Biology and phenology of scale insects in a cool temperate region of Australia

Grapevine scale *Parthenolecanium persicae Fab*.

Frosted Scale *Parthenolecanium pruinosum* Coc.

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Distribution of Scales in the Wine Growing Regions of Australia

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Grapevine scales

Grapevine scale *Parthenolecanium persicae* (Fab.) and Frosted scale *Parthenolecanium pruinosum* (Cocq.) are common grapevine scales in Australia arriving in Australia in the early 1900's

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Identification of juvenile scales, antennae and spines

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Adult scale size and reproductive capacity

Species	Body length (mm)	Body mass (mg)	Egg incubation (days)	Fecundity (Eggs/ female)
P. persicae	6.4 ± 0.17	17.5 ± 1.2	20.7 ± 0.27	1361 ± 128
P. pruinosum	5.1 ± 0.15	10.4 ± 1.0	19.5 ± 0.23	387 ± 113
p-value	<0.001	<0.001	0.002	<0.001

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Scales in Australian vineyards

- Biology and ecology of both insects are poorly documented for vineyards in Australia
- Persistence from year to year is a concern despite various pest management technique
- Factors causing the sporadic outbreaks in vineyards are scarcely known
- High population growth rate results in population rising above the economic threshold each season
- Overwintering as nymph under bark of vines

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Population and phenology

- Collection of population data was obtained from Chardonnay, Riesling, Sauvignon blanc and Pinot Noir grape varieties in three vineyards near Australian Capital Territory.
- Monthly sample was collected between October 2010 and September 2011
- Six vines of each variety was randomly selected among the infested vines per plot
- One of the cordon branch of the vine was tagged for insect count
- Data was analysed using Repeated Measure REML correlation model in Genstat 14.

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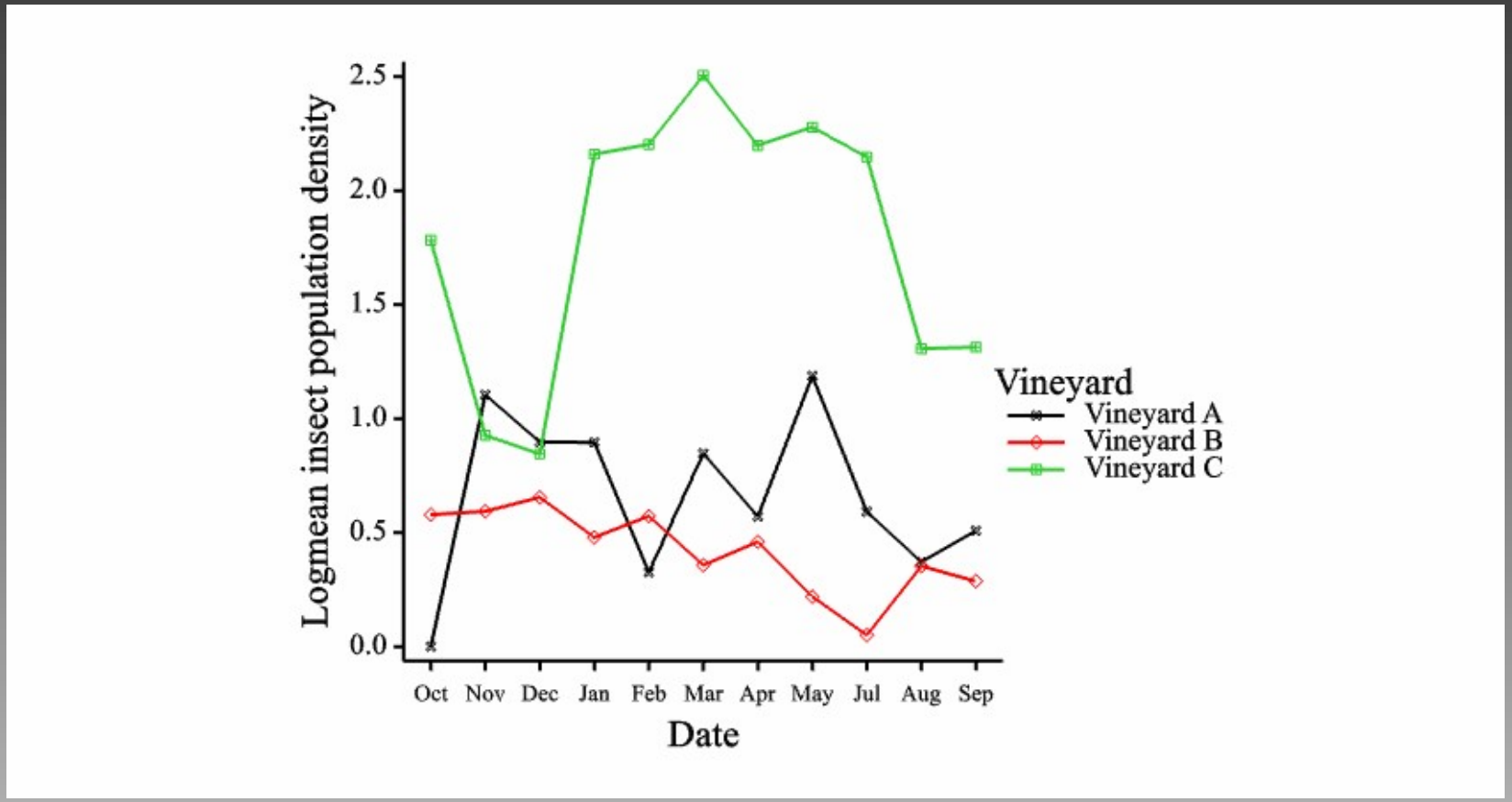
Change in scale population over time



