

Title: Low CO₂ concentration, a key environmental factor for developing plateau adapted rapeseed

Sha Liu^{*1}, Lin Tang²⁺, Rui Wang¹ and Yun Zhao^{1,3}

¹ College of Life Sciences, Sichuan University, Chengdu, China

²Tibet Academy of Agriculture and Animal Husbandry Sciences, Lhasa, China

³Science and Technology Innovation Center of Sichuan Modern Seed Industry Group, Chengdu, China

Rapeseed is a globally important oilseed crop, crucial for both food supply and renewable energy production. As climate change and shrinking arable land push agriculture into marginal environments, high-altitude regions represent a critical frontier. Yet their chronically low atmospheric CO₂ concentrations-20-30% below sea level-pose a fundamental barrier to photosynthesis and yield^[1]. Our study shows that CO₂ limitation, rather than light availability, is the primary physiological constraint on rapeseed performance in plateau ecosystems. To address this challenge, we developed a novel low-CO₂ screening platform to evaluate diverse genotypes. Six elite varieties were identified with significantly higher photosynthetic efficiency than local high-altitude cultivars, achieving 25-40% yield increases under plateau conditions while maintaining superior oil quality. Physiological analyses revealed that this adaptation involves modified activity of key photosynthetic enzymes and altered carbon allocation pathways (Fig. 1). These findings not only uncover mechanisms of crop performance under carbon limitation but also provide valuable breeding resources for marginal environments.

Currently, we are applying this screening strategy in plain regions to systematically select promising rapeseed genotypes for future cultivation in high-altitude areas. This approach is expected to further enhance rapeseed yield and stability in plateau ecosystems.

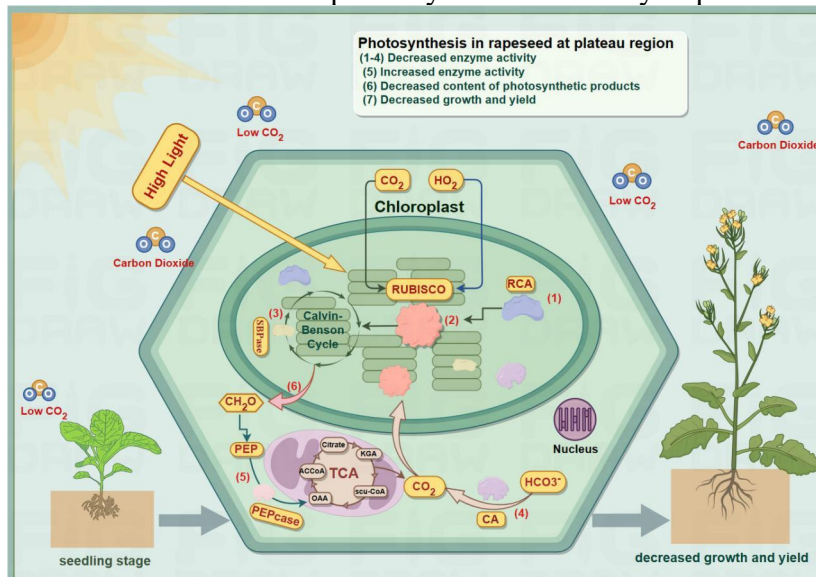


Fig.1 Mechanisms of changes in leaf photosynthesis at physiological and biochemical levels in rapeseed under plateau environment

References

1. LM Gerhart, JK Ward, *New Phytol*, 2010, 188, 674–695.