Linking Leaf Health with Wine Quality in Pinot Noir

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Supervisors

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Funding

Tamar Ridge Estates, TIA, GWRDC

Study Basis

- Wine quality was observed to vary with leaf health in Pinot Noir at Tamar Ridge Estates

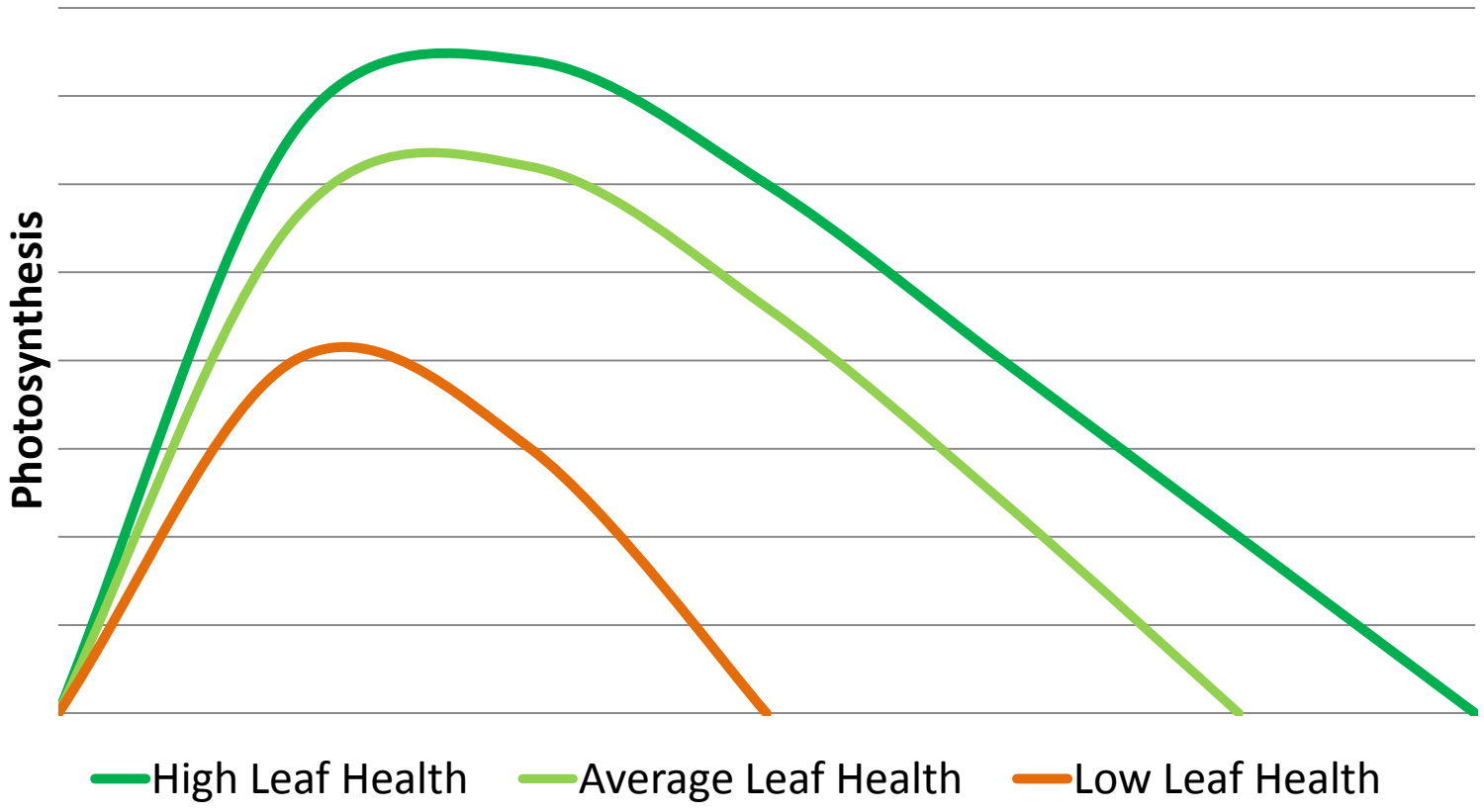
Leaf health

- Natural leaf life cycle
  - Emergence and Expansion
  - Maximum size and photosynthesis rate
  - Senescence
    1. Reduction in photosynthesis
    2. Dismantling of cellular components and compounds
    3. Remobilisation of nutrients
    4. Leaf fall

Leaf health

- Low leaf health
  - reduced maximum photosynthetic capacity
  - early senescence
  - Smaller size
- High leaf health
  - High photosynthetic capacity
  - Senescence delayed
  - Larger

Leaf Health


Photosynthesis
High Leaf Health
Average Leaf Health
Low Leaf Health

Project structure

- Two distinct tacks were taken:

1. Leaf health was manipulated in a uniform block with known early senescence
   - The **NITROGEN TRIALS**
2. Grapes were observed in blocks with changing leaf health
   - The **VIGOUR TRIALS**