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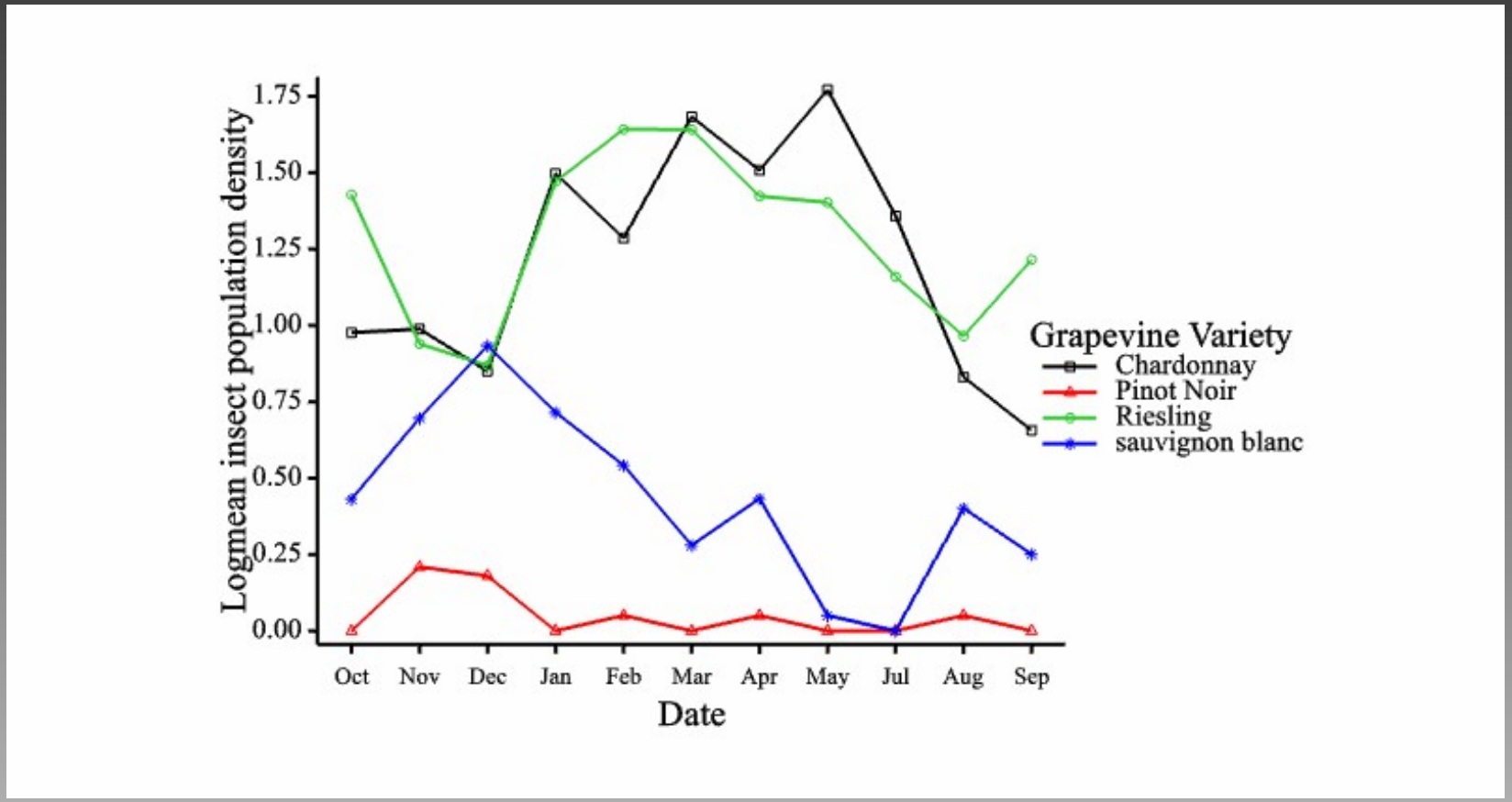
Density of scales on different cultivars



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Results

Fixed Term	Wald Statistic	df	F-statistic	Wald/df	F-probaility
Date	54.84	10	4.97	70.7	<0.001
Site	507.32	2	253.66	92.1	<0.001
Variety	58.24	3	19.41	91.2	<0.001
Date.site	285.25	20	12.82	103	<0.001
Date.variety	80.02	30	2.39	122.3	<0.001

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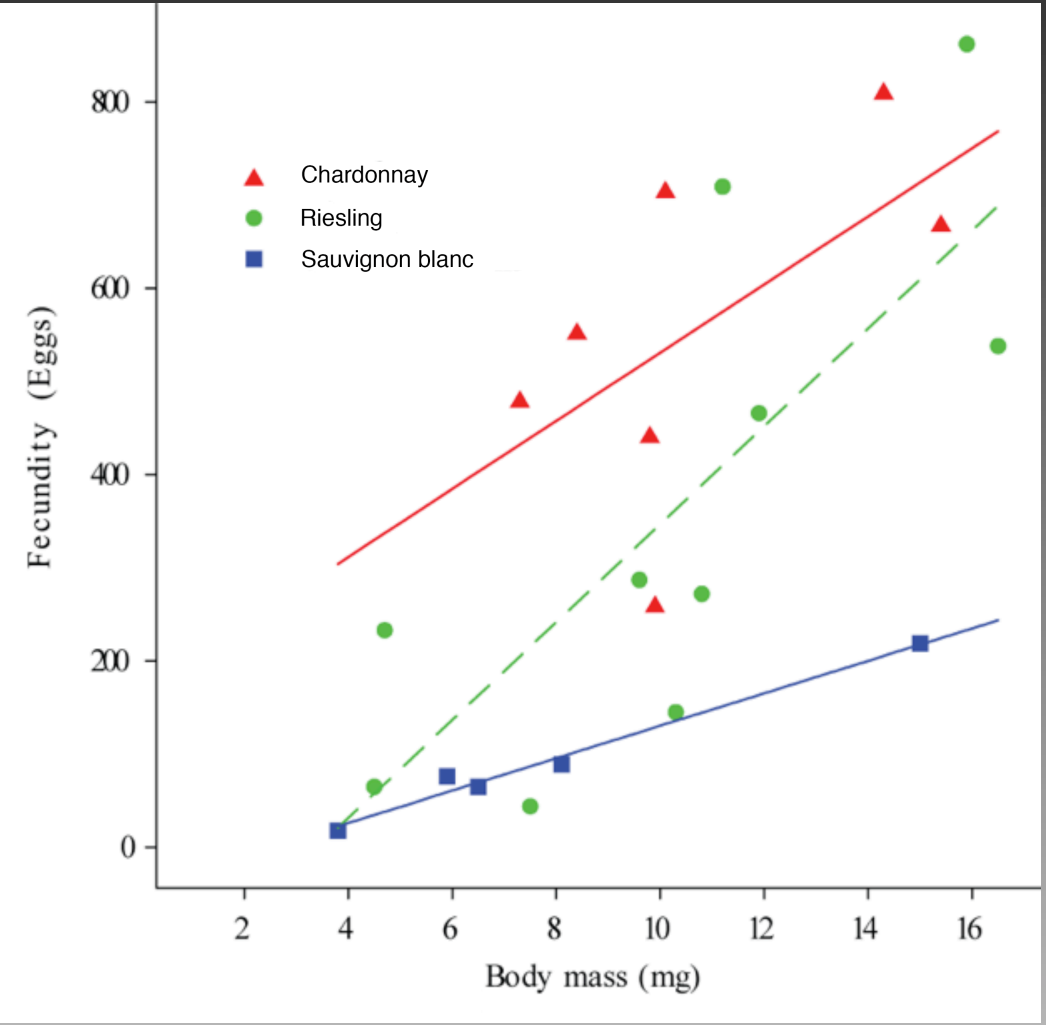
Effect of body mass on fecundity of frosted scale (P. pruinosum)



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Greenhouse experiment on scale effects on different cultivars

1. Seedlings of three grapevine variety were used in the study, Riesling, Pinot Noir and Sauvignon blanc.
2. Glasshouse experiment represented a completely randomised block design with 9 replicated blocks.
3. Each block consisted of 6 plants, two plants of each variety for control and infested. Plants were randomly arranged on bench/ block. Plants were spaced 70 cm apart to restrict foliage touching.

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4. After a month of seedling establishment in October (all on similar soil medium and pot size), 10 gravid female were released onto a branch of each vine plant by placing the adults on cotton wool and fastening onto the wood with a sticky tape.

