Abiotic and biotic factors involved in premature fruit drop of walnut in Australia

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Background

- Walnut production in Australia has increased rapidly as newly planted orchards mature. However, premature fruit drop prevents these orchards achieving potential crop yields.
- Premature drop of walnut can been caused by 1) non-pollination of receptive flowers, 2) abortion of the pistillate flower and, 3) fruit disease such as walnut blight and apical necrosis.
- This study examined factors involved in premature drop of walnut in semi-arid and cool-temperate growing regions of Australia.

Key findings

1) Cultivar, location and year

- Premature drop varied between cultivar, location and year (Table 1), with drop greater in;
  - *Chandler than Vina, Lara and Howard,*
  - *the semi-arid region than the cool-temperate region, and*
  - *2015-16 than 2014-15 (semi-arid region only).*
- Considerable drop occurred in the semi-arid region with 47-74% (fy15) and 66-89% (fy16) reductions in potential crop yields.

Table 1. Mean percent premature fruit drop in Vina, Lara, Howard and Chandler in semi-arid (Leeton, NSW) and cool-temperate (Swansea, TAS) regions in 2014-15 (fy15) and 2015-16 (fy16).

Cultivar	Premature fruit drop (%) [1]			
	Leeton (NSW)		Swansea (TAS)	
	fy15	fy16	fy15	fy16
Vina	61 b	70 a	38 b	29 b
Lara	54 ab	73 a	12 a	24 ab
Howard	47 a	66 a	37 b	17 a
Chandler	74 c	89 b	51 b	80 c

[1] *Means within each column accompanied by the same letter are not significantly different at P = 0.05.*

Details of premature fruit drop surveys

Surveys were conducted over two years in Vina, Howard, Lara and Chandler orchards in semi-arid (Leeton, NSW) and cool-temperate (Swansea, Tasmania) regions. For each survey single-tree plots (n=4) were selected from uniform areas of the orchard. Two limbs per tree were selected prior to budburst, and flower/fruit presence recorded at 2-3 day intervals from flower emergence to the completion of receptivity, and then at 1 week intervals to the onset of harvest. Symptoms of pistillate flower abortion, non-pollination drop and fruit disease were recorded at each assessment (Figure 1).

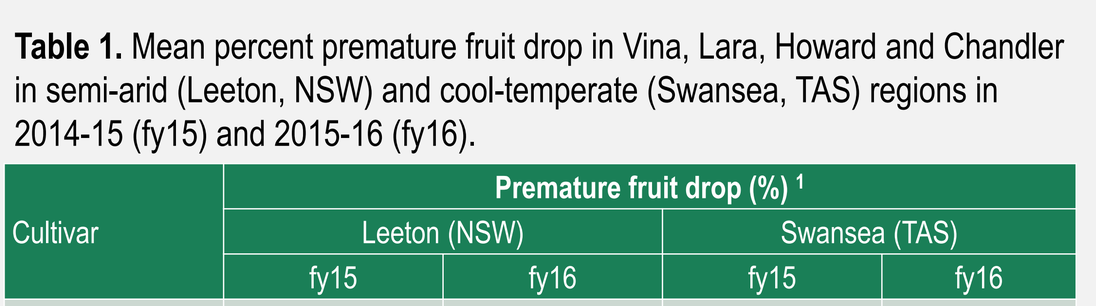

Figure 1. Fruit with symptoms of pistillate flower abortion (left), non-pollination (centre) and disease (right) in the semi-arid region (Leeton, NSW) in 2015-16.

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2) Temporal fruit drop

- Fruit drop in the semi-arid region mostly occurred within 4 weeks of flower receptivity (e.g., Figure 2), and was attributed to pistillate flower abortion and non-pollination. Fruit disease was the major cause of drop later in the season in both the regions.

