

Oxygen affects buds burst in grapevine

Grapevine is the most economically important fruit crop worldwide and is the mainstay of rural communities in over 100 countries. However, grapevine production is concentrated in latitudes of 30°-50°, and largely in maritime regions, due to its dependence on a seasonal, Temperate/Mediterranean climate. Growth beyond these climate regions is disorderly and requires intensive management, and hence often not commercially viable. Climate change and global warming is forecast to compress the viable growing zones and lead to increasing frequency of extreme weather events, with devastating impact on global productivity. The most climate-sensitive organ of the grapevine is the axillary bud, which undergoes an 18 month developmental cycle before buds burst, which drives the subsequent season's crop. Currently, there is very little understanding of how the bud senses and responds to climate signals, which is a key motivation for researchers at the University of Western Australia (UWA).



Fig. 1. Transition of dormant grapevine bud into shoot.

The gradually increasing temperature during winter transition to spring is known as a key regulator that initiates dormant buds to resume growth and develop into shoot (Fig. 1). Some studies have predicted that warmer spring temperature signals this massive structural change via regulation of respiration rate and other metabolic processes. To find out more about physiological changes that lead to buds burst in grape, an UWA research team investigated internal oxygen level, respiration rate and production of reactive oxygen species (ROS) during this crucial transition phase.

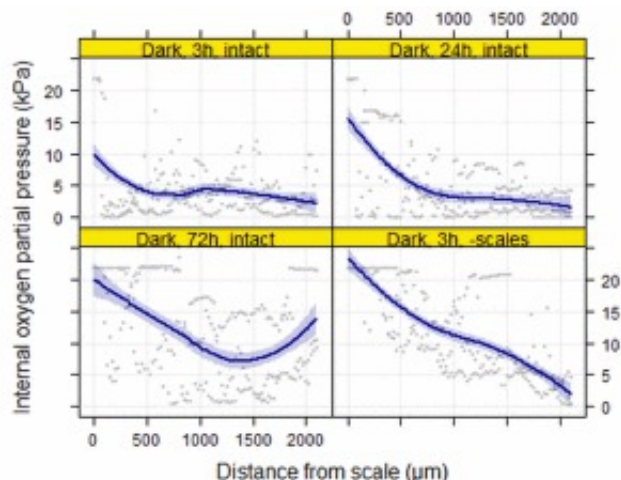


Fig. 2. Profile of the partial pressure of oxygen (pO₂) during grapevine buds burst. The pO₂ was measured after time of growing (0, 3, 24, or 72h) at 23 °C in darkness. Data represent scatterplots of raw data (n = 3), with a regression curve applied and 95% confidence intervals shown as light blue shading

The researchers found that oxygen level in internal tissues of the dormant buds was very low, less than a third of oxygen in normal air, and increased as the buds progressed to burst (Fig. 2). A higher oxygen level was initially detected in the tissues closer to bud scales, hard layers of buds protection, just after the buds experienced 24 hours of warm spring or ambient temperature. When the buds were kept for a longer time (72 hours) at this condition, oxygen level was getting higher and also arising in the tissues closer to the core. This showed that oxygenation of bud tissues involved an internal mechanism and were not solely controlled by diffusion. Along with these, the scales were also limiting oxygen diffusion into dormant buds (Fig. 2).

Buds respiration rates also showed a similar manner, a significant increase of CO₂ production was found after the buds were transferred to ambient temperature. This suggests that temperature increase has signalled the dormant buds to kick start respiration and resume growth. More interestingly, histology study of ROS suggested the same thing, that ROS was accumulated in the core of the buds or meristem area. ROS is known as important signalling molecules for cells and their presence in the meristem implies the activity resumption of this shoot candidate. These results lead to a further research to explore molecular signalling mechanism towards oxygen presence in grapes.

Publication

[Spatio-temporal relief from hypoxia and production of reactive oxygen species during bud burst in grapevine \(*Vitis vinifera*\).](#)

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