5. Plant growth data and insect count was made each month from December to March.

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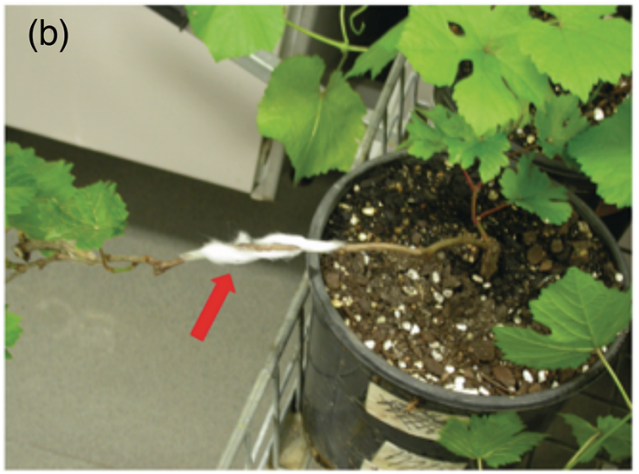

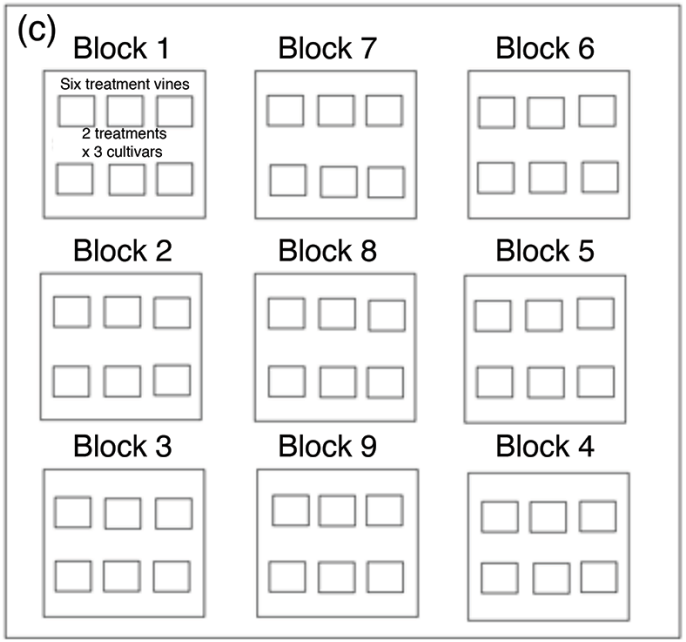

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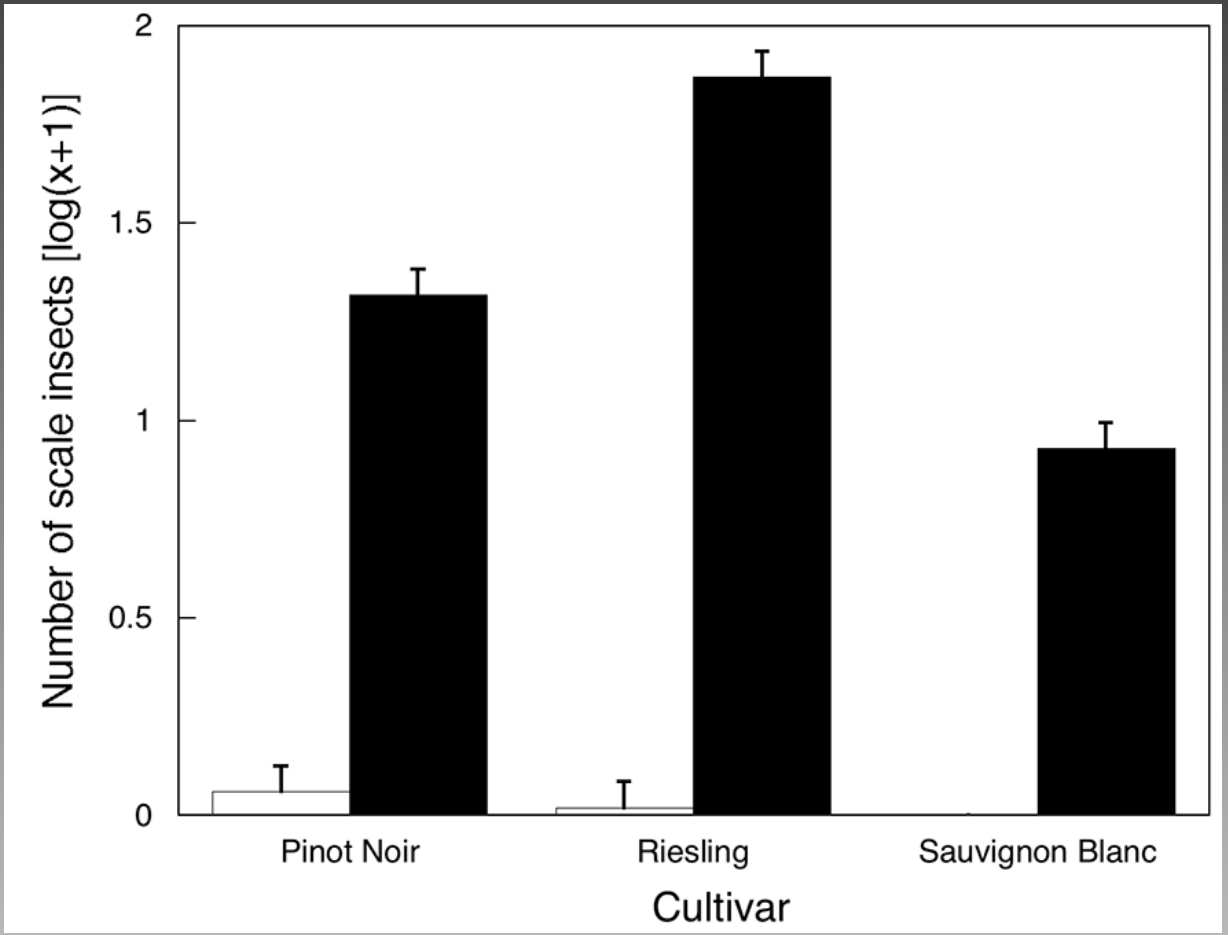

