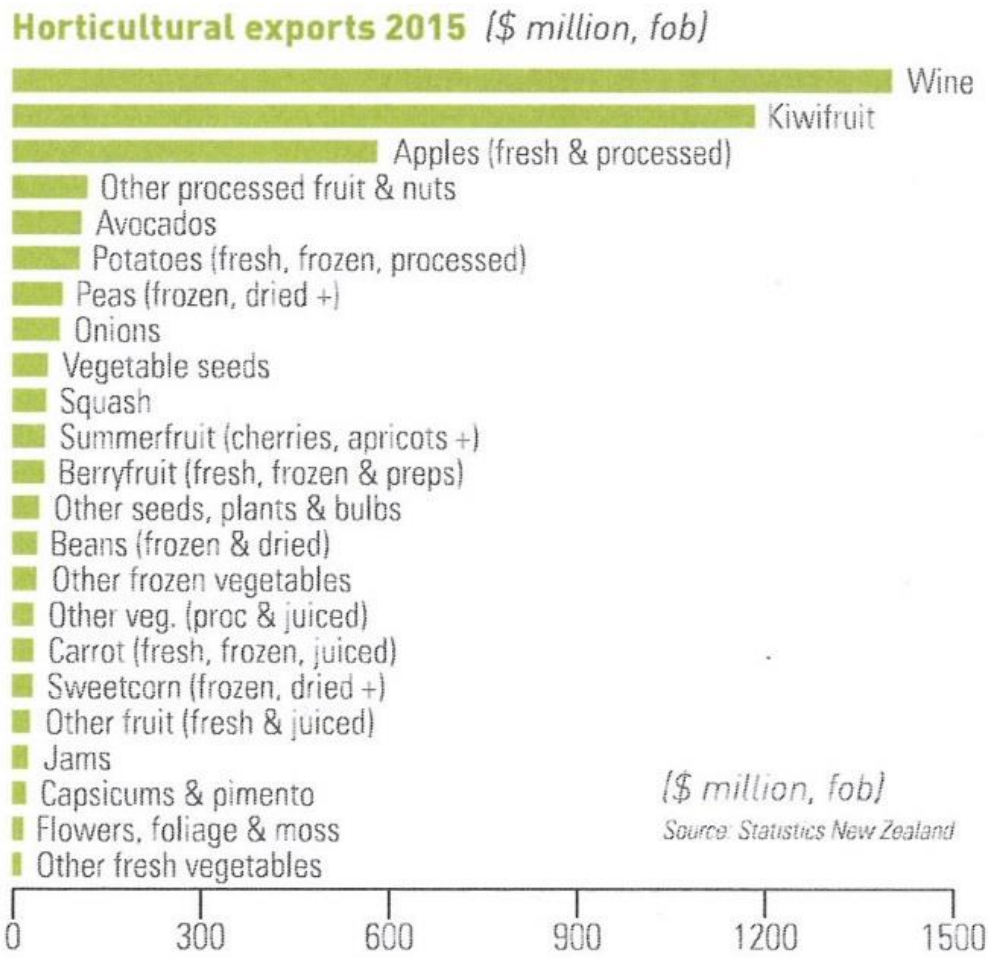
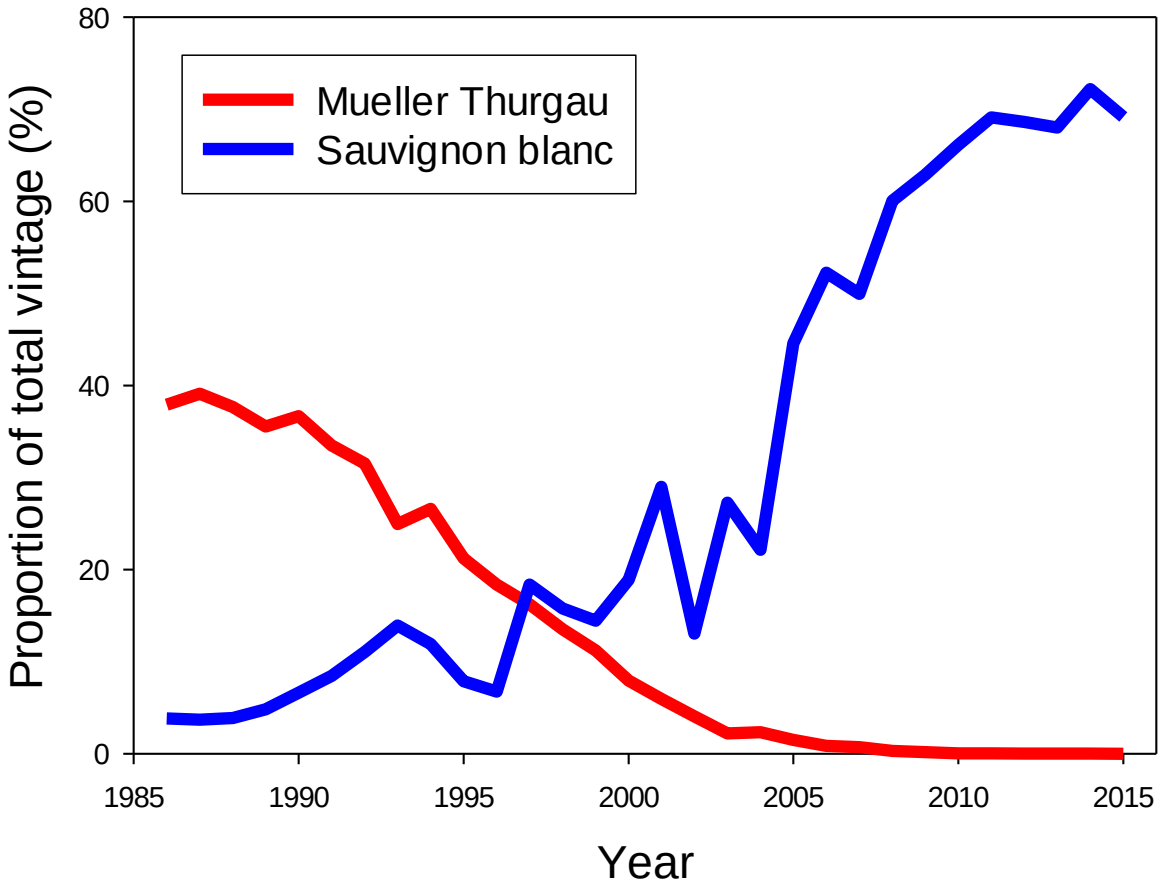
Wine is New Zealand's largest horticultural export