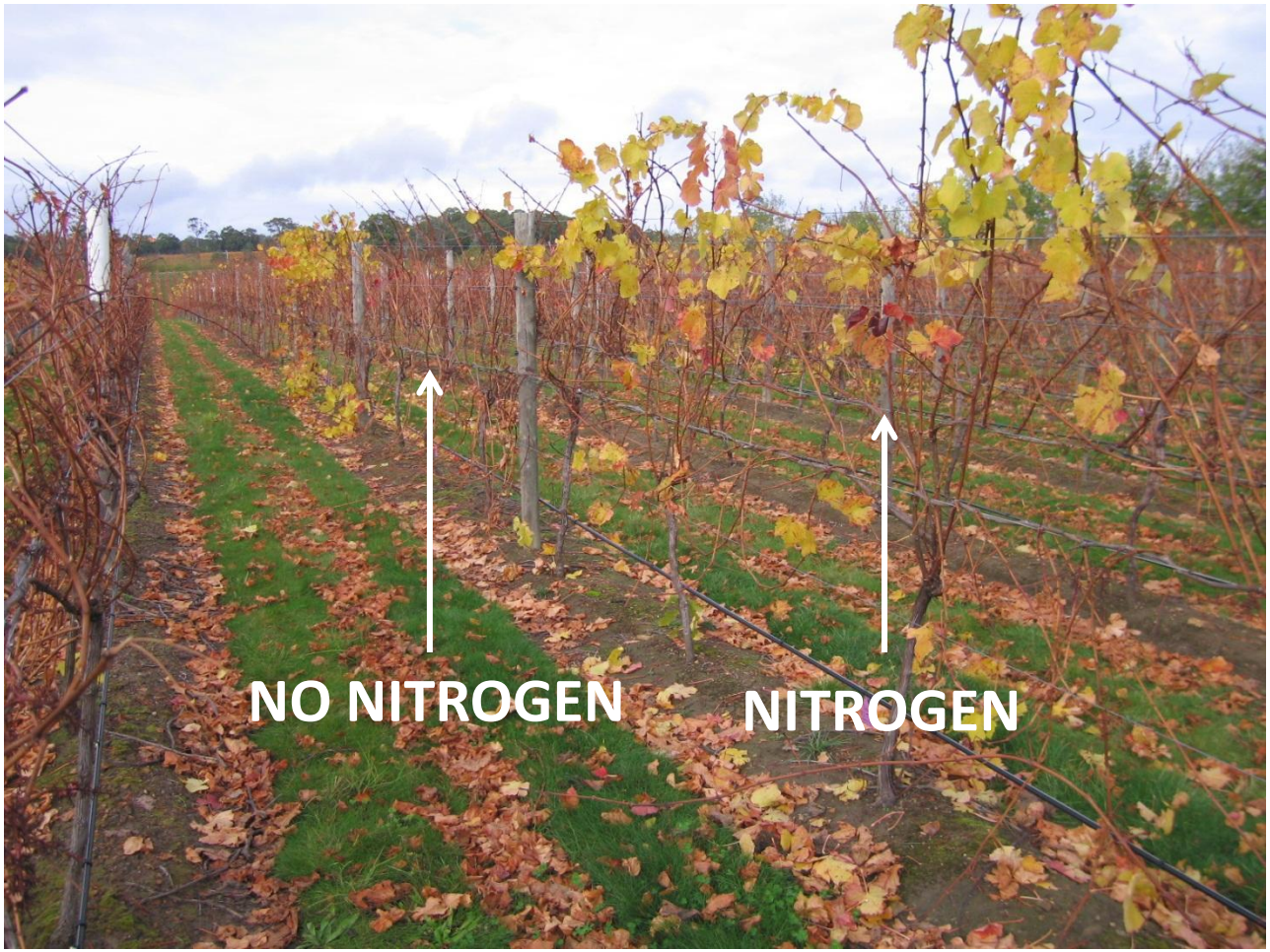
Methodology – **Nitrogen Trials**

- Pilot trials in 2005-06 determined that the poor leaf health was reduced when nitrogen was applied (irrigation had no impact)
- 2006-07, 2007-08 and 2008-09 trials varied:
  - **RATE** (0, 20, 50 kg N/ha)
  - **TIMING** (Pre-bloom, post-bloom, pre-veraison and post-veraison)

Methodology – **Nitrogen Trials**

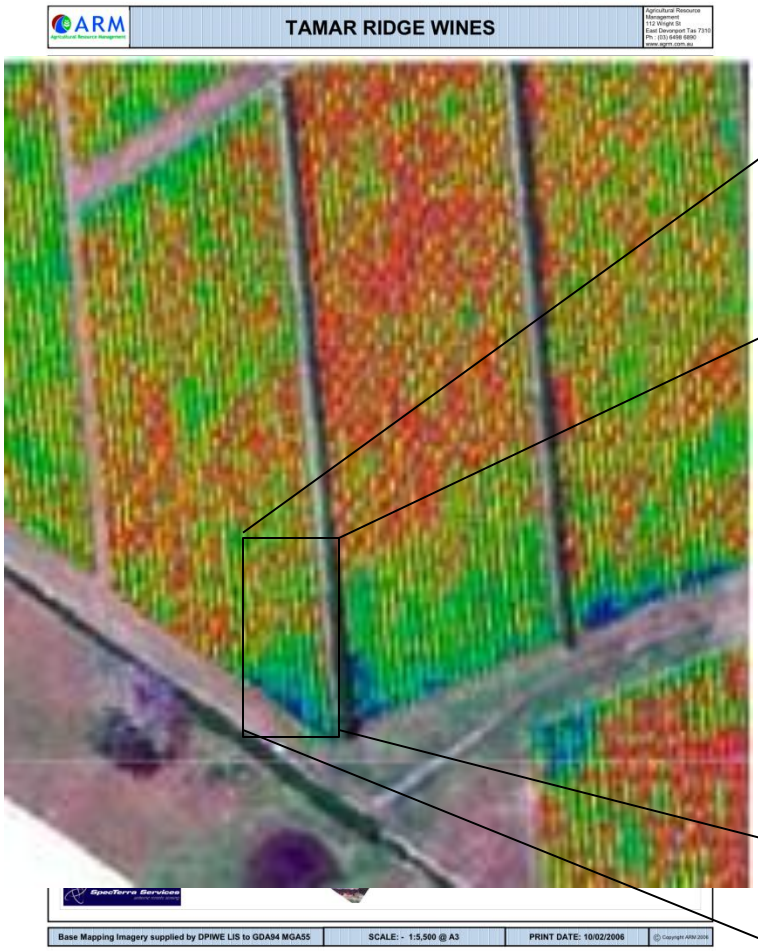
- Impact of nitrogen assessed on:
  - **Leaf health** (senescence date, chlorophyll content)
  - **Vine growth** (pruning weights)
  - **Yield**
  - **Fruit chemistry** (TSS, pH, TA, tannins, anthocyanins, total phenolics and Yeast Assimilable Nitrogen)
  - **Wine** (Fermentation rate, colour, anthocyanins, tannins and total phenolics)