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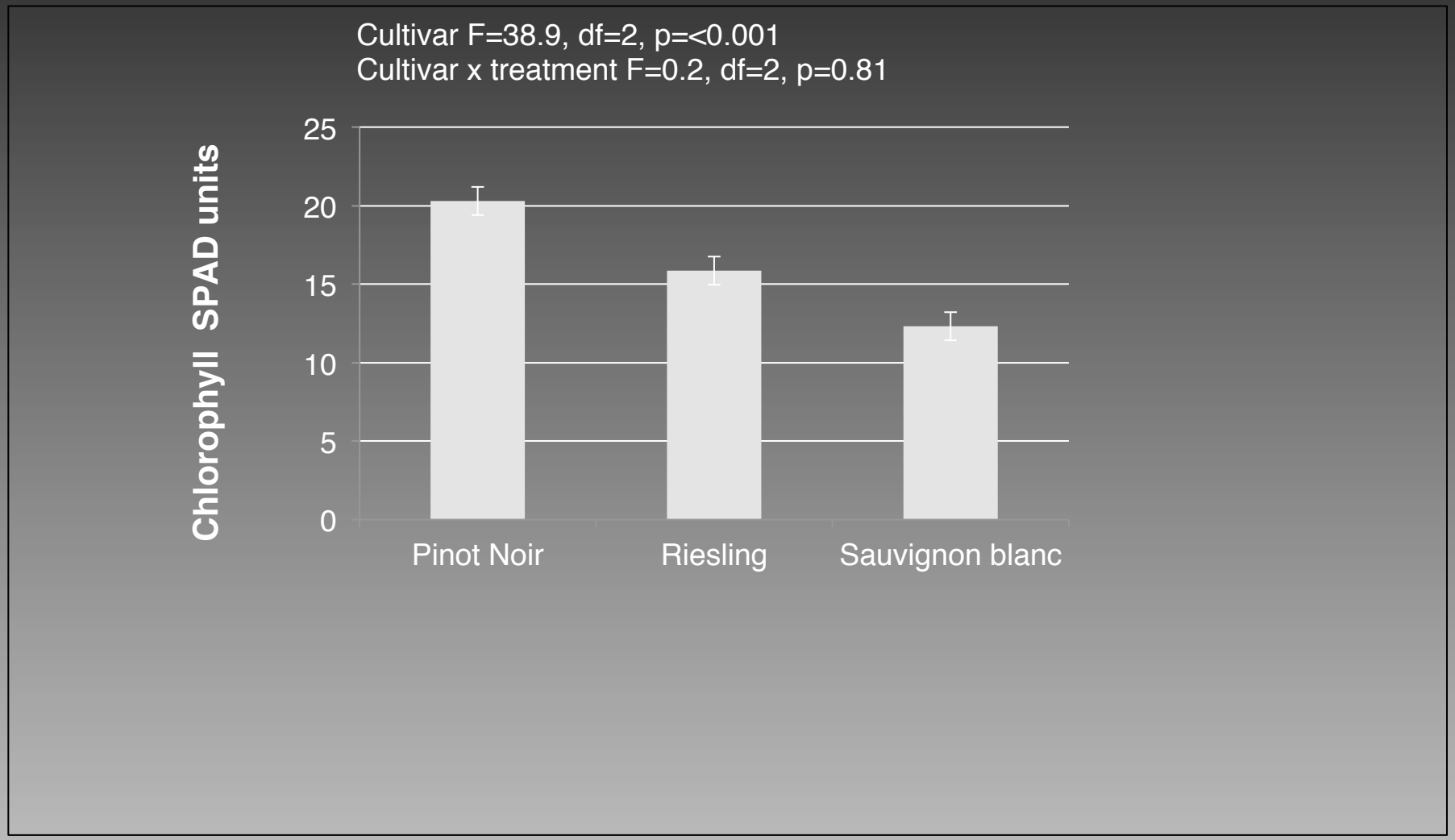
Cultivar differences in chlorophyll



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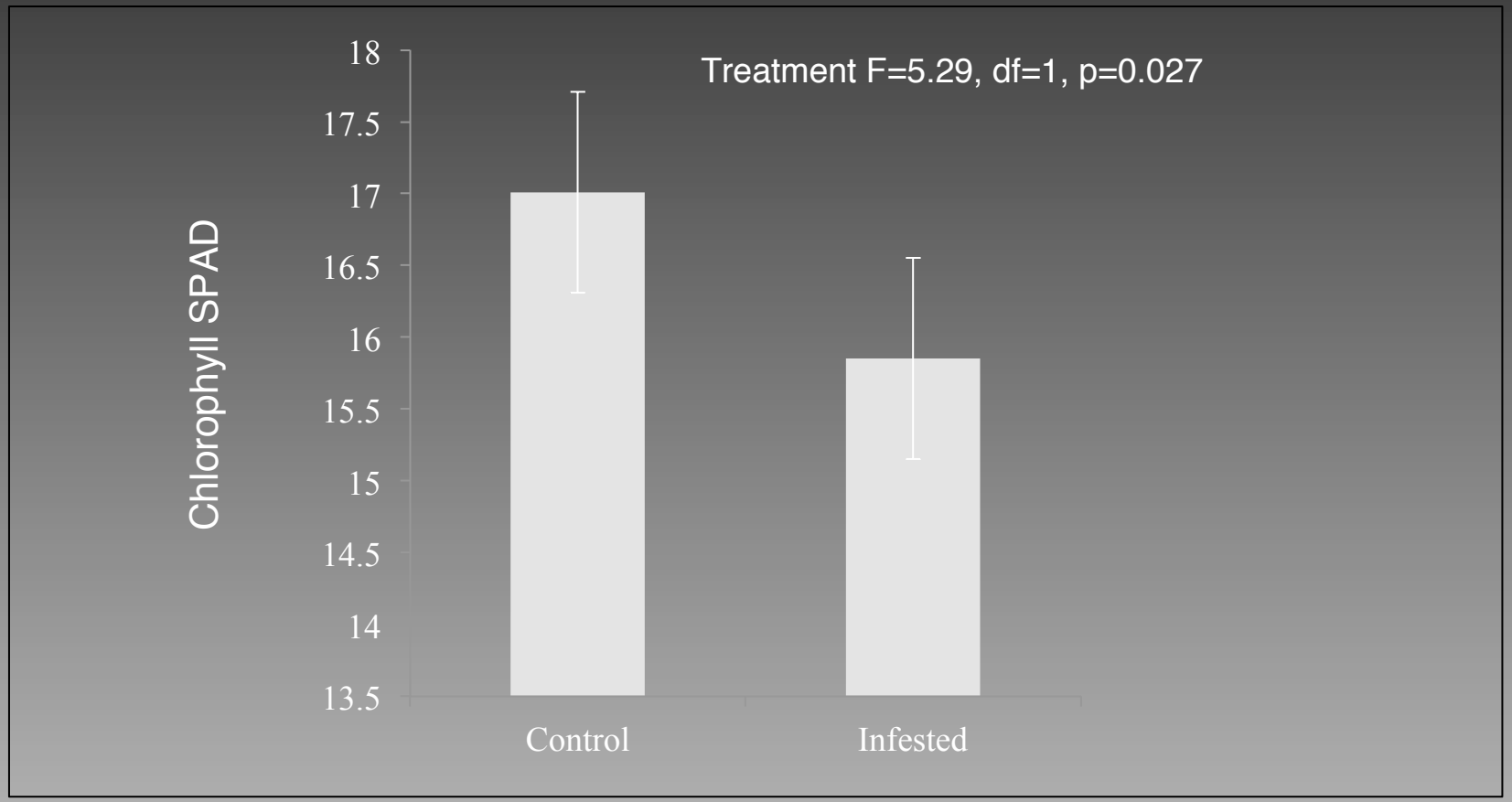
Overall effect of scale on chlorophyll in three cultivars



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Overwintering survivorship

Is survival mediated by plant characteristics or insect characteristics?

