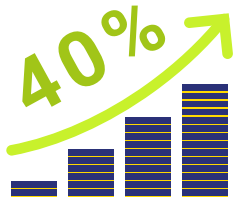


BREEDING FOR BETTER PHOTOSYNTHESIS

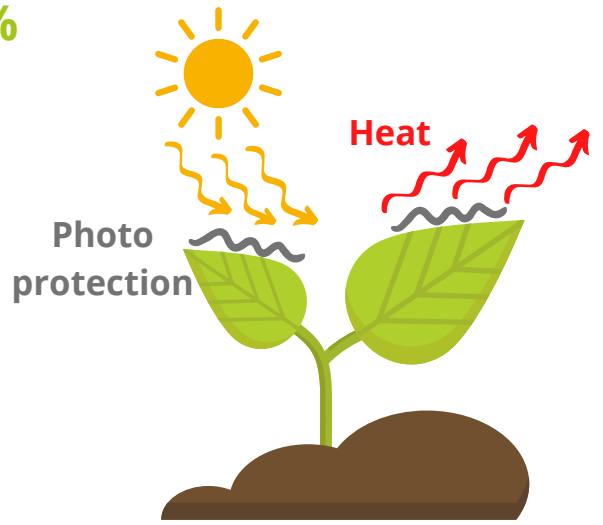
2. PHOTOSYNTHESIS IN THE CHANGING LIGHT



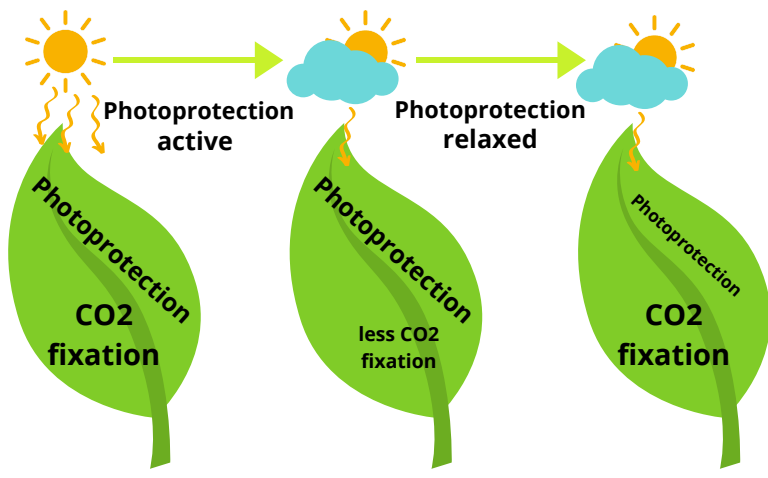
Accelerating the kinetics of photosynthetic responses to changes in irradiance can increase biomass by up to 40%

PHOTOPROTECTION

Plants in full sunlight activate a protective mechanism and dissipate damaging excess absorbed light energy as heat.