Leaf retention response



Methodology – **Vigour Trials**

- Aerial infrared imaging was used to identify blocks containing a large vigour gradient
- Zones were created and monitor vines established within each zone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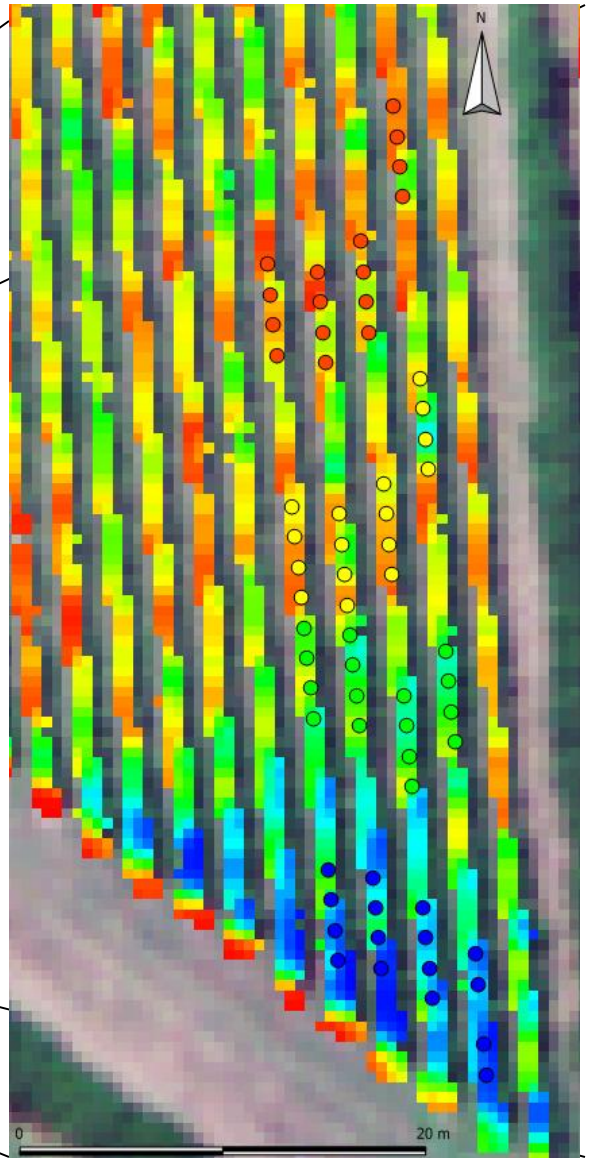
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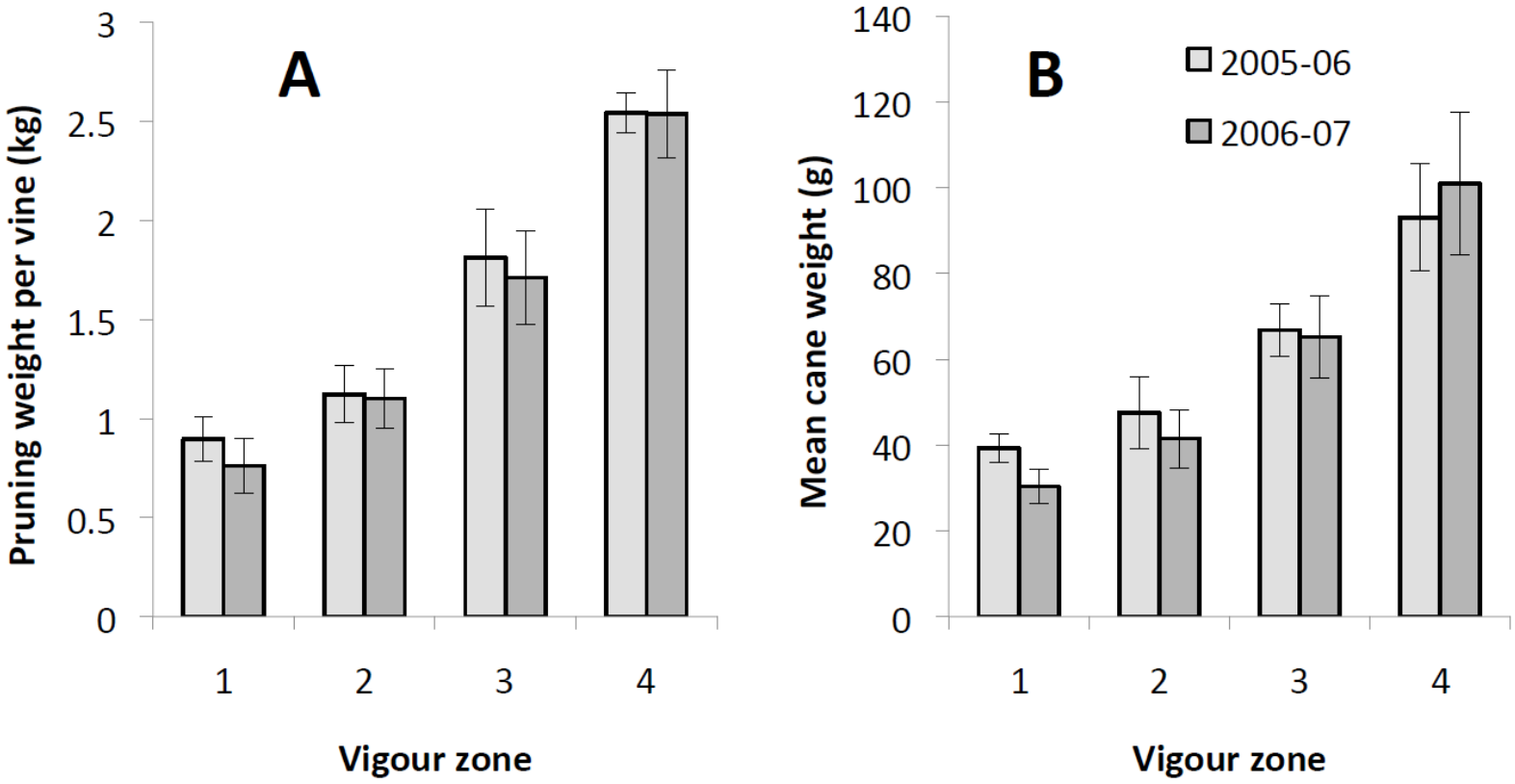
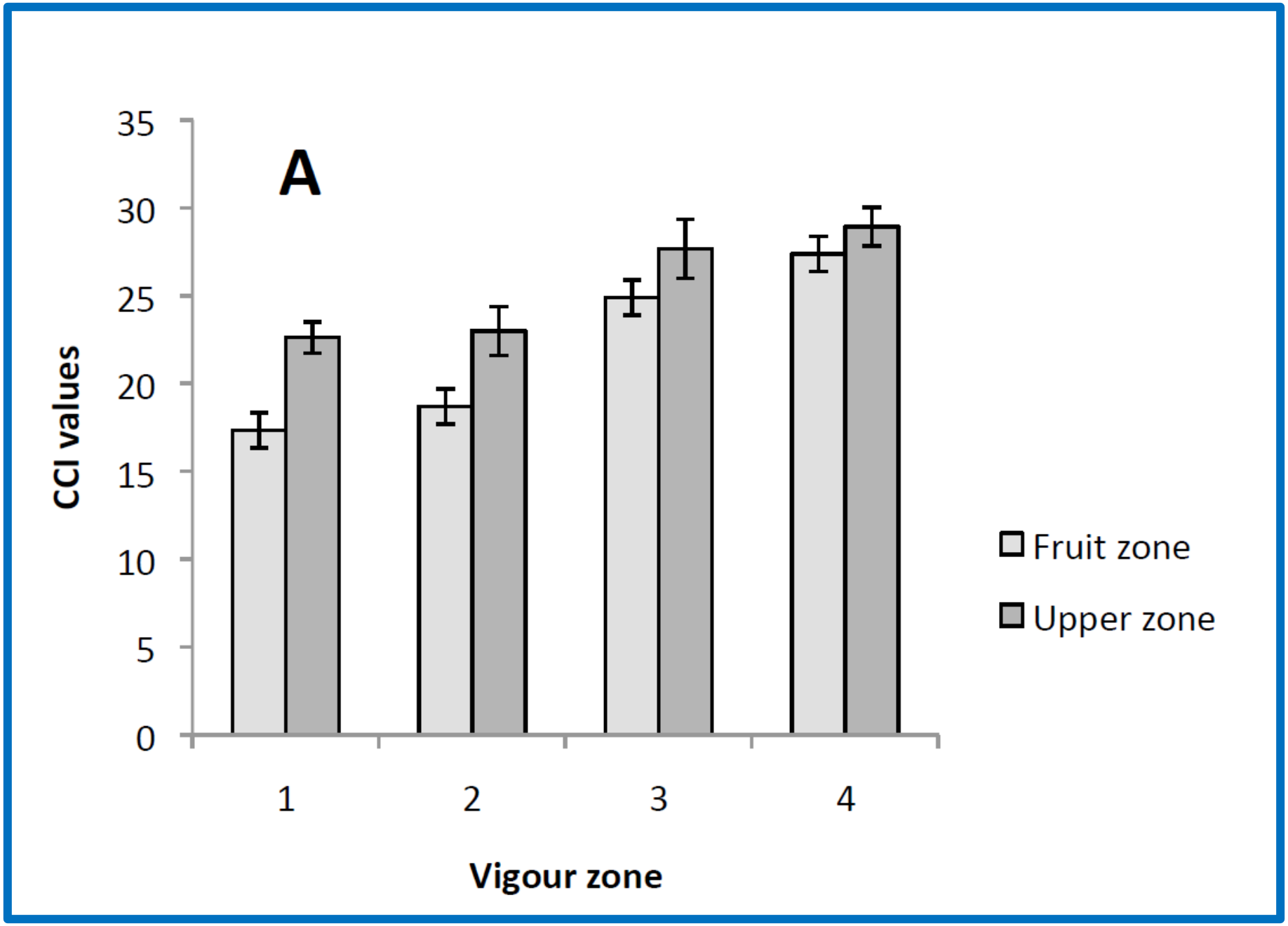


