MANIPULATING GRAPEVINE BUD FRUITFULNESS

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Abstract:

Context and purpose of the study - Bud fruitfulness is a key component of reproductive performance of grapevine. It plays a significant role in annual yield variation of vineyards as it is a prerequisite of crop production in the following season. Various exogenous and endogenous factors influencing the development of inflorescence primordia (IP) have been studied. However, the research on molecular genetic control of bud fruitfulness, especially how it interacts with environmental factors is still lacking. This study aims to investigate the molecular mechanism of effects of temperature and light on grapevine bud fruitfulness during initiation and differentiation of IP. The project also manipulated bud fruitfulness in field using canopy management practices and explore the influence on reproductive performance in the following seasons.

Material and methods - Semillon cuttings were propagated and exposed to six regimes of combined light (90, 200 and 600 PAR) and temperature (day/night 30/25°C and 20/15°C) in growth rooms. Bud samples were collected at three stages (E-L Stage 17, 35 and 38) for bud transcription analysis by RNA-seq and fruitfulness was assessed at E-L Stage 35, 38 and 43. In field, intensive shoot thinning was applied on Semillon vines at E-L Stage 17 to investigate the effect of this practice on canopy architecture and reproductive performance of grapevine over time. Plant area index and light interception by the canopy were captured at different growing stages and bud fruitfulness was assessed at dormancy by recording number and size of IP. Inflorescence and bunch architecture, and yield components were measured in the following seasons.

Results - In growth rooms, both number and size of IP were positively correlated to temperature and light within the given range. Shoot vigour was negatively associated with bud fruitfulness, indicating that there may be competition for resources between shoot growth and bud development. RNA-seq analysis revealed that temperature had a greater influence at early development (pre-flowering, E-L Stage 17) with 8530 differentially expressed genes (DEGs), while light was most important later (veraison, E-L Stage 35) with 5716 DEGs. Gene ontology enrichment analysis showed that the DEGs were mainly involved in biological functions of stress management under the temperature treatment and active cellular development under the light treatment. It was found in field that shoot thinning created a more open canopy and improved bud fruitfulness with more and larger IP. Inflorescence architecture was increased in the next season, suggesting a carry-over effect of the treatment on the enlarged IP. A compensation in bunch development was shown by increased berry number and weight and moreover, the extent of compensation was accumulative when the practice was imposed in consecutive seasons.

Keywords: Bud fertility, Inflorescence primordia, Yield potential, Bud transcription, Canopy management, Reproductive performance.