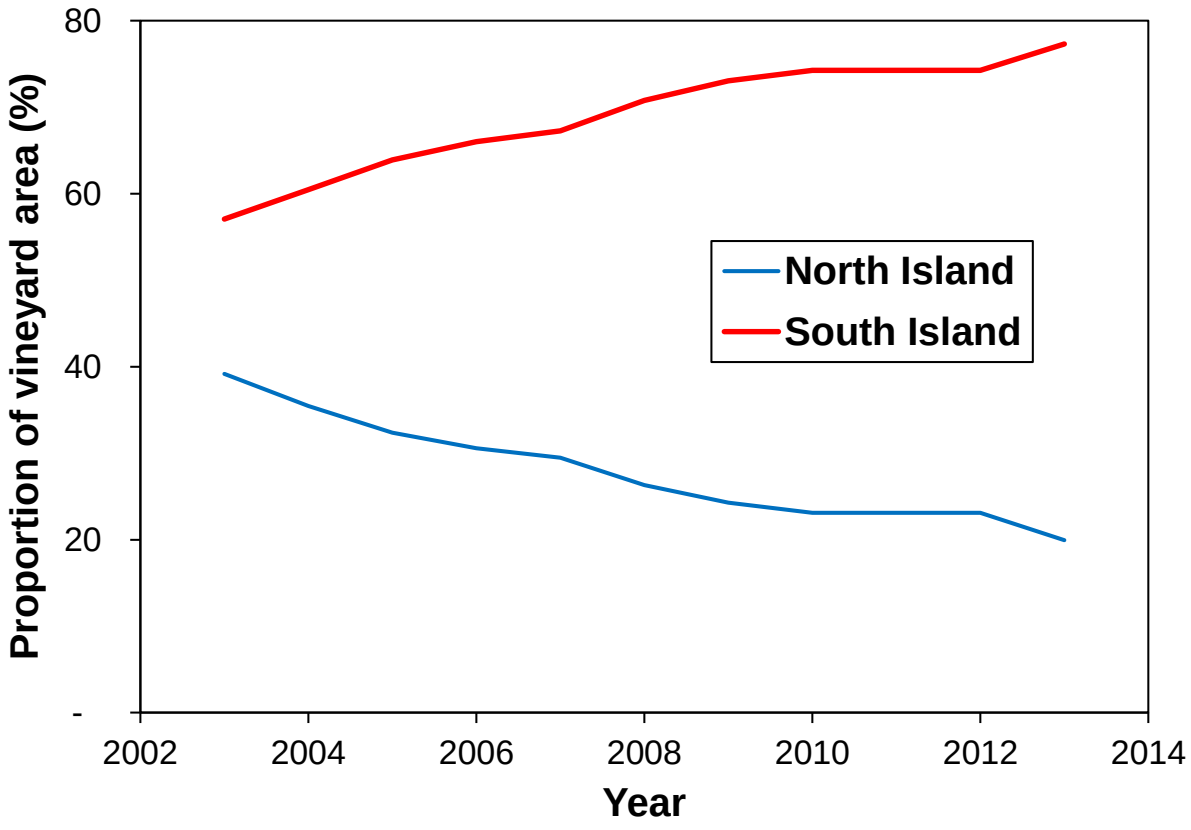


Source:
Fresh Facts 2015

A dramatically changing varietal mix



A changing regional vineyard distribution



Grape & Wine Research

- Dec 15 year $1.5B in export ($2.8B total revenue)
- 6th largest export sector
- National GWRP budget of ca. $7.0M
- **Key partners:**
  - New Zealand Winegrowers (NZW)
  - Plant & Food Research
  - University of Auckland (UoA)
  - Lincoln University
- NZW/MBIE Partnership recently approved
- Members rate R&D most valued NZW service*

*Source: NZW Annual Report 2014

Key wine sector risks

- Availability of irrigation water in dry years
- Key competitors (Chile, SA) closing the style/quality gap
- Frequency of extra warm vintages (i.e. 1998)
- Increasing production costs
- Short commercial vineyard life spans (trunk disease, virus)
- Biosecurity

Glassy winged sharp shooter + Xylella

Virus – mild strain cross protection

- Many strains of GLVaR-3
- Some appear more pathogenic than others
- Looking for mild strains of virus to vaccinate vines
- Multi regional replicated trial established
- 4 varieties inoculated with 3 different strains of GLVaR-3
- Karmun Chooi, Arnaud Blouin (PFR)

Virus – mild strain cross protection

- Possible differences in the severity and timing of foliar symptom expression in Merlot and Pinot noir

Sensing trunk disease

Increasing commercial lifespan of NZ vineyards

- TD a looming problem in NZ
- 60% of Marlborough vineyards <15 years old
- Vigorous higher cropping Sauvignon blanc very susceptible
- Sniff out trunk disease prior to onset of visible symptoms

Sensing trunk disease

Increasing commercial lifespan of NZ vineyards

- eNose and/or olfactory sensor arrays
- In vivo detection of specific volatile compounds produced by wood fungi
- Proof of concept for European canker in apples
- Work on *Eutypa* and *Botryosphaeria* in grapevines is pending

Virus – Mealybug control strategies

- Requires a combination of tactics
- Appropriate use of mealybug sex pheromones (2 species):
- Kill mealybugs but not other insects:
  - targeted, occasional use of selective insecticides
- How to monitor, identify and spray hotspots?
- Remove disruption of biocontrol by ants.

