

Overexpression of Rubisco and Rubisco activase rescues photosynthesis and biomass in rice under heat stress

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Introduction:

Global warming threatens food security by decreasing crop yields through inhibiting the activity of photosynthesis, in which Rubisco activation is extremely sensitive to temperature rise (Salvucci and Crafts-Brandner, 2004). Overexpressing Rubisco activase (Rca), which promotes the catalytic activity of Rubisco, was believed to be able to improve photosynthesis in high temperature (Yamori *et al.*, 2012). Previous studies showed that overexpression of Rca was always accompanied with decreases in Rubisco content, which resulted in the overall CO₂ assimilation and crop growth (Fukayama *et al.*, 2018). Our aim is to overexpress both Rubisco small subunit (RBCS) and RCA to avoid Rubisco decreasing, and improve rice photosynthesis and growth in high temperature.

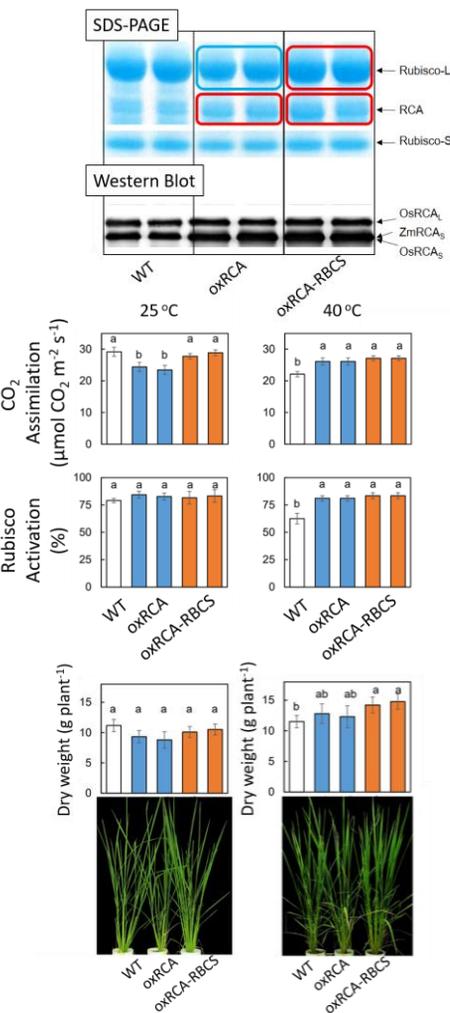
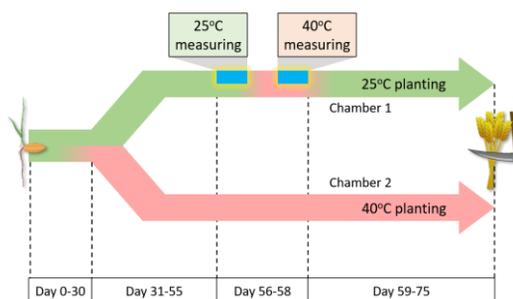
Method:

Plants

- *Oryza sativa*
- Wild-type Notohikari (WT)
- Rca overexpressing Notohikari (oxRCA)
- co-overexpressing Notohikari (oxRCA-RBCS)

Growth condition

- Normal growth temperature: 25°C
- High growth temperature: 40°C



Result

Rca is overexpressed in leaf tissue, while Rubisco remains unchanged.

SDS-page shows Rca overexpression in oxRCA-RBCS plants, when Rubisco content was not influenced. Western blot was used to confirm the present of Rca.

Photosynthesis of oxRCA-RBCS was increased in high temperature.

25°C: Co-overexpression showed no difference with WT in CO₂ assimilation (A) and Rubisco activation
40°C: Co-overexpression showed higher A and Rubisco activation compared with WT

Biomass of oxRCA-RBCS increases in high temperature.

25°C: Co-overexpression showed no difference with WT in biomass
40°C: Co-overexpression showed higher biomass compared with WT

Conclusion

Rubisco and Rubisco activase co-overexpression rice showed increased Rubisco activase content, improved photosynthesis, higher Rubisco activation and improved biomass production in high temperature, compared with WT.