1. Explore the relationship between bark thickness of different cultivars and associated thermal characteristics.
2. Investigate expression of cold tolerance in *P. persicae.*

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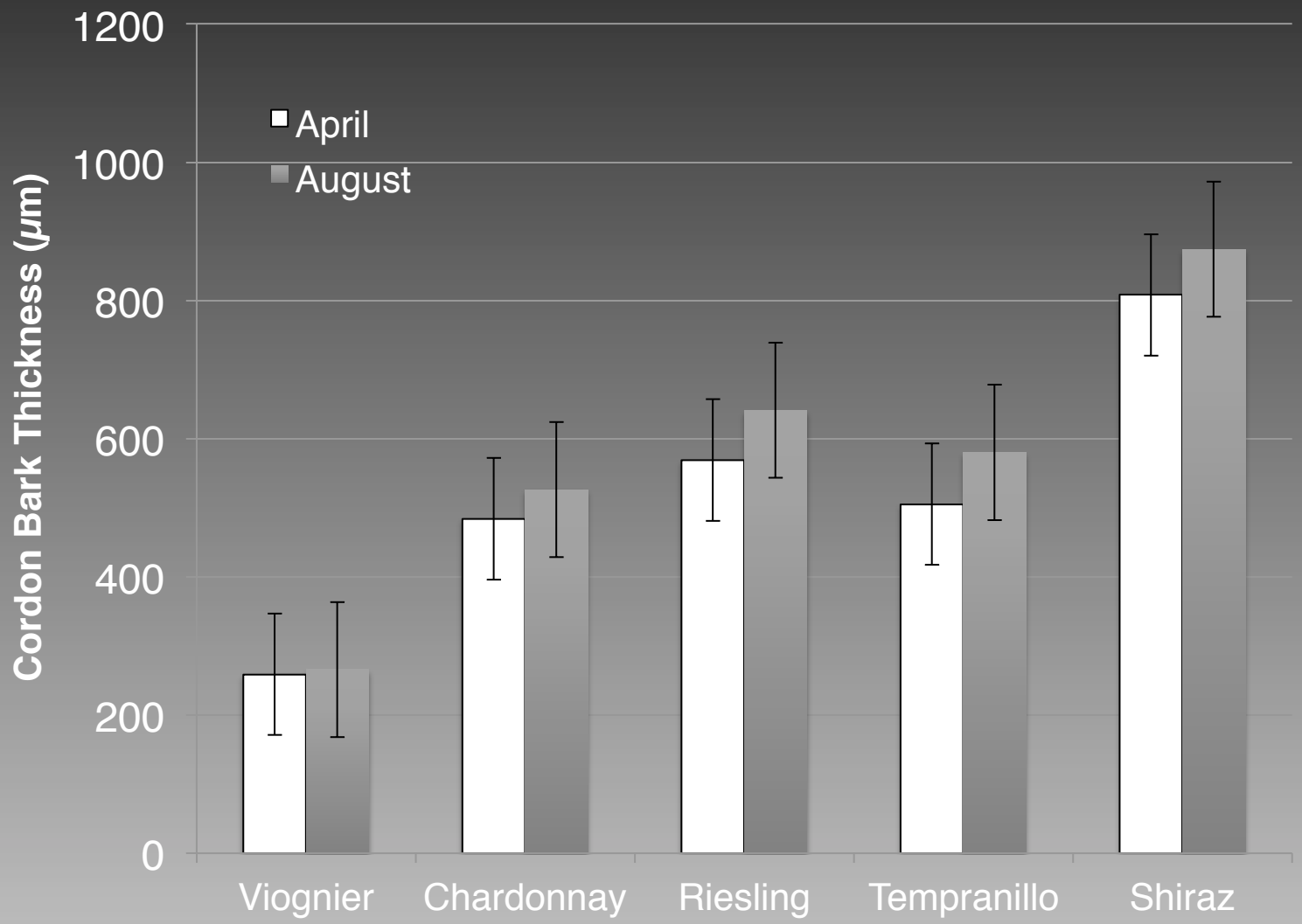
Cordon bark thickness



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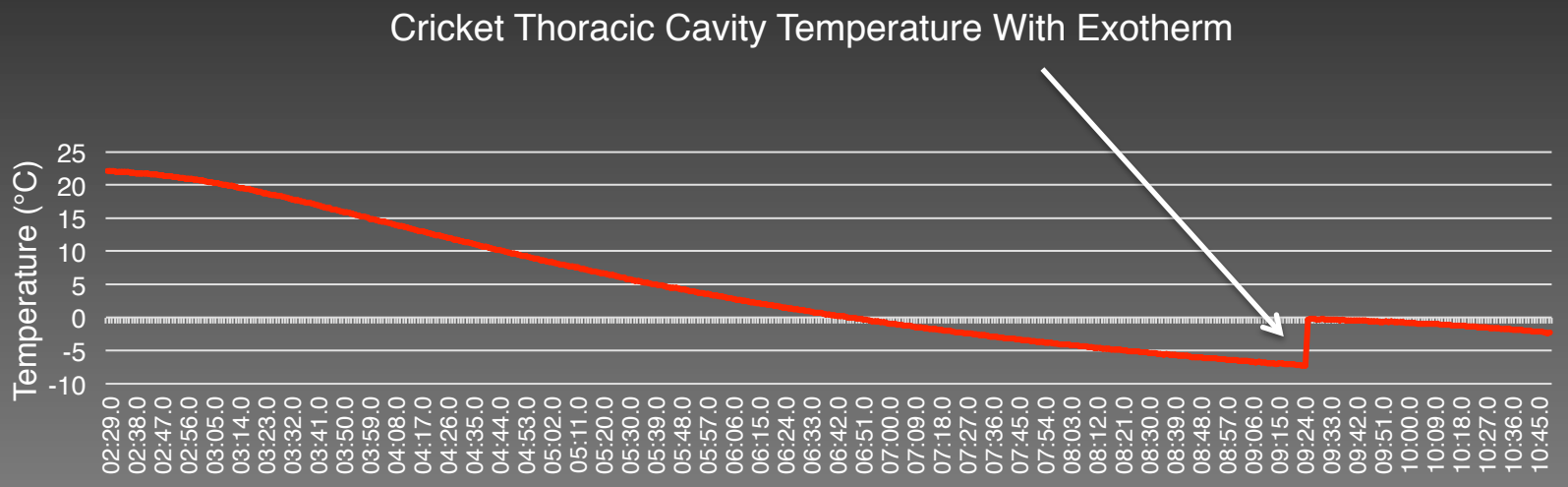
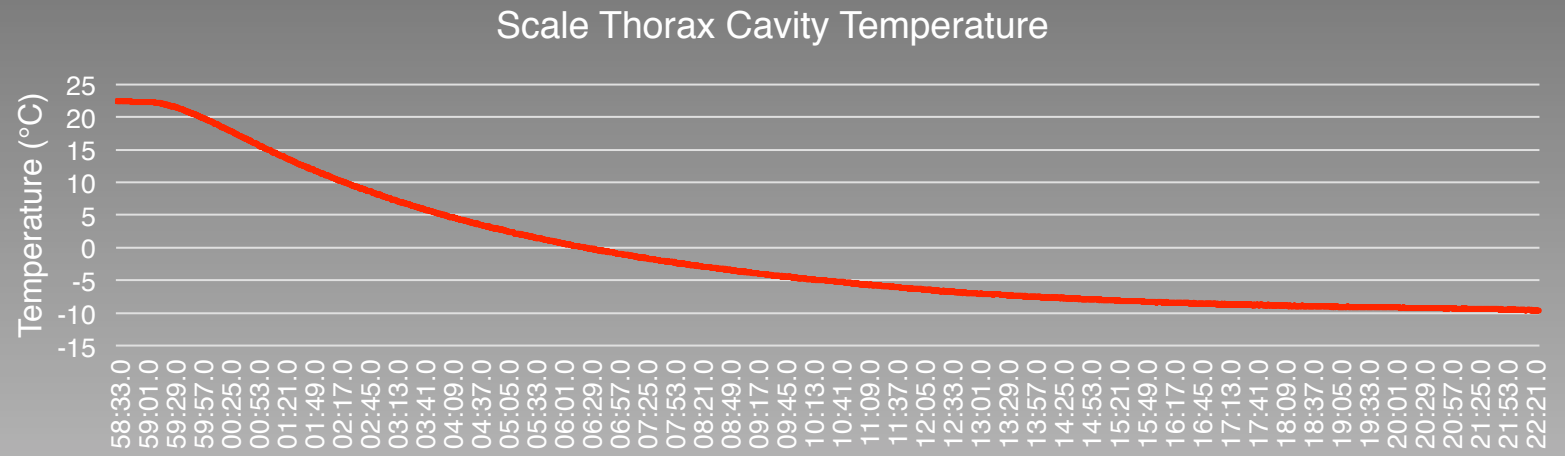
Dry scales do not freeze, even at 10˚C