Virus – mealybug biocontrol

Biocontrol options:

- Keep mealybugs on sward in summer rather than move up to vines
- Managing natural enemies
- Accommodate overwintering strategies of parasitoids
- How to manage parasitoid habitat to improve biocontrol.

Biosecurity – future challenges

- More invasive species incursions, some accumulation of major pests
- New organisms without surveillance systems (plant pathogens)
- New organisms with surveillance systems but no good eradication tools
- Socially acceptable surveillance systems and eradication tools
- Classical Biological Control with more rapid biosafety

NZ Winegrowers Vineyard Ecosystems

“the resilience and profitability of the NZ wine industry has been improved through increased vineyard longevity”

- NZW + Ministry for Business Innovation & Employment Partnership (50:50 investment)
  - Mix of stretchy science (MBIE) and applied outcomes (NZW)
- Key research providers Plant & Food Research and UoA
- $7 million total investment over 7 years
- Improve vineyard commercial lifespan by 5–10 years
- Reduce reliance on synthetic herbicides

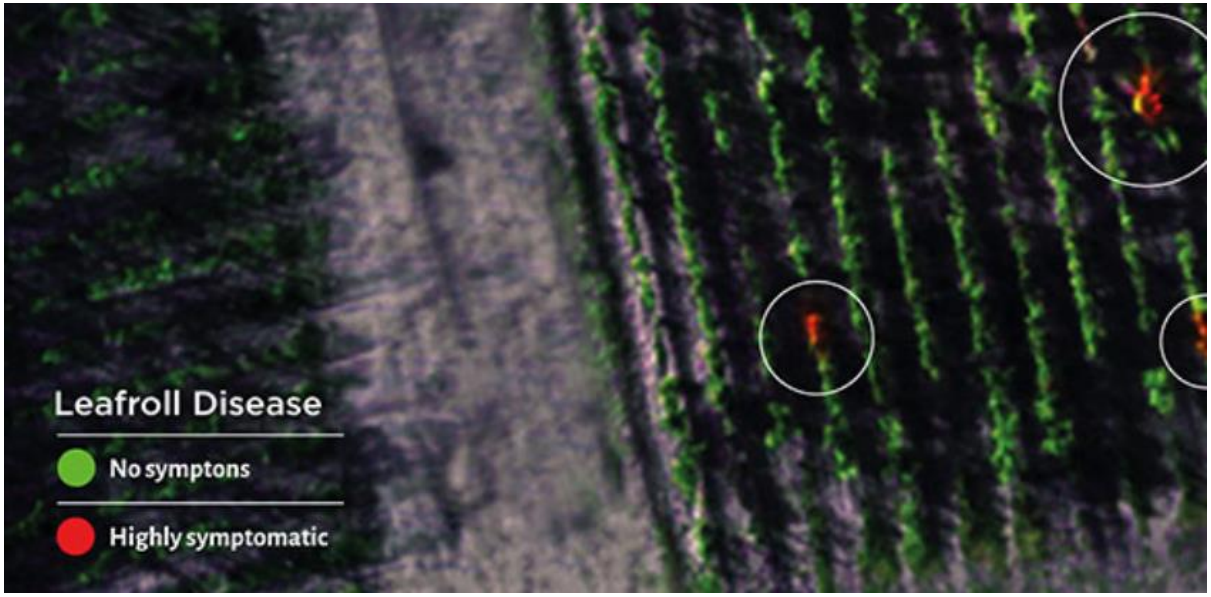
Digital viticulture – mesh networks

- Used commercially in several vineyards
- Ara/Bankhouse cover 500 ha
- Can visualize real time temperatures across 60 nodes
- Respond to sprinkler frost management in very targeted way
- Can control irrigation semi automatically
- Options to add other sensors
  - Soil moisture
  - Leaf wetness…

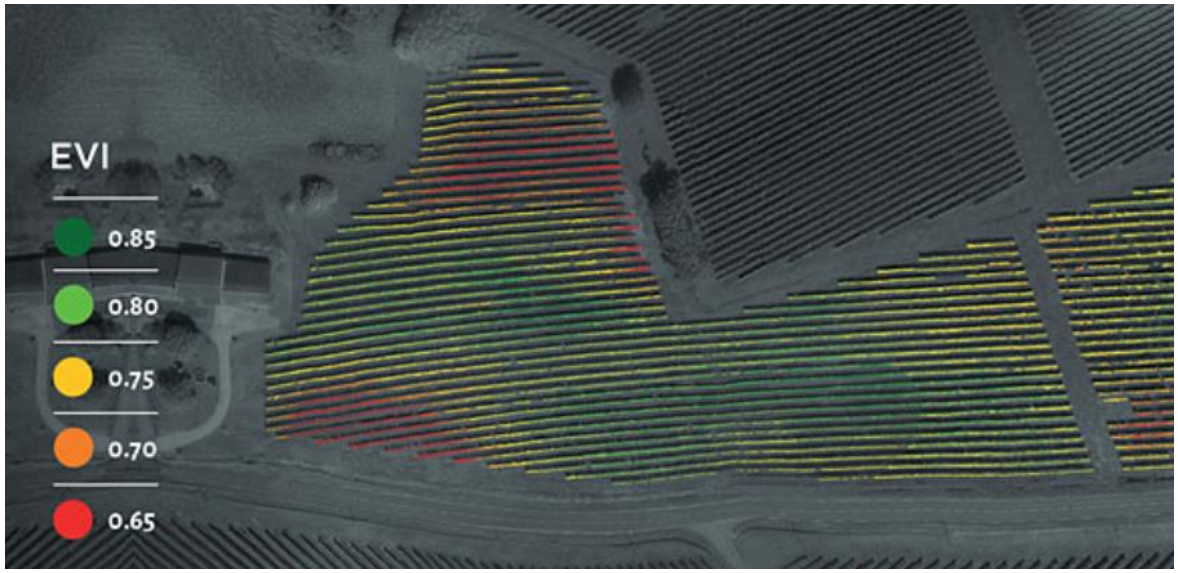
Digital viticulture – multispectral imaging

