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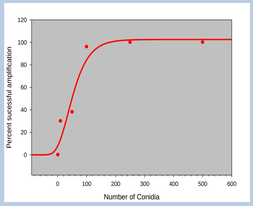
Seeks to understand the environmental factors that influence disease development and use this knowledge to develop more efficient approaches to disease management.

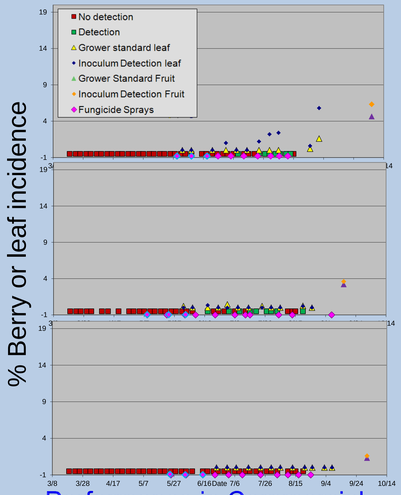
Inoculum Detection for Timing Fungicide Application

Spore Traps Placement

Custom built , costly $255 to produce were used



Sensitivity of PCR detection of trapped spores



Performance in Commercial Vineyards

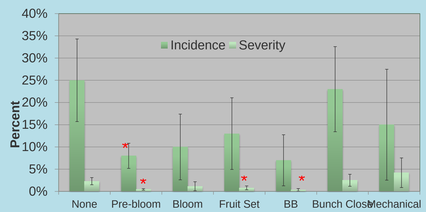
Split blocks of at least 0.2 hectare

The Pacific Northwest grape powdery epidemics do not always appear to be initiated following conditions suitable for ascospore release, indicating that overwintering inoculum is not always present. We have developed qualitative and quantitative PCR approaches for detecting airborne inoculum. We have demonstrated that delaying fungicide application until detection does not increase disease development despite eliminating 2.4 fungicide applications/year over three years of testing in commercial vineyards. Cooperator – Gary Grove, Washington State University

Early season leaf removal for disease management

Removal of leaves from the fruiting zone is a common practice in most western vineyards to aid in Botrytis management post bloom. However, there could be benefits to earlier removal. Two years of commercial vineyard trials have demonstrated that leaf removal when inflorescences are separating resulted in significant reduction disease incidence without impacting fruit quality or yield. Earlier leaf remove appears to result in less powdery mildew and botrytis bunch rot development thus improving growers' ability to meet fruit quality targets. (Collaborator: Patty Skinkis, Oregon State University)

Powdery Mildew Fruit disease

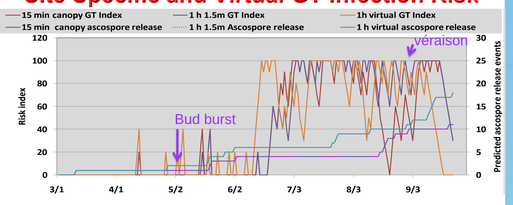


No leaf pulling | Pre-bloom removal | Bunch close removal

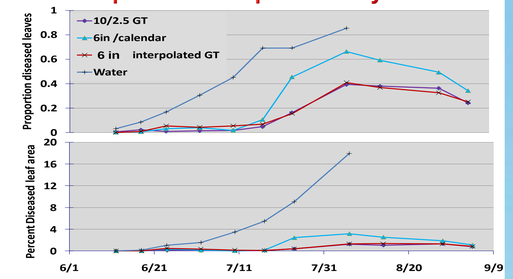
Treatment	Cluster wt (g)	Berry wt (g)	SS (°Brix)	pH	TA (g/L)	Total skin phenolics (mg/g)	Total Anthocyanins (mg/g)
pre-bloom	113.77	1.20 ab	21.7	3.13	10.5	9.95	2.44
bloom	128.03	1.14 ab	21.2	3.11	10.9	9.83	2.44
fruit set	102.57	1.00 b	21.9	3.13	9.9	9.83	2.33
BB to P	117.07	1.03 ab	20.9	3.12	10.2	11.04	2.47
Closure	128.76	1.32 a	20.7	3.14	11.0	9.55	2.48
Control	143.18	1.08 ab	21.5	3.15	10.1	9.38	2.38
Mechanical	119.38	1.02 b	20.9	3.16	10.3	10.93	2.73
P	*0.48*	***0.026***	*0.82*	*0.99*	*0.98*	*0.54*	*0.99*

Means presented from 2009 harvest. Statistical analysis conducted by ANOVA, REGWQ means separation with exception of [a]Kruskal-Wallis.

Site Specific and Virtual GT Infection Risk



Development of Grape Powdery Mildew

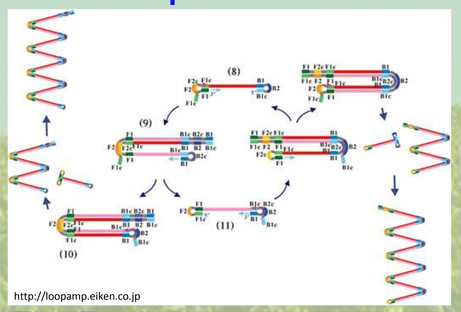


Use of virtual weather data in the Gubler/Thomas Model resulted in the same disease levels and number of pesticide applications (n=9). Sulfur applications began at 6in (6" shoot growth) or 10/2.5 (daily average temp 10 C with 2.5 mm rain) with subsequent applications based on infection risk or a calendar program (every 10-14 days).

