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INFLUENCE OF TEMPERATURE AND LIGHT ON VEGETATIVE GROWTH AND BUD FRUITFULNESS OF GRAPEVINE CV. SEMILLON

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Abstract

Aim: To investigate the effects of different levels of temperature and light intensity on grapevine vegetative growth and bud fruitfulness, which includes the number and size of inflorescence primordia in primary buds.

Methods and Results: Five hundred Semillon cuttings were collected from field during dormancy. After rooting, the cuttings were propagated in growth rooms under six different controlled environments, including two temperature regimes (30 °C day to 25°C night, and 20°C day to 15°C night), and three levels of light intensities (90, 200, and 600 PAR, respectively) within each temperature regime. Light intensity and temperature at the bud zone were measured for each newly grown shoot at two stages to confirm the effectiveness of treatments. Vegetative growth, including leaf area, shoot weight and length, number of nodes, and internode length were recorded before all shoots were trimmed to 10 nodes each. Bud fruitfulness was assessed by bud dissection analysis at three stages according to the development of shoots. The number of anlagen and inflorescence primordia were recorded and the cross-sectional area of inflorescence primordia were measured. Results demonstrated that vegetative development was accelerated by higher temperature (with more nodes each shoot), but was negatively correlated with light intensity. Moreover, shoot leaf area, the weight and length of shoots, and internode length were higher under the lower temperatures and lower light intensities. There is a positive linear relationship between bud fruitfulness and both temperature and light, with more and larger inflorescence primordia under higher temperature and higher light intensity.

Conclusions: This study showed that the vigour of grapevine can be advanced by higher temperature, however, the vine capacity was negatively correlated with both temperature and light. For bud fruitfulness, the temperature and light can have a significant and synergetic impact both on the number and the size of inflorescence primordia in primary buds.

Significance and Impact of the Study: Bud fruitfulness is a key component of reproductive performance of grapevine and it plays a significant role in annual production of vineyards. Environmental factors such as light and temperature are important parts of terroir and can have a strong impact on the formation of inflorescence primordia in latent buds, which determines the potential yield for the coming season. This study provides a better understanding on how temperature and light can change the vegetative growth and bud development of grapevine. The findings will be helpful for the management of vineyards to regulate yield in a changing climate.

Keywords: Bud fertility, vegetative growth, bud development, inflorescence primordia, potential yield

Influence of Temperature and Light on Vegetative Growth and Bud Fruitfulness of Grapevine cv. Semillon

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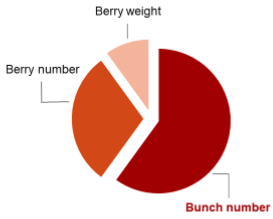
Background & Aims

- In grapevine, bud fruitfulness is defined as the formation of inflorescence primordia (IP) in mature latent buds (Srinivasan and Mullins 1981). The number and size of IP play a key role in yield variation as they form the potential yield for the next season (May 2000).
- It is well established that the main components of grapevine yield are bunch number per vine and berry number per bunch, which together account for about 90% of seasonal yield variation (bunch number 60%, berry number 30% and berry weight 10%) (Clingeleffer et al. 2001, Guilpart et al. 2014).



Seasonal yield variation:

- Bunches per vine – **60%**
- Berries per bunch – **30%**
- Berry weight – **10%**

- This study aimed to investigate the effects of different levels of temperature and light intensity on grapevine vegetative growth and bud fruitfulness, which includes the number and size of inflorescence primordia in primary buds.