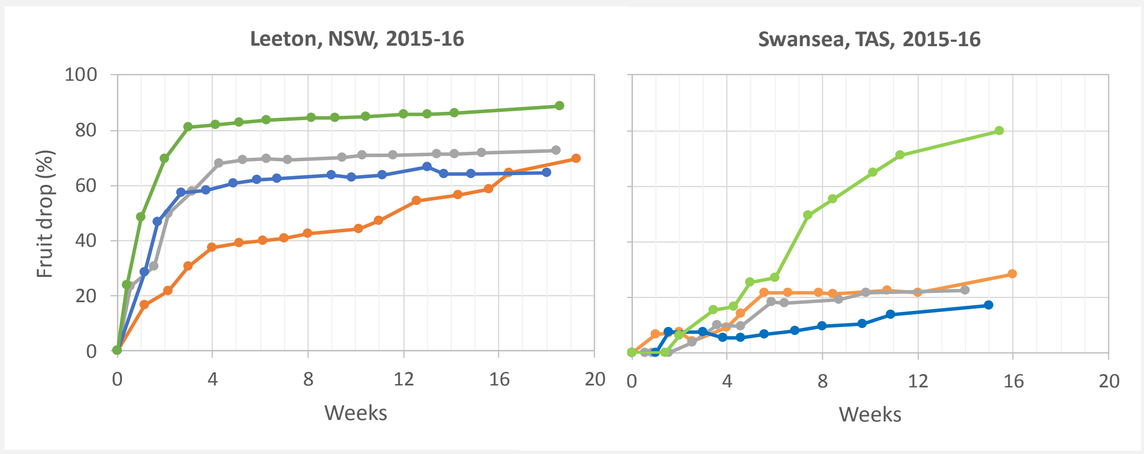

Figure 2. Mean percent fruit drop in Vina (orange), Lara (grey), Howard (blue) and Chandler (green) between flower receptivity (week 0) and the onset of harvest (weeks 15-19) in semi-arid (Leeton, NSW) and cool-temperate (Swansea, TAS) regions in 2015-16.

3) Non-pollination drop (NPD)

- Presence of susceptible flowers in the days of, and days following temperatures of ≥36°C was positively correlated to NPD in the semi-arid region (Figure 3). Exposures of susceptible flowers to high temperatures explained 93% of the variability in the rate of NPD in both the regions.

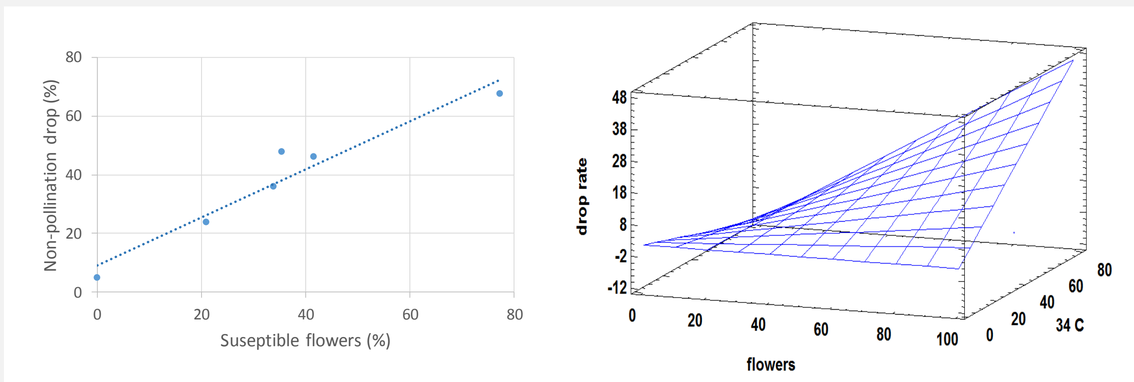

Figure 3. Mean percent NPD of susceptible flowers i.e., flowers that were receptive or were yet-to-be receptive, after ambient temperatures of ≥36°C in the semi-arid region (Leeton, NSW) (left), and estimated response surface of percent NPD four weeks after exposure of susceptible flowers to ≥34°C in the semi-arid and cool-temperate (Swansea, TAS) regions in 2014-15 and 2015-16 (right).

Conclusions

- **Differences in the timing and rate of fruit drop between semi-arid and cool-temperate regions are considerable.**
- **Environmental variability amongst growing regions, year to year fluctuations in weather and different responses by individual cultivars impacted on pollination and/or development of flowers.**
- **High ambient temperatures during the flowering period may have reduced pollen and/or pistillate flower availability or viability; research into the potential causes of NPD is ongoing.**