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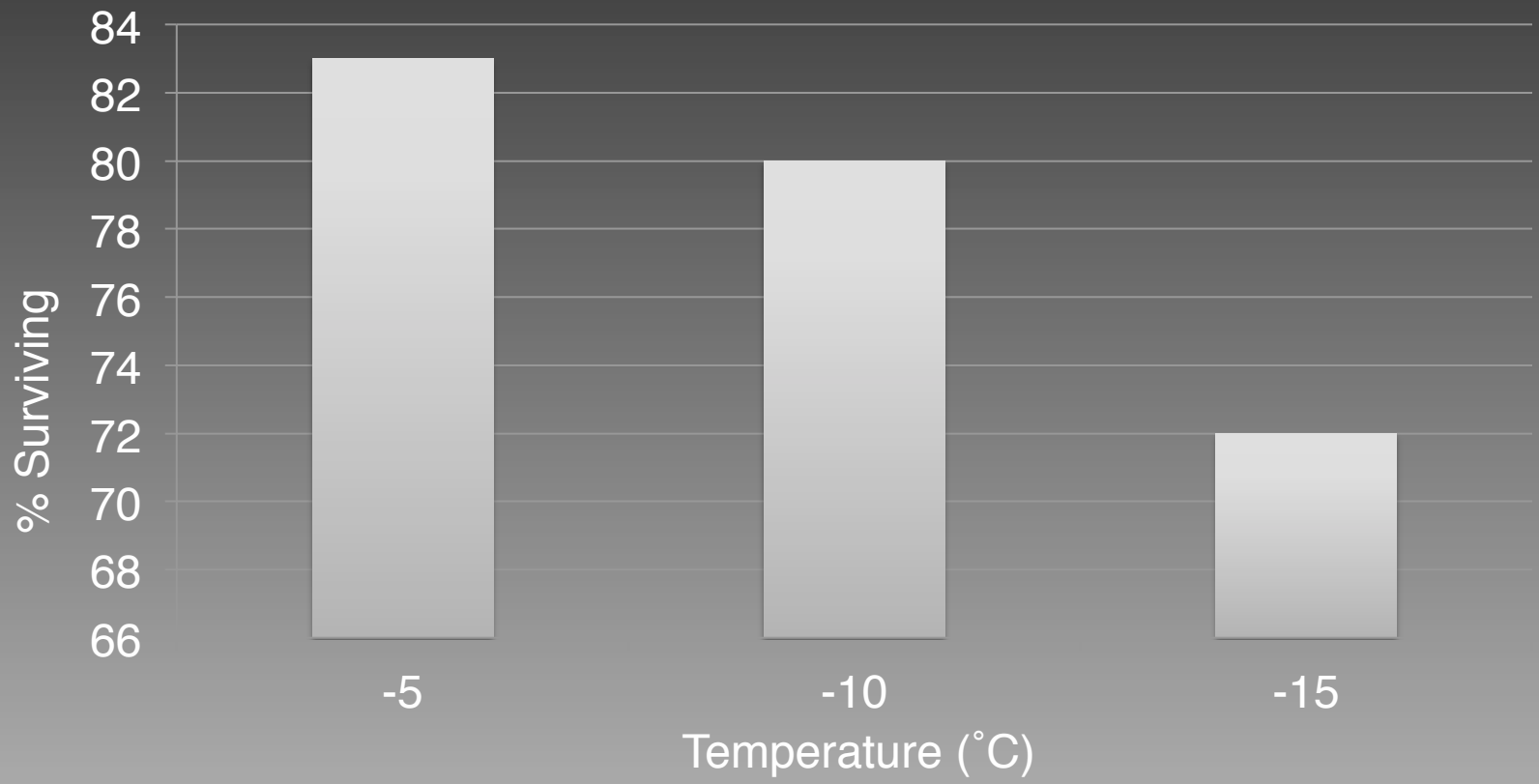
Survivorship following temperatures below zero in dry conditions