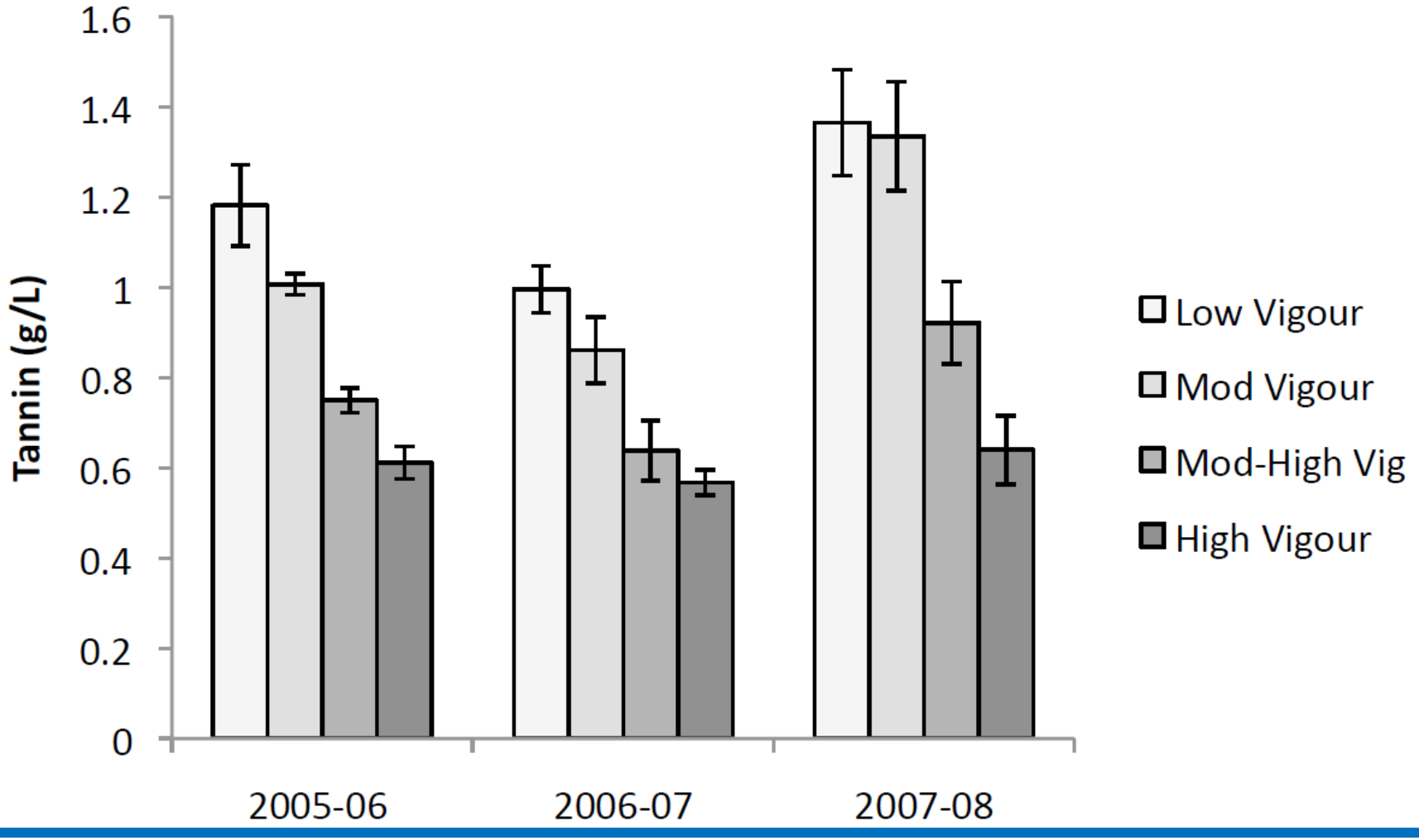
Figure 3.2-1 Block A pruning weights (A) and mean cane weights (B) in 2005-06 and 2006-07. Error bars represent standard errors of the mean.


A
35
30
25
20
15
10
5
0
CCI values
1
2
3
4
Vigour zone
Fruit zone
Upper zone

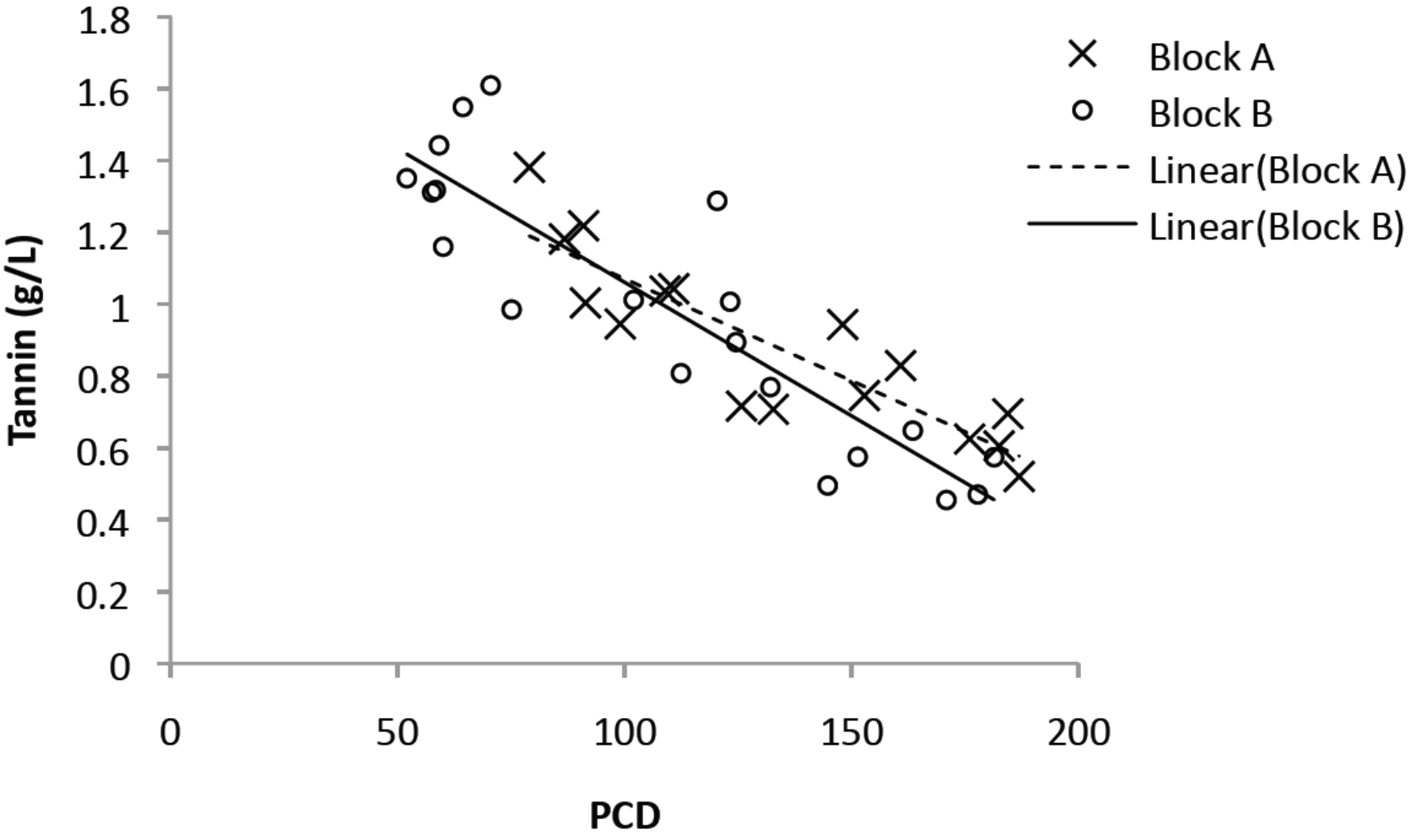
Vigour, Yield and Fruit Quality

- In one block, yield increased with vigour
- In a second block, yield and vigour were unrelated.
- Fruit composition in each block was very similar at a given vigour level
- FRUIT QUALITY RELATED TO VINE VIGOUR MORE THAN YIELD