- Virus ID already exists in California arriving in NZ
- Red varieties only
- At stage when symptoms obvious

- White varieties
- Early stage in season
- Other non visible symptoms
  - Water stress
  - N, K, Mg deficiency



Precision undervine management



- Vine performance very sensitive to understory completion
  - Vine age, soil type etc…
- Cultivation and undervine mowing options problematic in stony soils

- Can use multi spectral imaging to create maps of weak vine growth and excessive competition
- Only remove undervine sward in areas where competition is detrimental ?
- Use more targeted or eco-friendly control measures

Precision canopy spraying

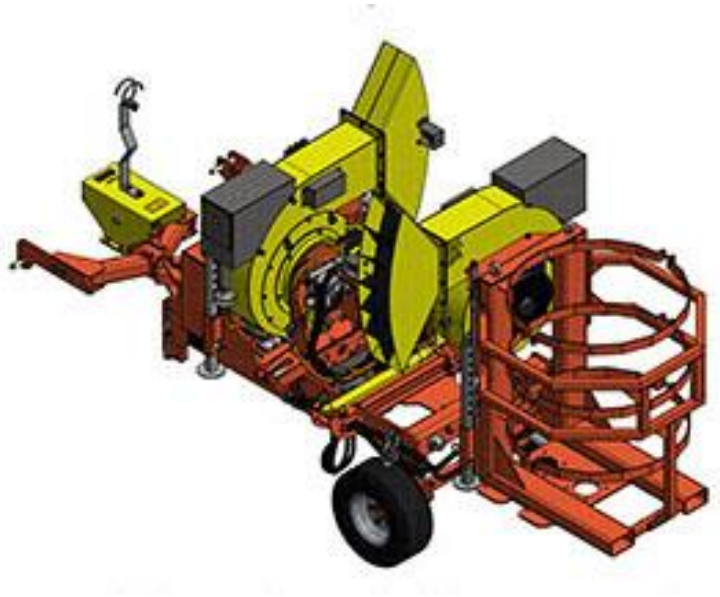
- Multirow spraying using small Quantum mist heads
- Narrow row short canopies
- Have been built up to 6 rows
- Problems with outer row coverage angled headlands etc…
- Used with auto-steer and full GPS prescription but…
- Now optimized for 4 rows
- In commercial use at Indevin's Bankhouse Vineyard

Heating/heat shock

Agrothermal™ Systems

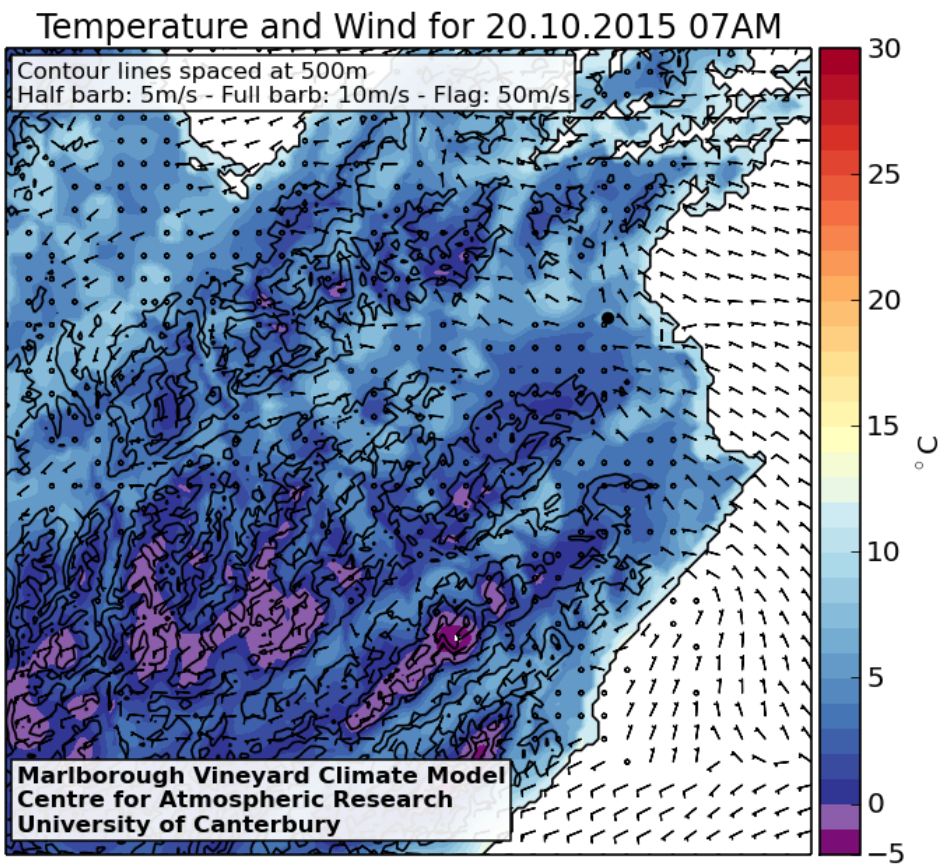
Thermal Plant Treatment (TPT)

- Originally designed for Frost protection but application changed
- Improves fruit set ?
- Reduces moisture?
- Sterilizing action ?
- Improves disease control?
- Not unreasonable to think that the TPT may elicit host plant defenses



