VITRUVIAN TECHNOLOGIES

Precision Disease Prediction for New Zealand Viticulture

Industry briefing | Sensor-driven disease management at vineyard scale

$210M+	5,300 ha	165	33%
Estimated annual industryloss to fungal disease (NZ)	Identified pipeline acrosstarget regions	Vineyards in activeoutreach pipeline	Spray reduction demonstratedin NZ peer-reviewed trials

The market problem

New Zealand's wine industry generates over $2 billion in annual exports, built on a reputation for clean, sustainably grown fruit. Protecting that reputation depends on effective disease management. The primary tool most growers use, the fixed-interval spray calendar, is structurally misaligned with the biology it is meant to control.

Calendar-based programmes apply fungicide at fixed intervals regardless of whether infection conditions exist. The result is systematic over-application in low-pressure periods, under-response when pressure builds quickly, accelerating resistance across the chemical classes growers depend on, and a direct cost burden of $11,400 per hectare per year when spray waste and yield losses are combined.

Three structural failures underpin this cost.

- Microclimate mismatch: Fungal infection is a block-level event governed by canopy humidity, leaf wetness and localised temperature. A single regional weather station cannot resolve these conditions across a vineyard. Programmes calibrated to regional averages systematically misread risk at the block level.
- Timing disconnection: Powdery mildew spore release follows rainfall events, not calendar dates. Spore-trapping trials across five New Zealand regions confirm that growers consistently apply fungicides before measurable infection pressure exists, with at least three spray rounds per season applied in advance of any inoculum.
- Resistance acceleration: Repeated fixed-interval applications have driven near-complete QoI (Group 11) resistance in Erysiphe necator populations across Marlborough and Hawke's Bay. An entire fungicide class has been removed from recommended New Zealand programmes. DMI (Group 3) sensitivity is also declining, narrowing the available management toolkit.

The Sustainable Winegrowing New Zealand programme, which certifies 98% of New Zealand's vineyard area, caps botrytis-specific applications at six per season. Programmes that routinely approach this ceiling have no headroom when a genuinely high-pressure season arrives.

The Vitruvian platform

Sensor network architecture

Vitruvian deploys a mesh of low-power field sensors across vineyard properties at two to three nodes per hectare, communicating via LoRaWAN radio to a single property gateway. The AU915-band network operates at 10 to 15 kilometre line-of-sight range with no per-node SIM costs and five to ten year battery life per node under standard hourly transmission schedules.

LoRaWAN was selected after evaluating cellular IoT, short-range mesh and satellite IoT alternatives. Cellular coverage is unreliable in Central Otago's gorge terrain, and per-node SIM plans are cost-prohibitive at the densities required for meaningful microclimate resolution. LoRaWAN resolves both constraints in a single architecture.

Predictive model stack

Sensor data flows through a four-layer inference pipeline producing disease-specific, block-level spray recommendations with a 168-hour forward window across all three primary fungal pathogens simultaneously: Botrytis cinerea, Erysiphe necator (powdery mildew) and Plasmopara viticola (downy mildew).

- Spatial layer: Identifies highest-risk blocks across the property mesh at two to three nodes per hectare resolution.
- Temporal layer: Calculates hours-to-threshold for each pathogen at each location, converting reactive spray decisions into planned interventions.
- Infection probability layer: Generates continuous risk scores accounting for cumulative microclimate exposure history rather than individual hourly readings.
- Forward layer: Combines current infection probability with seven-day weather projections to identify the optimal spray timing window within the coming 168 hours.

Validation and pilot

The model stack has been validated across three components: a NIWA-calibrated synthetic dataset of 14,115 hourly readings for the 2025/26 Central Otago season; multi-season backdating against the 2023/24 La Nina anomaly year and the 2024/25 frost-and-humid-autumn season; and an active pilot deployment at a Gibbston Valley vineyard delivering live sensor data through 2025/26.

Against the 2025/26 synthetic dataset the model recommended 33% fewer botryticide applications with no change in powdery mildew coverage, consistent with the 2004 New Zealand Plant Protection Society Marlborough field trial benchmark. Across both backdated seasons, disease pressure rankings were directionally correct relative to known regional outcomes.

Gibbston Valley was selected as the primary pilot site as the most demanding validation environment in Central Otago: highest rainfall, highest elevation, greatest topographic complexity. A system validated here performs reliably across the region.

Market opportunity and recoverable value

The identified pipeline spans approximately 165 vineyards representing over 5,300 hectares of planted area across Central Otago, Auckland, Hawke's Bay, Canterbury and Marlborough. At the current cost burden of $11,400 per hectare per year, the total addressable problem within this pipeline alone exceeds $60 million annually.

Recoverable value by vineyard scale

The table below quantifies recoverable value across representative scenarios using conservative, peer-reviewed assumptions. Spray waste recovery at 33% reflects the New Zealand Plant Protection Society benchmark. Disease loss avoidance at 80% of $5,000 per hectare reflects the proportion attributable to conditions detectable before they become unrecoverable, based on two seasons of Central Otago field observation.

	8ha Central Otago	15ha Central Otago	15ha Hawke's Bay / Marl.
Spray waste recovery (33% of $6,400/ha)	$16,896	$31,680	$37,125
Disease loss avoidance (80% of $5,000/ha)	$32,000	$60,000	$60,000
Total recoverable value	**$48,896**	**$91,680**	**$97,125**

All figures NZD. Spray waste recovery at 33% of $6,400/ha. Disease loss avoidance at 80% of $5,000/ha. HB/Marlborough spray waste recovery reflects higher programme intensity. Source: Vitruvian analysis.

Data network effect

Vitruvian's platform carries a structural competitive advantage that compounds over time. Fungal spores spread through wind-borne dispersal, meaning the inoculum pressure arriving at any vineyard is partly determined by conditions on neighbouring properties. A single-property system cannot observe this. As the network grows within a sub-region, the spatial model gains landscape-level data that improves prediction accuracy for every connected property.

Each additional season of live sensor data deepens the calibration base for that sub-region's specific microclimate. A model trained on three seasons of Kawarau River valley data is a materially more reliable predictor of Gibbston Valley disease risk than one trained on a single season. This accumulated calibration history is non-replicable on a faster timeline and represents a durable data advantage over any later entrant with identical hardware.

Sustainability and export market alignment

Vineyard activities account for 17% of the New Zealand wine industry's total emissions, with diesel representing 56% of the vineyard footprint. New Zealand Winegrowers' Roadmap to Net Zero 2050 identifies reduced diesel use and chemical application as critical industry priorities. Export buyers in the UK, EU and US are applying increasing scrutiny to pesticide residue profiles. A platform that delivers an auditable, quantified reduction in spray rounds is aligned with the direction the industry must travel regardless of individual grower motivation.

Current status and pipeline

Vitruvian is in active pilot engagement with vineyard operators in Central Otago's Gibbston Valley sub-region. The 2025/26 pilot season is delivering live sensor validation data. Commercial expansion is underway across Auckland, Hawke's Bay, Canterbury and Marlborough, with a pipeline of approximately 165 vineyards representing over 5,300 hectares identified.

The 2026/27 pilot programme is open nationwide. Early adopter positions in each sub-region are limited by network design rather than commercial availability, reflecting the compounding accuracy benefit that accrues to first movers in each sub-regional network.

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This document is based on the Vitruvian Technologies Whitepaper (2026). Financial figures are estimates based on conservative assumptions and will vary by vineyard, season and management practice. They are not a guarantee of specific financial outcomes. Vitruvian Technologies Limited is a New Zealand registered company.