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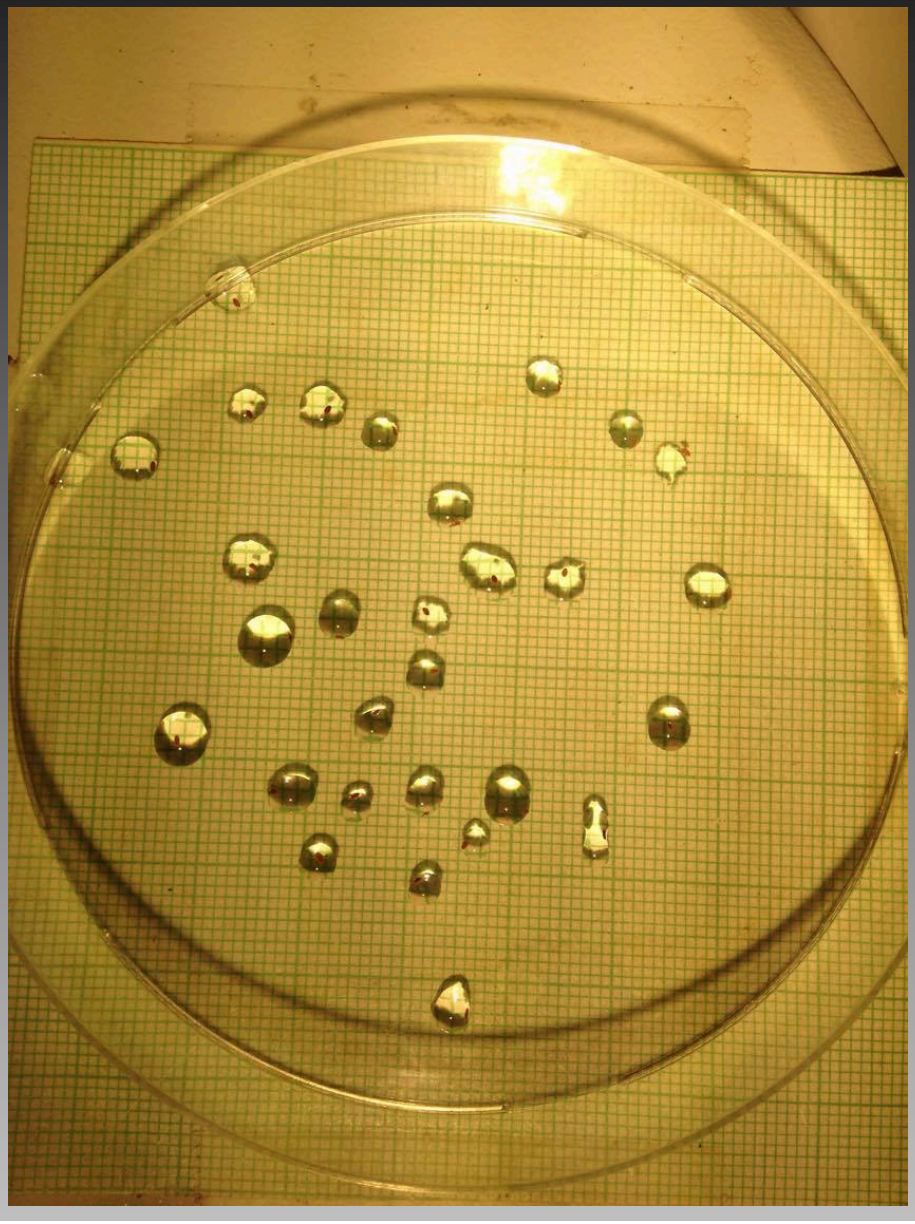
Wet inoculation technique



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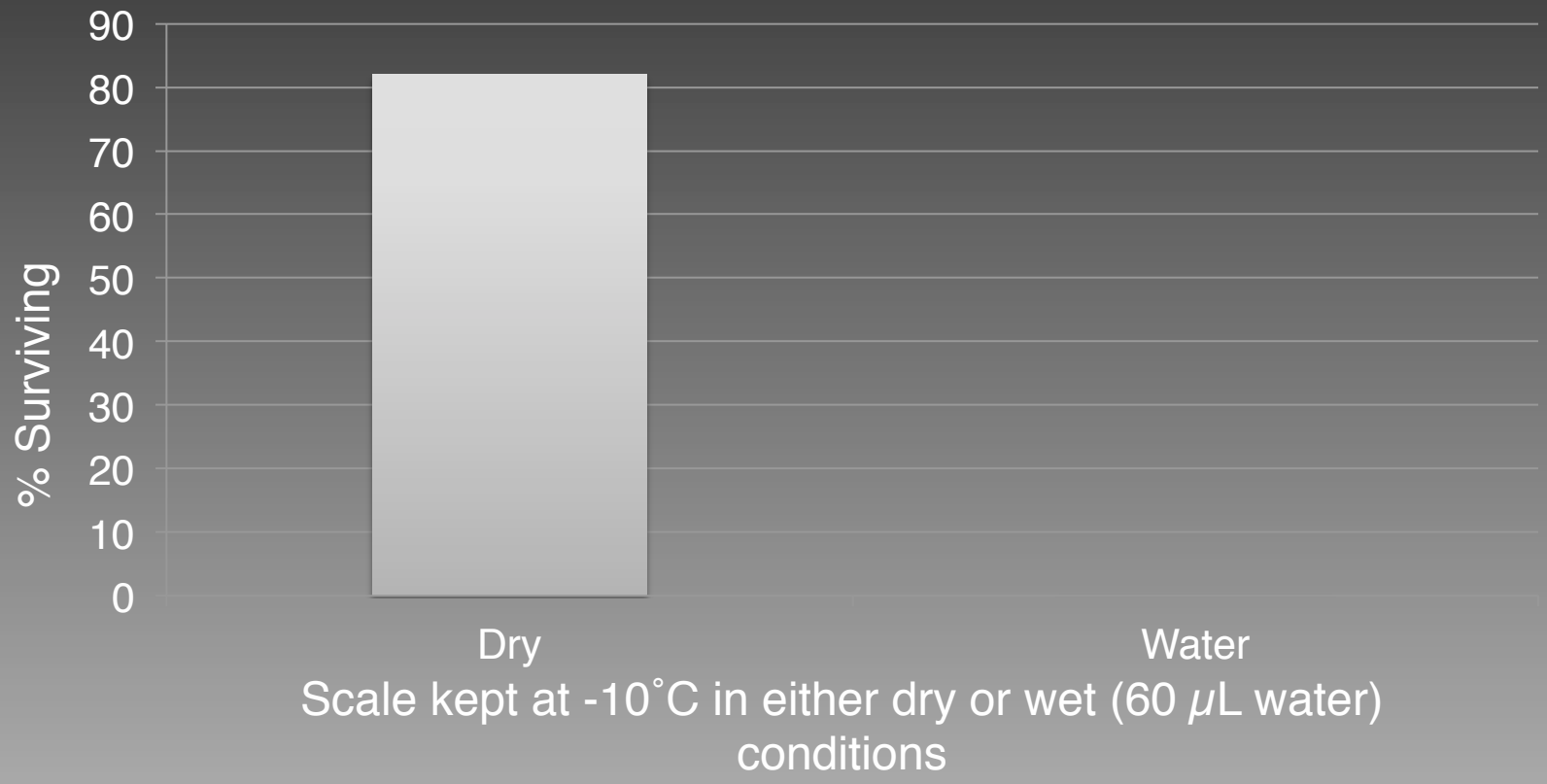
Survivorship of scales kept at -10˚C