Frost mapping

20 October 2015 - 7am



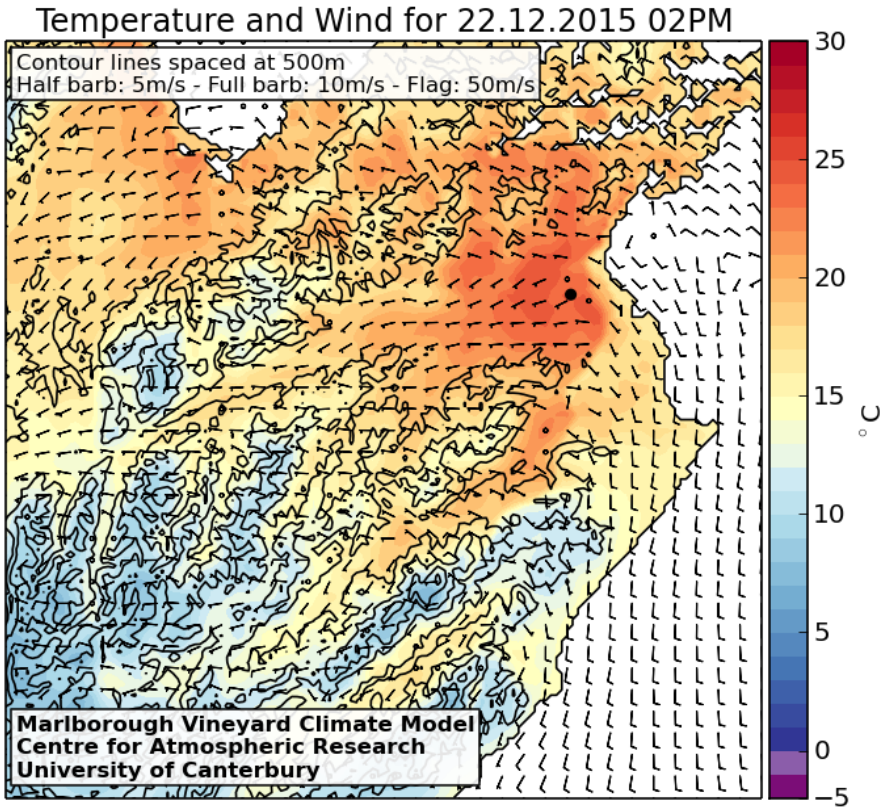
- Andrew Sturman Canterbury University, Mike Trought - Plant and Food Research
- http://wineclimate.co.nz
- Refinement of existing frost maps and predictions
- Interesting phenomena:
- “wave patterns” to frost distribution
- High altitude airflow over mountains disturbs temperatures at on plains

Heat ranger frost fighting

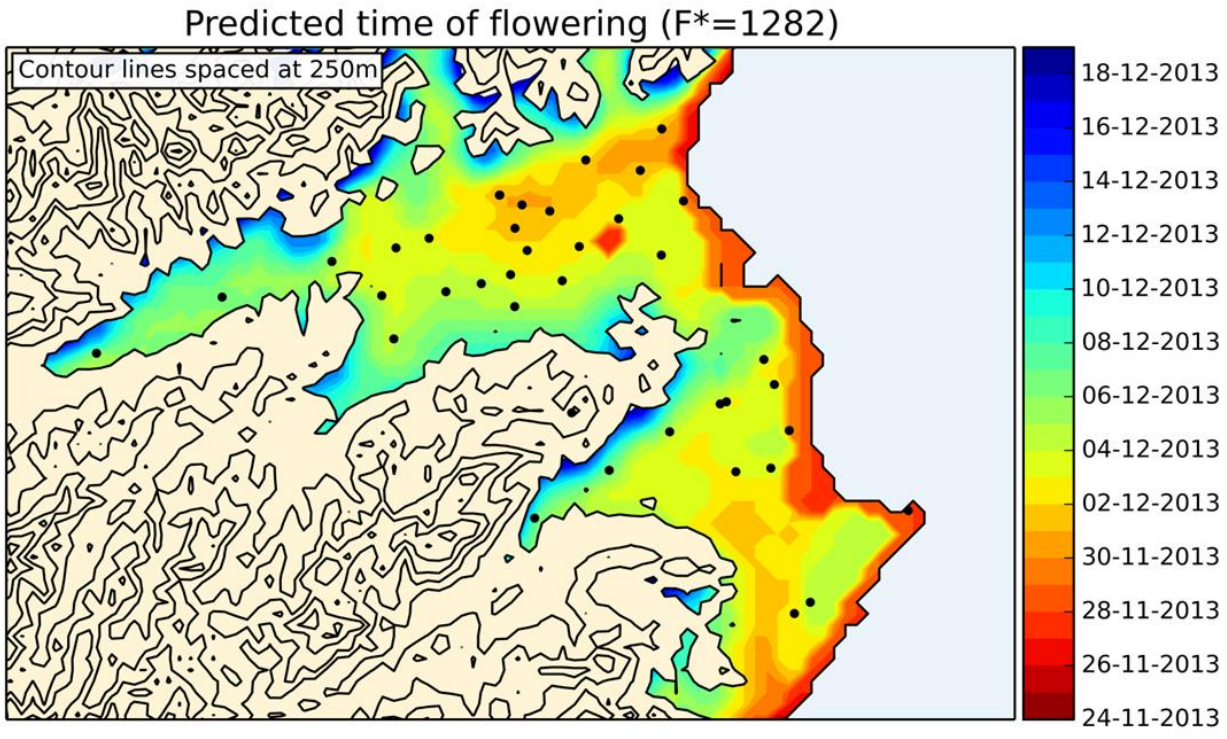
- Director Fred Phillips
- Hamilton company Heat Ranger Ltd
- burns LPG, rotates 360º and can
- Theoretically protects up to 15ha. of vineyards
- High unit cost $200k

Wind and temperature modelling

- Andrew Sturman, Tobias Schulmann et al. - University of Canterbury
- A regional weather forecast for air temperature, wind speed and wind direction based on the Weather Research and Forecasting model
- Climate change adaptation strategies
  - Varieties, rootstocks
  - LA:FW manipulations
  - Genetic improvement