Wine Tannin and Vigour



Wine Tannin and Vigour



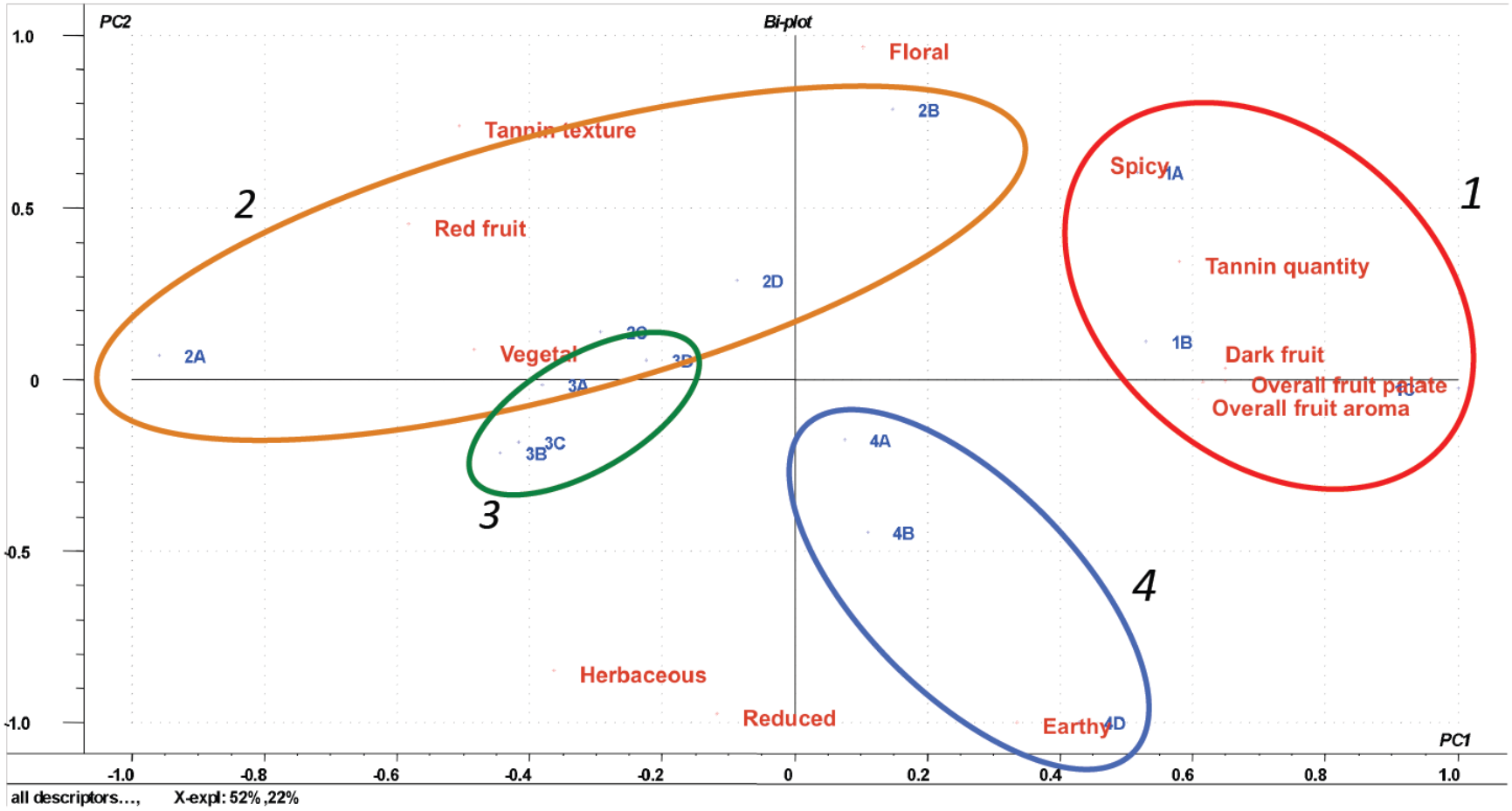


Figure 3.4-7 Principal component analysis output of sensory analysis of wines from block A Pinot Noir in the 2007-08 season. Best 7 tasters, two outlier points removed. Numbers represent the vigour zones (1 = low, 4 = high), and letters indicate the replicate block for each vigour zone. 52% of the variability is explained by PC1 (X-axis), and 22% of the variability is explained by PC2 (Y-axis).