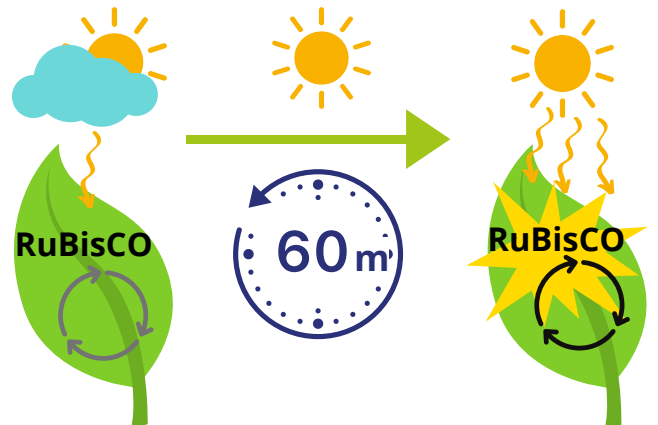
LIMITATIONS



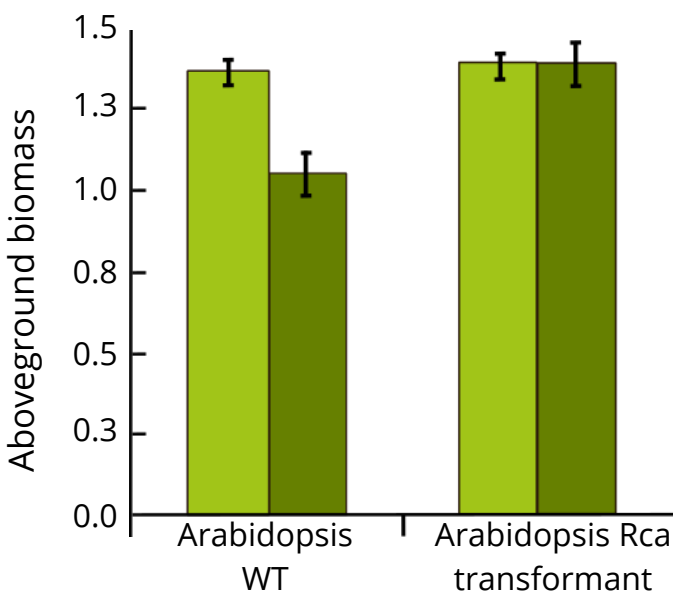
Light strongly fluctuates within crop canopies, due to changing cloud cover, solar angles, and leaf shading. Plant responses to both increases and decreases in light intensity are too slow and limit photosynthesis.

When a leaf transitions from high to low light, slow relaxation of the photoprotective mechanism causes temporary decline of CO₂ fixation. Based on Kromdijk et al. 2016 [1].

The activation of RuBisCO by RuBisCO activase, when leaves transition from low to high light, can take up to 60 min.



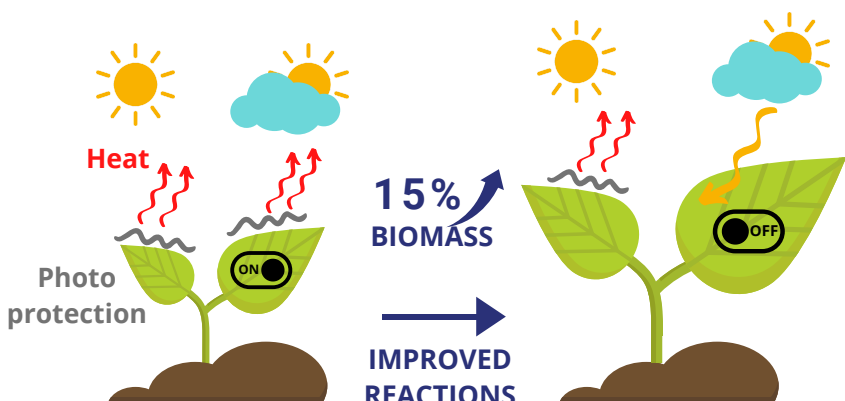
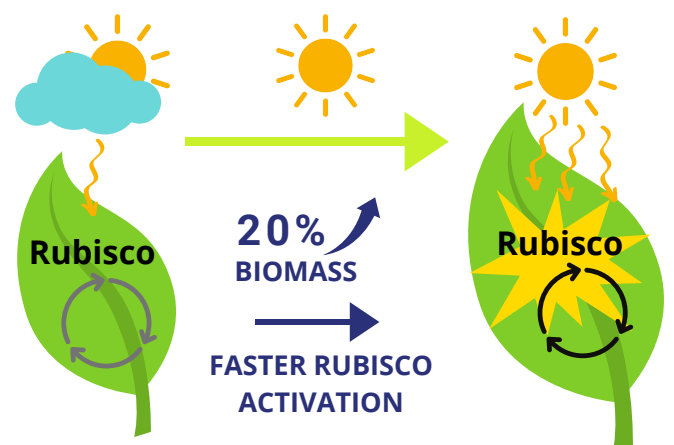
SOLUTION



Research in Arabidopsis has shown that the **recovery of photoprotection is faster in plants containing an isoform of RuBisCO activase (Rca) that differs in its regulatory properties.**

Arabidopsis wild type (WT) plants grown under fluctuating light (dark green) produced 40% less biomass compared to those grown in continuous light (light green). But **RCA transformant plants in fluctuating light (dark green) performed as well as those in continuous light (light green)**; modified from Carmo-Silva & Salvucci 2013 [2]).

Modelling work provides evidence indicating that **faster activation of RuBisCO has the potential to improve carbon assimilation in wheat by as much as 20%.**



Accelerating the kinetics of photo-protection induction and relaxation in the C₃ species tobacco by genetic engineering achieved a **15% increase in plant biomass under field conditions.**

References: [1] DOI: 10.1126/science.aai8878; [2] DOI: 10.1104/pp.112.213348