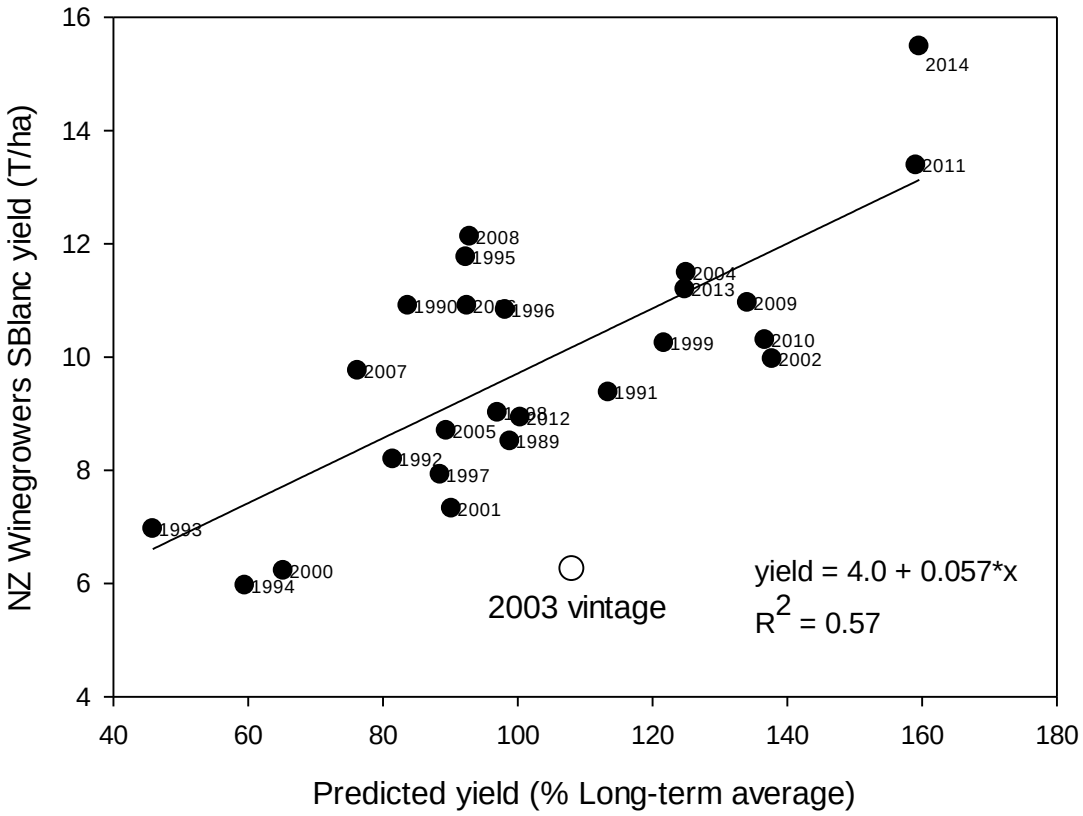


Flowering date prediction maps



- Amber Parker – Lincoln University
- Uses GFV model
- Temperatures during flowering at sub-regional level
- Working on bunch weight predictions

Yield modelling/prediction

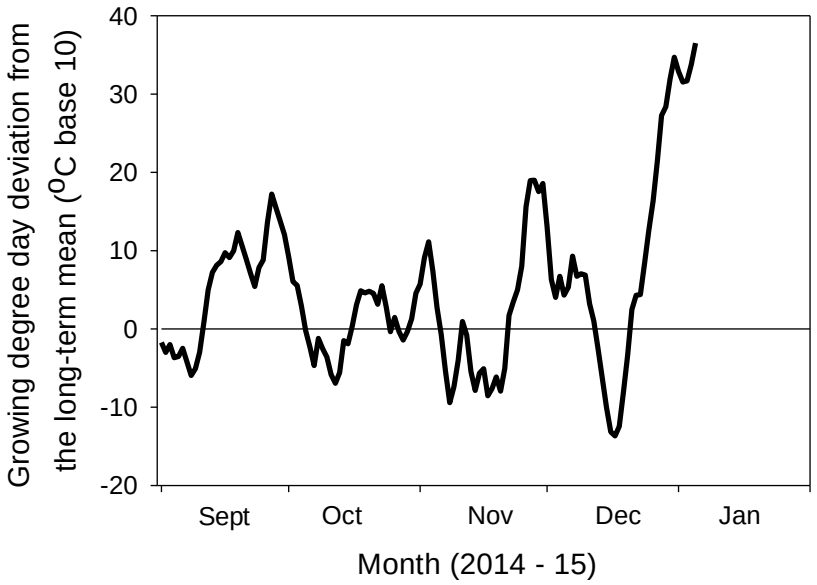


- Temperature based (for now)
- Only validated for SB in Marlborough
- One-off events can still have major influence
- Growing “mitigation” activity makes prediction more difficult

NZ Winegrowers Vinefacts Newsletter

- NZ Winegrowers funded project
- 30 weekly newsletters
- Expanding service:
  - Marlborough and SB specific to multi-region and multi variety
- Members only service
- Working on automation of data aggregation and presentation
- Substitute in-field phenology collection with modelled data

Yield prediction – pruning/thinning strategies



- laying 4-canes at pruning (up from 3)
- Will get 30% more crop when converting from 3-4 canes
- Early and cool flowering keep the cane
- Late and warm flowering remove extra cane (leave in canopy)