Leaf retention season 1

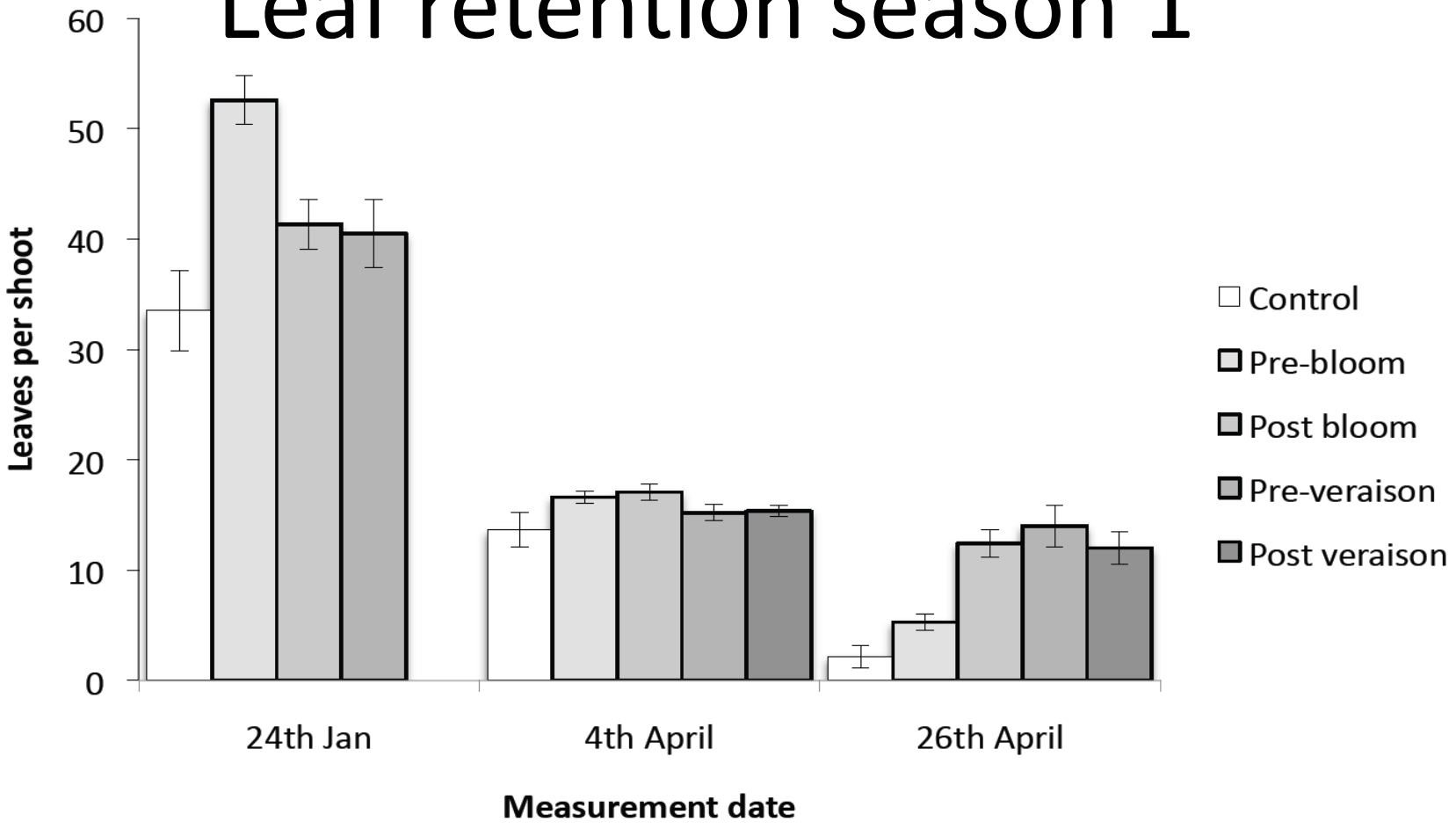


Figure 4.2-1 Response from nitrogen application timing on leaf counts per shoot in 2006-07 (note that the post veraison nitrogen application treatments were not assessed at the end of January). Error bars represent standard error of the mean.

Leaf retention season 2

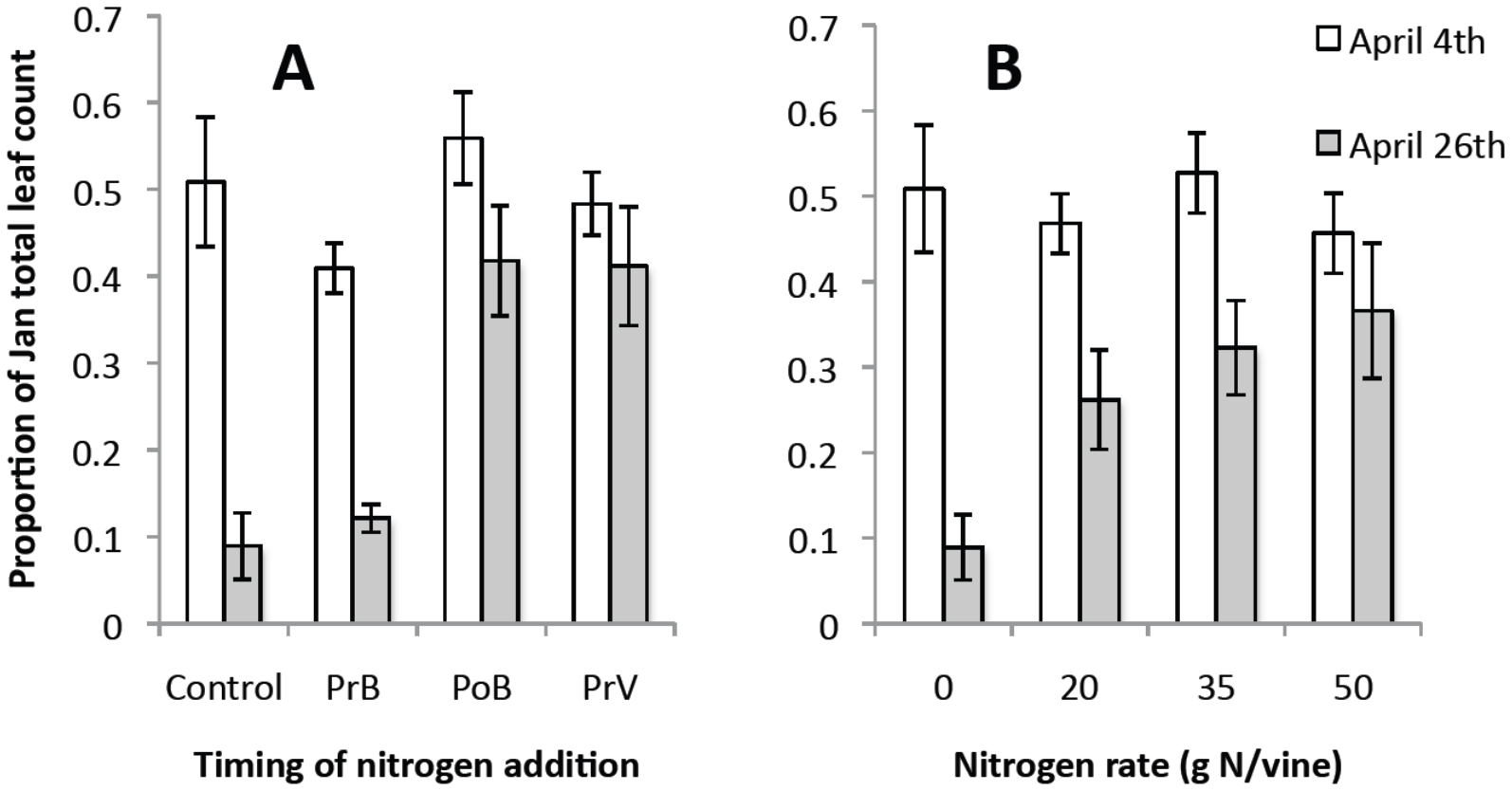


Figure 4.2-4 Leaf retention on the 4th and the 26th of April, expressed as proportions of the January leaf counts, as affected by application timing (A) and rate (B), in 2006-07. Timings were PrB – pre-bloom; PoB – post bloom; PrV – pre-veraision. Error bars represent standard error of the mean.