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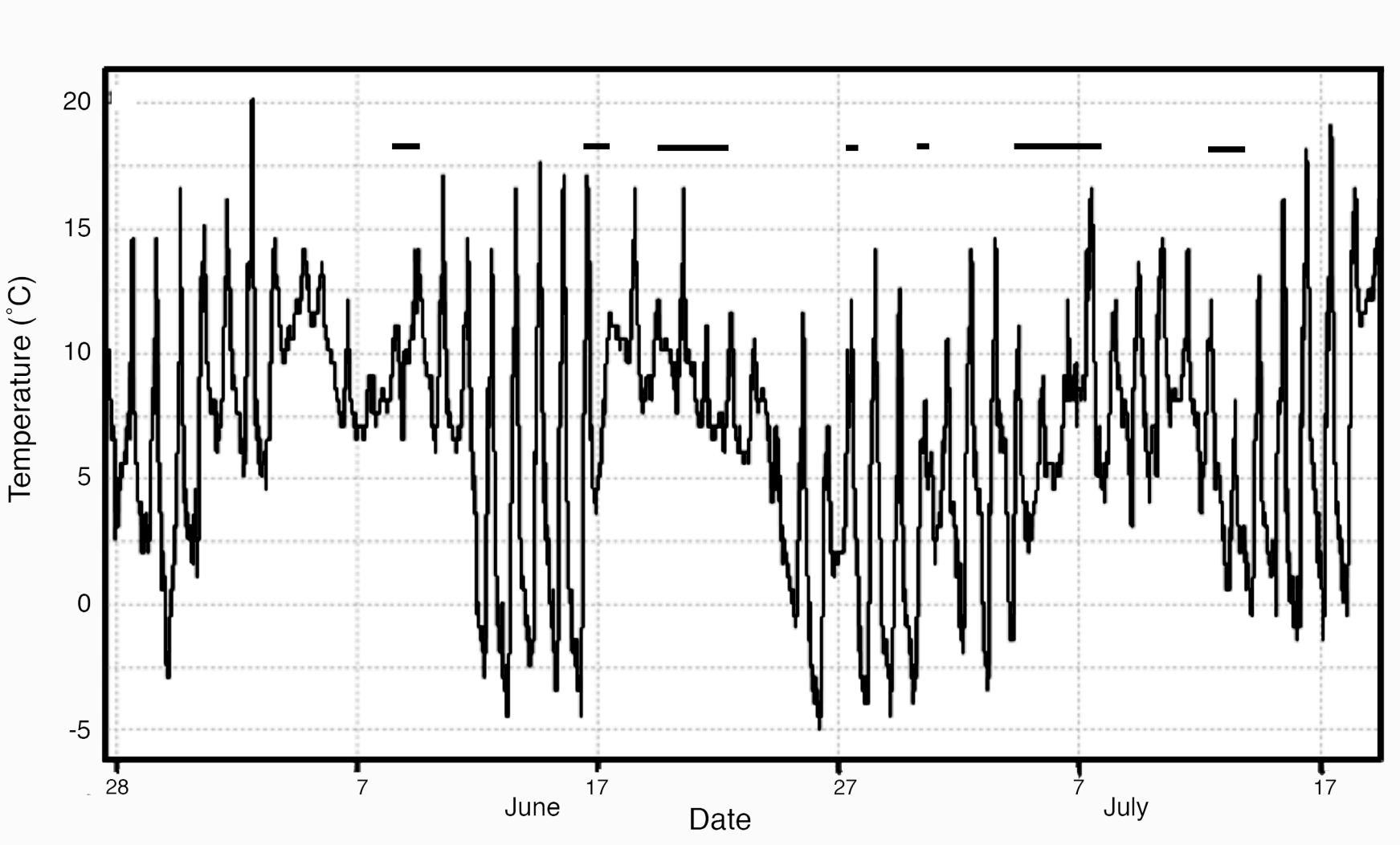
Daily temperature change and timing of rainfall



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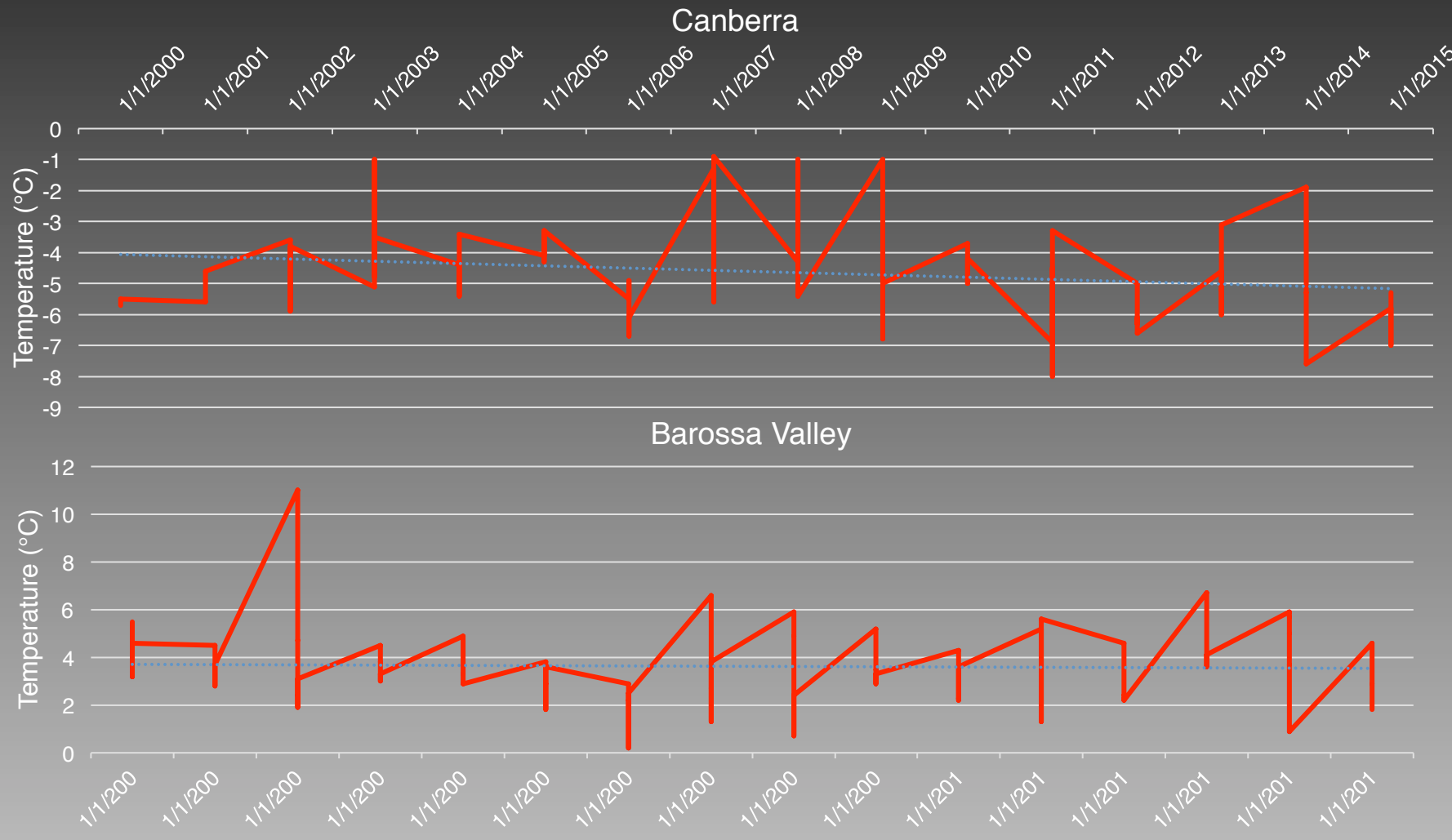
Comparison of Canberra and Barossa Valley 10 year mean minimum temperatures



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Conclusions

- Pest outbreak varies among individual vineyards, although cultivars appear to affect distribution of outbreak. Winter conditions may play an important role and the species of scale can influence rate of population growth.
- Grape cultivars significantly influenced the population dynamics within a vineyard.
- Cultivars appear to be either resistant or tolerant to scale.
- Cultivars did not appear to affect overwintering survivorship.
- Scale insects appear to survive cold temperatures, but when wet at sub-zero temperatures, they freeze and die.

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