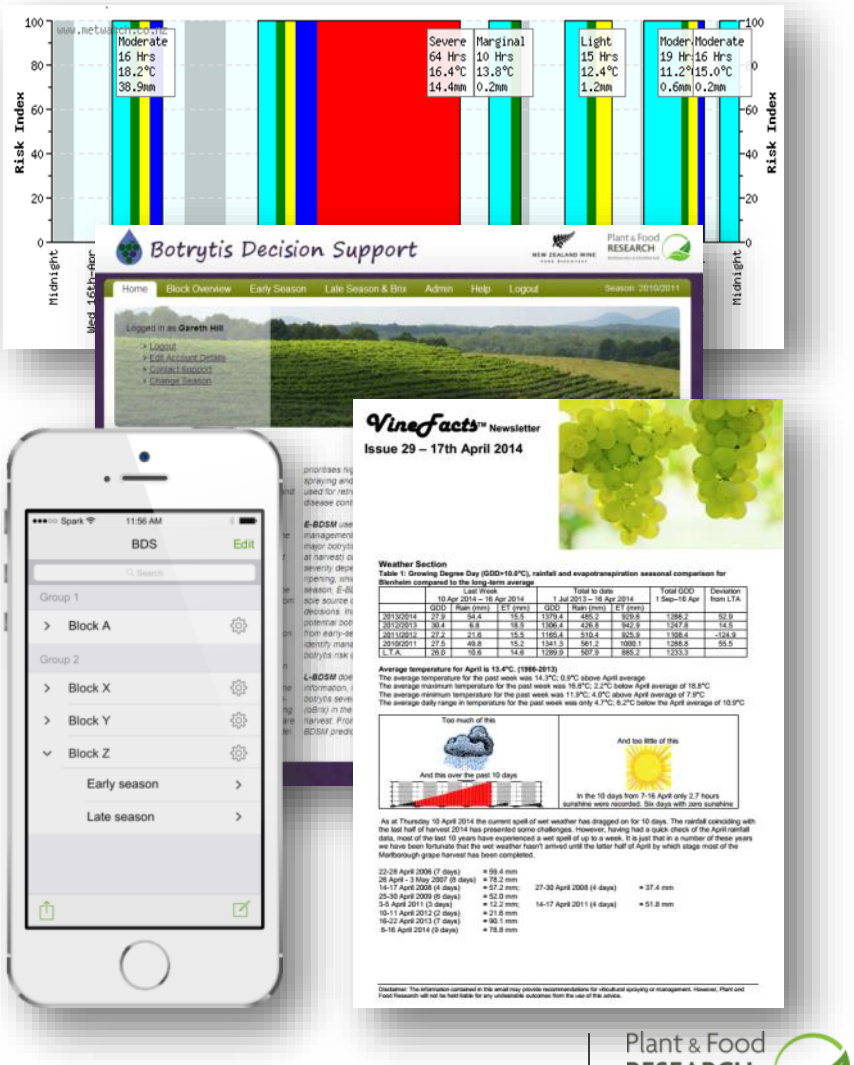
e.g. Flowering is 7 days later + 30% extra crop 10 days more to ripen

therefore predicted harvest date is 14 days later than average

Grower assessment “too much risk”.

Botrytis decision support

- Decision support systems
- Issues with uptake
- Perceptions of risk and risk aversion
- Accuracy and reliability
- Simplifying user experience
- Rotbot™ smartphone app
- VineFacts™

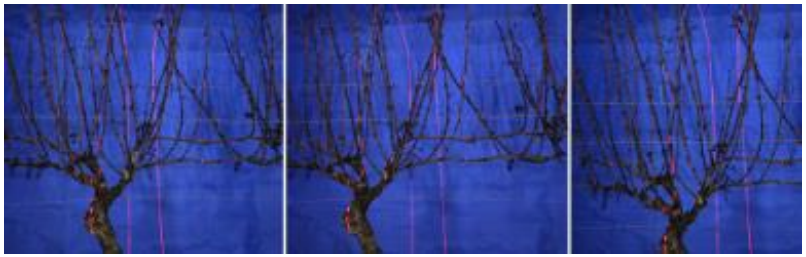


Mechanical thinning/shaking

- Mechanical shaking at pea size reduces berries per bunch
- Slows growth of retained berries
- Removes bunch and fruit zone trash
- Ripening rate same as control
- Ok for up to 25% reduction
  - need combo strategies for more reduction
- Substantially reduces botrytis incidence
- Effect still noticeable in vitro so plant response also likely

Robotic cane pruning for grapevines

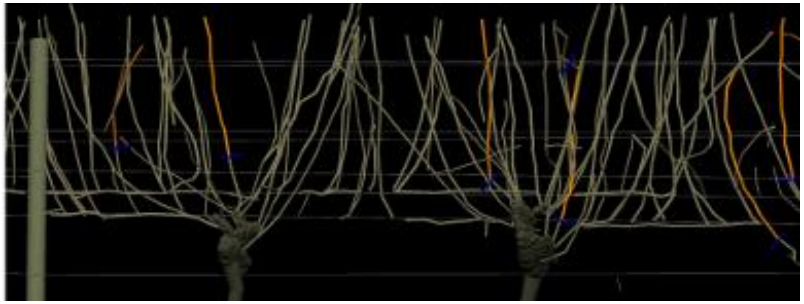
Tom Botterill University of Canterbury



- The AI was “trained” to make good pruning decisions
- a six-jointed robot arm reaches amongst the canes and makes the required cuts with a spinning cutting tool
- Major technical challenges:
  - building a 3D model of the complex vine structure
  - Identifying wires and things not to cut
  - Deciding which canes to remove
  - Planning path for arm

Robotic cane pruning for grapevines

- After four years of development,
- 3D models are correct enough to make decisions about where to prune,
- dynamic robot arm control is still under development
- the robot must stop at each plant to make the cuts

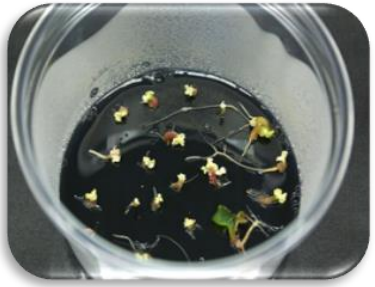


Awakening mobile elements

- Transposable elements driving epigenetics
- Work with somatic embryos
- Easy to ensure ‘even’ treatment of tissue
- Regenerated plants less likely to contain chimeras
- Somatic embryogenesis likely to stimulate transposition