Leaf chlorophyll

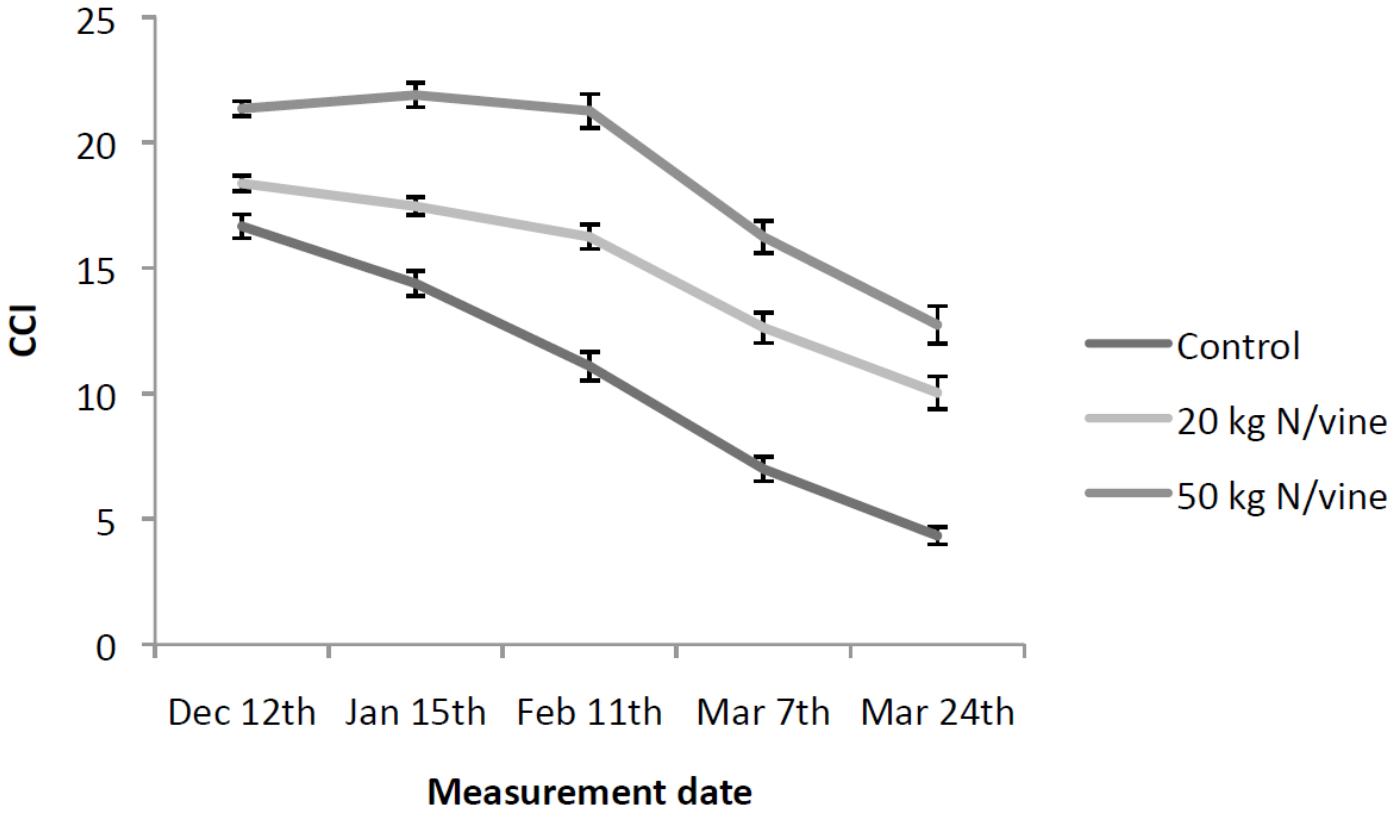


Figure 4.2-10 Leaf chlorophyll through the 2007-08 season as a result of different rates of nitrogen application. Error bars represent standard error of the mean.

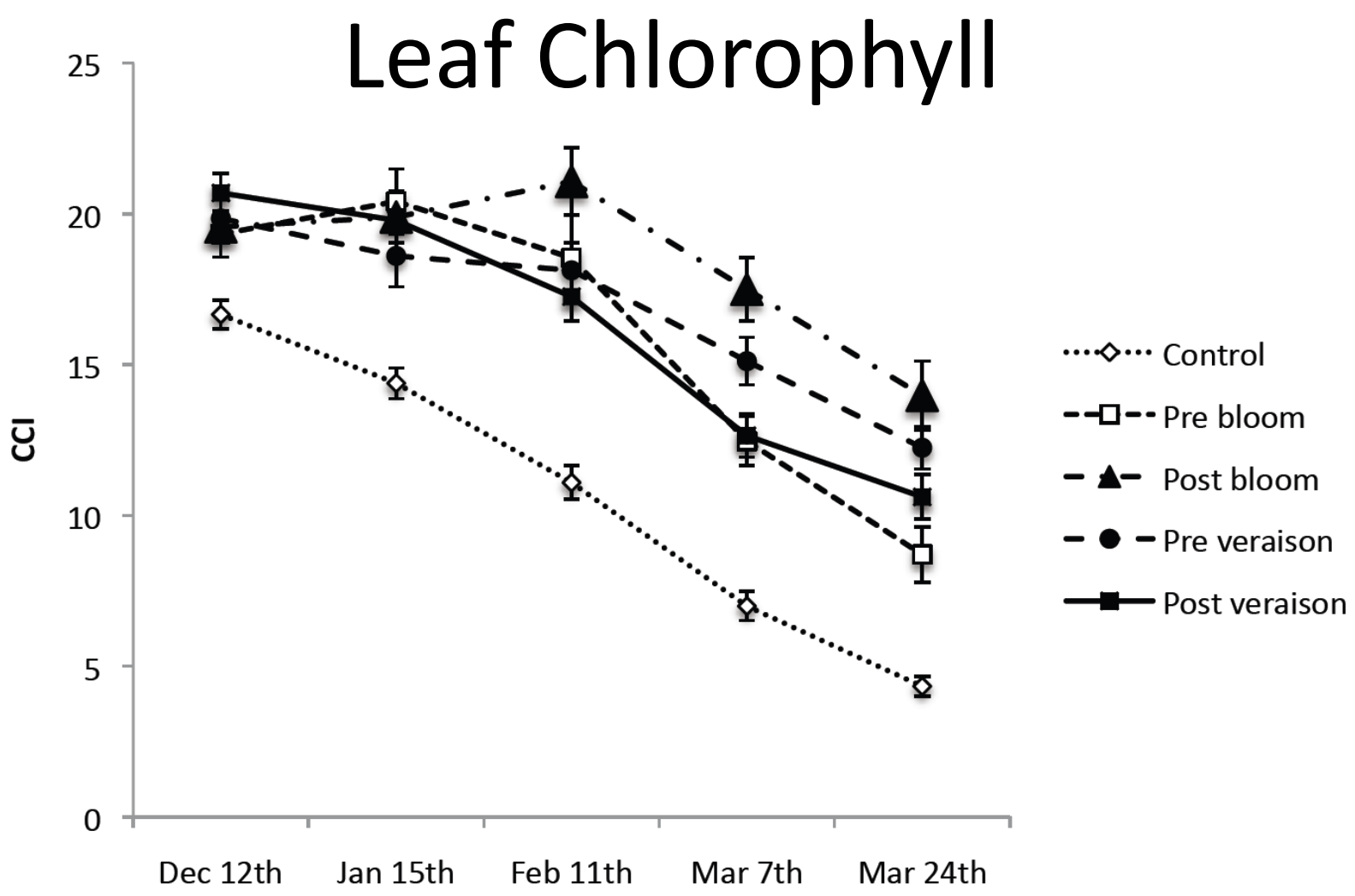


Figure 4.2-8 Leaf chlorophyll concentration estimates as CCI units throughout the 2007-08 season, in response to nitrogen application timing. Error bars represent standard error of the mean.