Grower Performed LAMP-PCR for Inoculum Detection

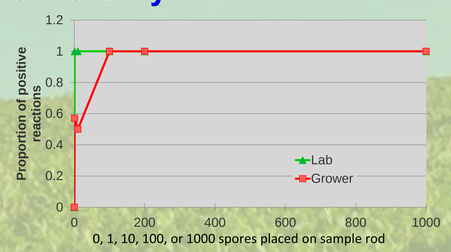
Inoculum detection for timing fungicide applications has been shown to reduce fungicide use but requires significant capital equipment (>$48,000) and highly skilled labor and expensive DNA extraction procedures. A grower preformed LAMP-PCR technique was developed that requires $1,900 in equipment, unskilled labor and less time. In the first year of testing, growers were able to detect 10 spores 57% of the time and had 75% accuracy rate for field samples when compared to LAMP-PCR conducted in a LAB by skilled labor and 90% accuracy rate to quantitative PCR. Cooperator – Gary Grove, Washington State Univ.

The Concept



http://loopamp.eiken.co.jp

Sensitivity



The Equipment

Approximately $1900 + a freezer

Field Performance

Comparison to Taqman based qPCR

qPCR	LAMP PCR Positive	LAMP PCR Negative
Positive	125	11
Negative	3	194

Samples from 7 commercial vineyards (N=211)and 1 research vineyard (N=114)

Comparison grower performed and Lab performed LAMP

Grower	Lab Positive	Lab Negative
Positive	15	3
Negative	11	24

Samples from 5 commercial vineyards

The Procedure

DNA Extraction and Amplification

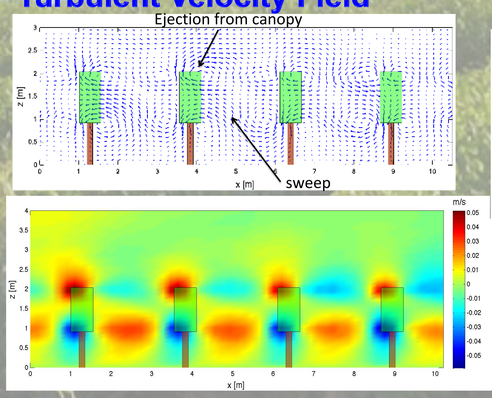
- Centrifuge (13000×g) for 5 min
- Boil for 5 min
- Transfer 5 µl to PCR tube with 45 µl master mix
- Incubate at 65°C for 45 min
- Incubate at 80°C for 5 min
- Check turbidity
- Centrifuge for 1 min check for pellet

Costs		PCR	qPCR	LAMP-PCR
Expendables	sample rods	$ 0.30	$ 0.30	$ 0.30
	primers	$ 0.18	$ 0.87	$ 1.36
	plastics	$ 0.53	$ 0.18	$ 0.50
	Master mix	$ 0.56	$ 1.81	$ 1.91
	Extraction kit	$ 3.95	$ 3.95	$ 0.15
	Gel	$ 1.00	$ 1.00	$ -
	Processing time	4 h	4h	2 h
	Labor	3 h @$40/h	3 h @$40/h	0.5 @ $20
Cost/sample - 10 samles/time		$ 18.52	$ 20.11	$ 10.22
Capital	trap	$ 215.00	$ 215.00	$ 215.00
	PCR	$ 16,000.00	$ 48,000.00	$ 1,900.00

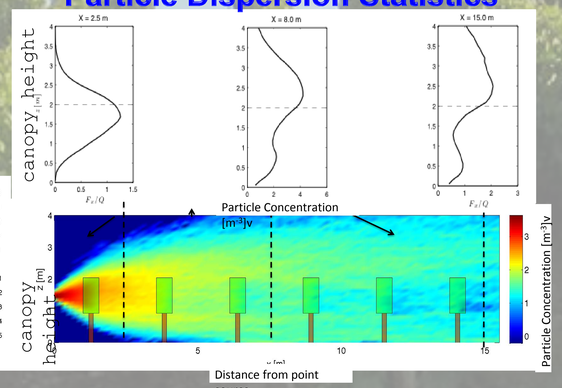
Modeling Particle Dispersion in Sparse Canopies

There is a limited understanding of the factors that influence dispersal of fungal pathogens with vineyards. Preliminary models of turbulent airflow and its effect on dispersal of fungal spores in vineyards have been developed. The models can be used to direct scouting and management efforts to specific areas of vineyards where disease is most likely to develop, assist in the deployment of spore traps for monitoring airborne inoculum. They could also be used to develop a mechanistic model for grape phenology and pathogen development allowing for the in silico examination of training system and their impact on grape growth and disease development. Collaborators: Rob Stoll, Eric Pardyjak, Utah University and Patty Skinkis, Oregon State University)

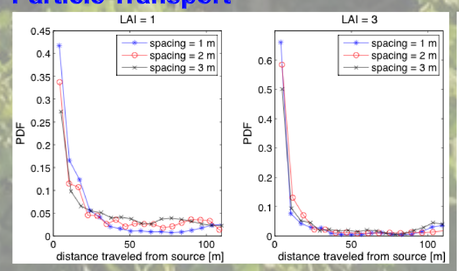
Turbulent Velocity Field



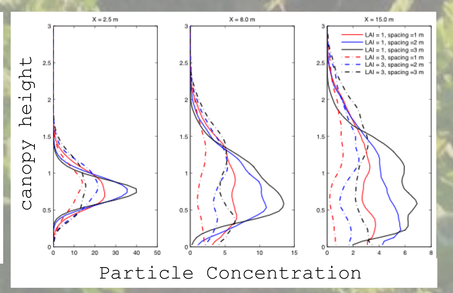
Particle Dispersion Statistics



Predicted Long-distance Particle Transport



Predicted distance above canopy



An Integrated Modeling Approach