Chris Winefield, Darrel Lizzamore (Lincoln University), Ross Bicknell and Susan Thompson (PFR)

Awakening mobile elements

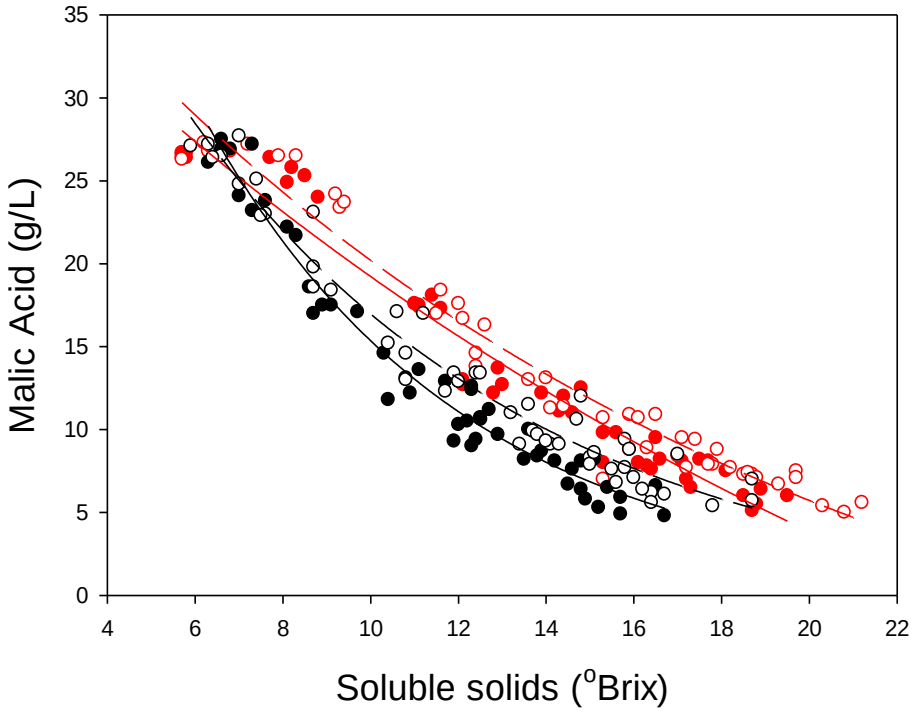


- Expose somatic embryos to a range of stresses for 48 hrs
- Remove stress and allow a recovery period
- Transfer embryo masses to regeneration media
- Regenerate plantlets, harden off and grow on in pots until of sufficient size

Awakening mobile elements

- Generating new clones of existing varieties
- No industry/market hurdle
- Especially interested in bunch architecture and fruitset aptitude
- Phenological differences also of interest in climate change context
- PM tolerance etc…probably a step to far for clonal mutation

De-synching sugar and flavour



- Manipulating leaf:area crop load at key stage desynchronizes sugar accumulation from other key metabolites (SB)
- Results often confounded by berry growth “compensation”
- Leaf area:fruit mass ratio determines the rate of sugar accumulation
- Other key metabolites time x temperature dependent
- Prospect of producing flavorsome SB wines at lower sugar

NZ Winegrowers Lifestyle wines

“Position New Zealand as number 1 in the world for high quality, lower alcohol and lower calorie wines”

- Primary Growth Partnership Programme
  - Market research and sensory analysis
  - Tools for vine management and winemaking
- NZW + 18 co-investing wine companies + MPI
- Key research providers Plant & Food Research and UoA
- $17 million total investment over seven years
- Benefit to NZ of $285 million by 2023

References and links

- Virus – mild strain cross protection Karmun Chooi, Arnaud Blouin (PFR)
- Sensing disease – Dion Mundy, Monica Walters, Nigel Larson et al. (PFR)
- Virus – Vaughn Bell, John Charles (PFR)
- Biosecurity – Max Suckling, John Charles (PFR)
- NZ Winegrowers Vineyard Ecosystems – Nick Hoskins http://www.nzwine.com/research/research-programme-1/major-programmes-1/vineyard-ecosystems/
- Mesh networks – Dave Rankin Indigo systems www.indigosystems.net,nz
- Multispectral imaging – Richard van der Put http://www.skysquirrel.ca/
- Precision understory management – Paul Johnstone et al. (PFR)
- Precision canopy spraying – Greer Eady Aspiration Holdings Ltd http://www.ahl.net.nz/
- NZ Winegrowers Mechanical thinning/shaking – Sue Neal. Michael Trought (PFR)
- Agrothermal™ Systems – Marty Fischer marty@agrothermalsystems.com
- Heat Ranger™ frost fighting Fred Phillips http://heat-ranger.com/
- Frost mapping Andrew Sturman, Michael Trought http://wineclimate.co.nz/

References and links

- Mesh networks – Dave Rankin http://www.indigosystems.net.nz/contactindigo.html
- Wind and temperature modelling – Andrew Sturman, Mike Trought (PFR) http://wineclimate.co.nz/
- Wind and temperature modelling – Andrew Sturman, Mike Trought (PFR) http://wineclimate.co.nz/
- Flowering date prediction maps – Amber Parker (Lincoln University)
- NZ Winegrowers Vinefacts Newsletter – Mark Eltom (NZW)
- Yield prediction – pruning /thinning strategies – Mike Trought (PFR)
- Robotic cane pruning for grapevines – Tom Botterill (University of Canterbury) http://www.cosc.canterbury.ac.nz/tom.botterill/
- Awakening mobile elements – Chris Winefield, Darrel Lizzamore (Lincoln University)
- Botrytis decision support – Gareth Hill (PFR)
- Mechanical thinning/shaking – Mike Trought (PFR)
- De-synching flavour and sugar – de la Noue, Bennett, Trought, Martin (PFR)
- NZ Winegrowers Lifestyle Wines – David Jordan http://www.nzwine.com/research/research-programme-1/major-programmes-1/pgp-lifestyle-wines-research-programme/

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