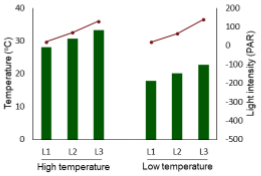
Design & Methods

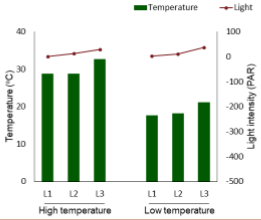
- **Growth rooms:** Waite Campus, University of Adelaide
- **Grape variety**: Semillon from cuttings, season 2018-19
- **Treatments**: temperature and light

Table 1. Light and temperature treatments on grapevines

Treatments	High temperature			Low temperature		
	Light 1	Light 2	Light 3	Light 1	Light 2	Light 3
Light intensity (PAR)	90	200	600	90	200	600
Day temperature	30°C			20°C		
Night temperature	20°C			15°C		
Photo period	16hr			16hr		
Humidity (%)	50-60%			50-60%		

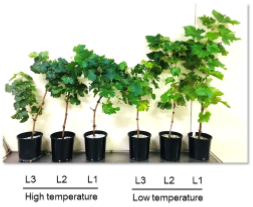
Light and temperature measurements in growth rooms at two stages

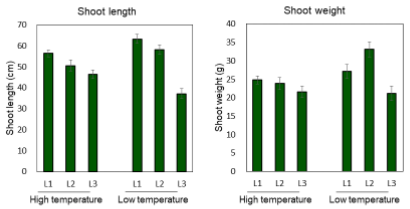




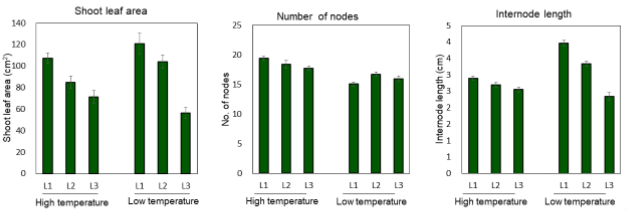
Results

Vegetative growth

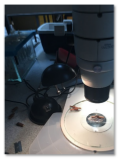


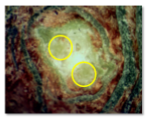


Higher temperature + higher light intensity → More advanced growth, but short and small

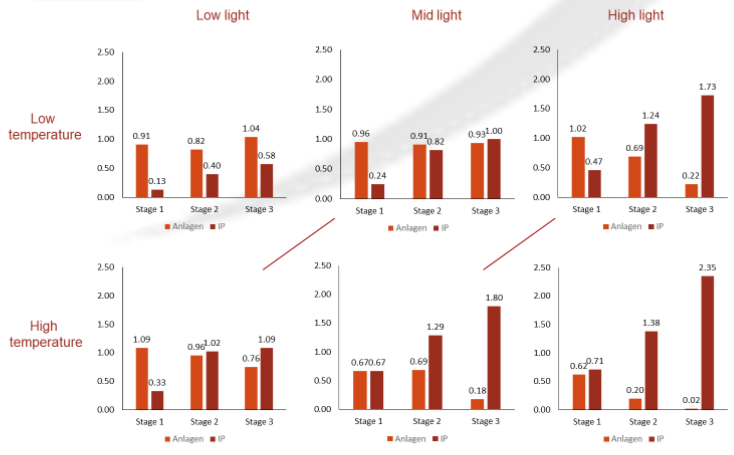


Bud dissection analysis





- **Sampling stages**
  - Stage 1: shoots half lignified
  - Stage 2: shoots fully lignified
  - Stage 3: leaf fall
- **Data collection (node 4-8)**
  - Anlagen number
  - IP number
  - IP area



Higher temperature + higher light intensity → Anlagen were significantly promoted into IP

Similar effect:
Low temperature + mid light ----- High temperature + low light
Low temperature + high light ----- High temperature + mid light

Conclusions

- Higher temperature and higher light intensity advanced vegetative growth of Semillon vines, with more nodes on shoots. However, the size of the grapevines stayed small, with lower leaf area and shoot weight, and shorter shoot length and internode length.
- Higher temperature and light promoted the differentiation of anlagen into inflorescence primordia, while the lower temperature and light can slow down or even inhibit the development of anlagen, hence resulted in less inflorescence primordia in the bud.
- Bud fruitfulness was positively related to temperature and light, including both number and size of inflorescence primordia. Moreover, temperature and light had a synergetic effect on the development of inflorescence primordia.

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