





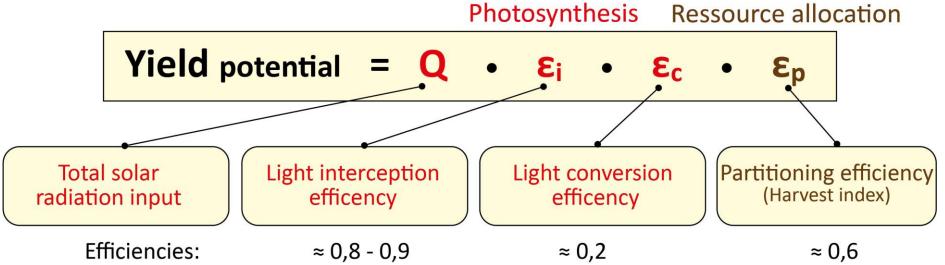
Improving Photosynthesis

- Focus Group Y-1 -

Peter Westhoff (HHU Düsseldorf, Coordinator)

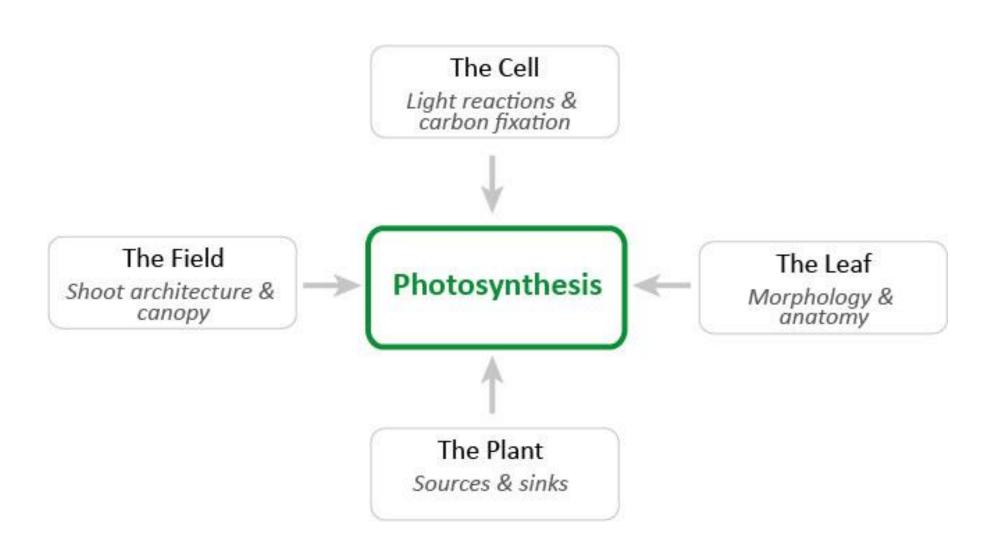
Determinants of Yield Potential





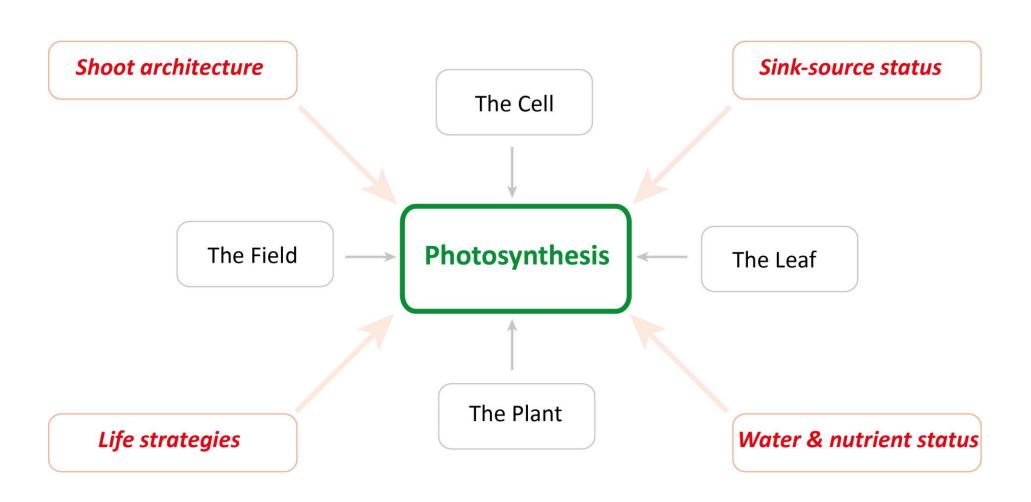
Photosynthesis

- A Multidimensional Process -



Photosynthesis

- Its Integration into Whole-Plant-Physiology -

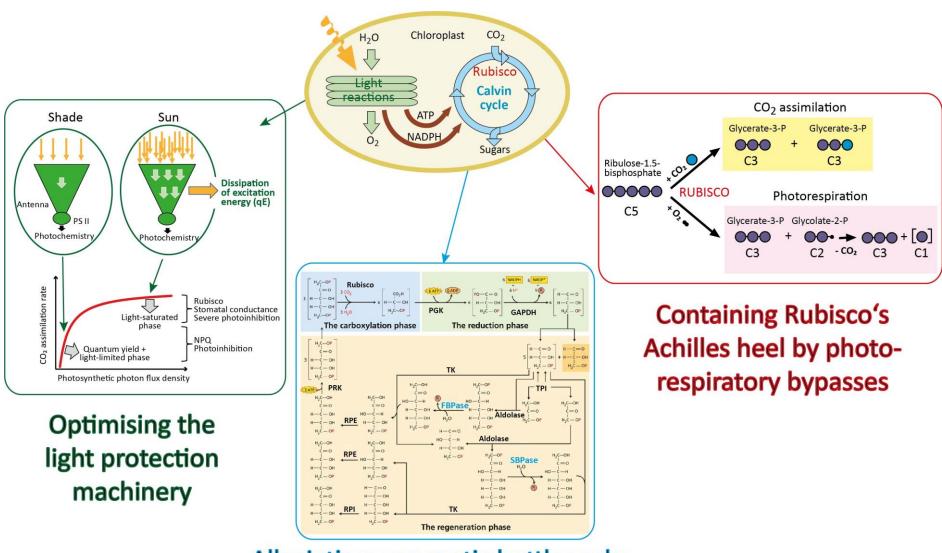


How to Improve Photosynthesis?

- Knowledge-based directed engineering
 - √ Functional photosynthetic submoduls
 - √ Global regulators of photosynthesis-related gene expression
- Exploiting genetic diversity for the identification of unknown genes/alleles
 - ✓ Natural genetic diversity
 - ✓ Artificially induced diversity by mutagenesis

Knowledge-Based Engineering

- Photosynthetic submodules -

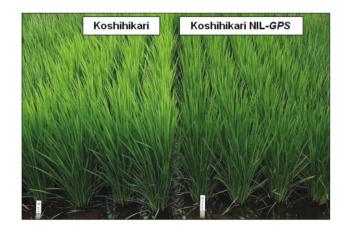


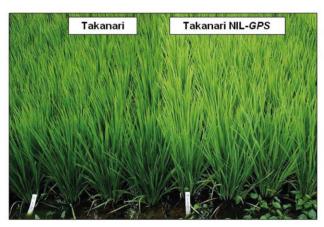
Alleviating enzymatic bottlenecks in the Calvin-Benson cycle

How to Improve Photosynthesis?

- Exploiting Genetic Diversity in Rice -

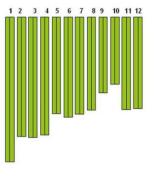
Field growth

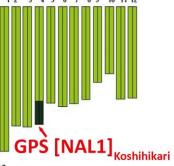


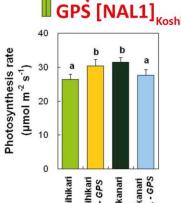


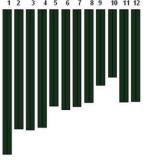
Genotype

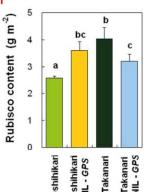
Photosynthetic performance













The Research Strategies

- Different, but Complimentary -

Genetic diversity-guided identification of 'Photosynthesis Optimisation Genes/Loci'

Knowledge-guided identification of 'Photosynthesis Optimisation Genes/Loci'



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Selection of candidate plants by smart phenotyping and verification



Directed modification and verification of 'Photosynthesis Optimisation Genes/Loci'

Optimising Photosynthesis

- Single Plants vs. Canopy -

Single Plant Photosynthesis

The Cell

- Rubisco and its auxiliary proteins
- Limiting steps in RuBP regeneration
- Photorespiration
- Regulatory interactions between the light reactions and CO2 assimilation
- Synthetic pathways supplementing the Calvin-Benson cycle and bypassing Rubisco
- Photoprotection

The Leaf

- Leaf anatomy and mesophyll conducatance
- Leaf form & shape
- Interlinkage of CO2 supply and water status
- Transcription factor networks (linking to cellular photosynthesis)

Sink-source interactions

- · Adjusting sink and source strength
- The role of intermediary sinks (stem fructans in grasses)



Canopy photosynthesis

- · Balancing light supply and protection
- Extending light interception into the far-red
- Optimising light absorption within the canopy