Leaf chlorophyll

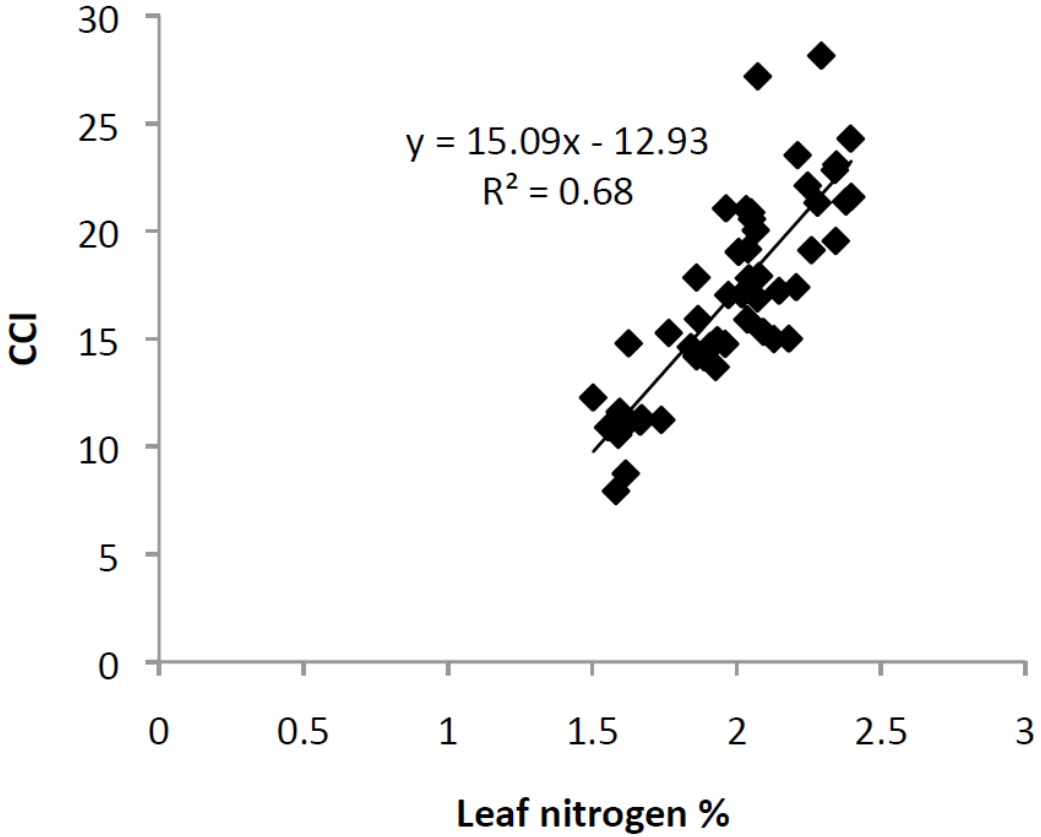


Figure 4.2-12 Leaf chlorophyll concentration estimation by CCM200 meter in February 2008 in CCI units against leaf nitrogen percentage from veraison leaf lamina samples

So nitrogen is great then?

- Nitrogen certainly increases leaf health, but it also increases growth….

Pruning weights

1st Season

Application timing	*Pruning weight per vine (kg)*	*Mean cane weight (g)*
Control	0.83a	31a
PrB	1.22b	45b
PoB	0.89a	33a
PrV	0.90a	32a
PoV	0.81a	31a
Sig	***	***

2nd Season

Application timing	*Pruning weight per vine (kg)*	*Mean cane weight (g)*
Control	1.18a	45a
PrB	1.64b	58b
PoB	1.79b	63b
PrV	1.60b	55b
PoV	1.80b	63b
Sig	***	***

Timing did not impact pruning weight in the second season – NITROGEN RECYCLING IS VERY EFFICIENT

Light in the canopy

N rate (g N/vine)	***Percent light inside canopy***
0	15.1a
20	11.0b
50	7.9c
Sig	*

Nitrogen and Fruit Development

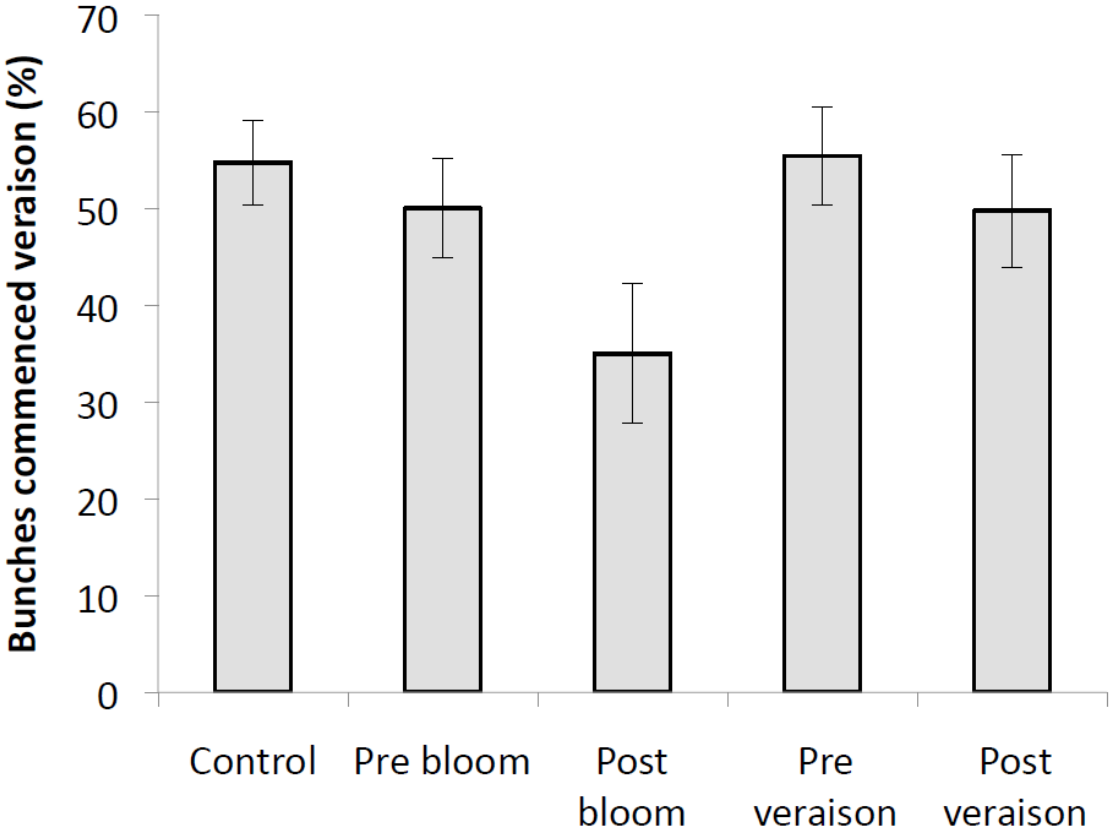


Figure 4.3-4 Impact of nitrogen application date on veraison commencement on monitor shoot basal bunches in 2007-08. Error bars represent standard error of the mean.

Nitrogen and Yield

Nitrogen rate (g N/vine)	*Per vine yield total (kg)*	*Per vine yield clean fruit (kg)*
Control	3.2a	3.1a
20	4.1b	3.7b
50	3.6ab	3.0a
Sig	**	**

- More nitrogen led to loss from increased botrytis
- Yield change to increase in bunches per vine

Nitrogen and Wine Quality

- Very little difference in wine tannins and anthocyanins
- High rates of nitrogen could lead to decreased tannin
- Both an exposure and a direct chemistry link (i.e. external bunches also had lower tannin)

Does nitrogen in the field = DAP in the ferment?

- Both increase fermentation rate
- E-nose analysis indicates there are significant differences in wine quality
- Conclusion: DAP IS NOT THE SAME AS FIELD NITROGEN

Conclusions on Nitrogen

- High nitrogen applications lead to:
  - High vigour
  - Increased botrytis
  - Decreased tannin
- Moderate nitrogen applications lead to:
  - Little change in wine quality but increased YAN
  - Minimal change in botrytis infection
  - Increased yield

Conclusions on Nitrogen

- Adding nitrogen prior to bloom increases growth but doesn't increase late season leaf health
- Adding nitrogen just after bloom may delay veraison
- Adding nitrogen around veraison can delay senescence with no increase in growth UNTIL THE FOLLOWING SEASON

Conclusions on Leaf Health

- Late season leaf health can be used to indicate vine vigour
- Poor late season leaf health may indicate low nitrogen status
- Vines with different late season leaf health will lead to different wines