



河南科技学院
HENAN INSTITUTE OF SCIENCE AND TECHNOLOGY



Melatonin enhances crop resilience to climate-related stress: evidence from peanut

Zhang, Zhiyong

Launceston, Australia

12 March 2026

Presentation contents

1. Melatonin synthesis in plants

2. Versatile melatonin functions

3. Effects of melatonin on peanut development and yield

4. Mechanisms of melatonin improving peanut development and yield

5. Acknowledgments

Melatonin synthesis

N-acetyl-5-methoxytryptamine

- ◆ Natural synthesis in animal, plant and microbe
- ◆ Found in plant in 1995

TPH: tryptophan hydroxylase

TDC: tryptophan decarboxylase

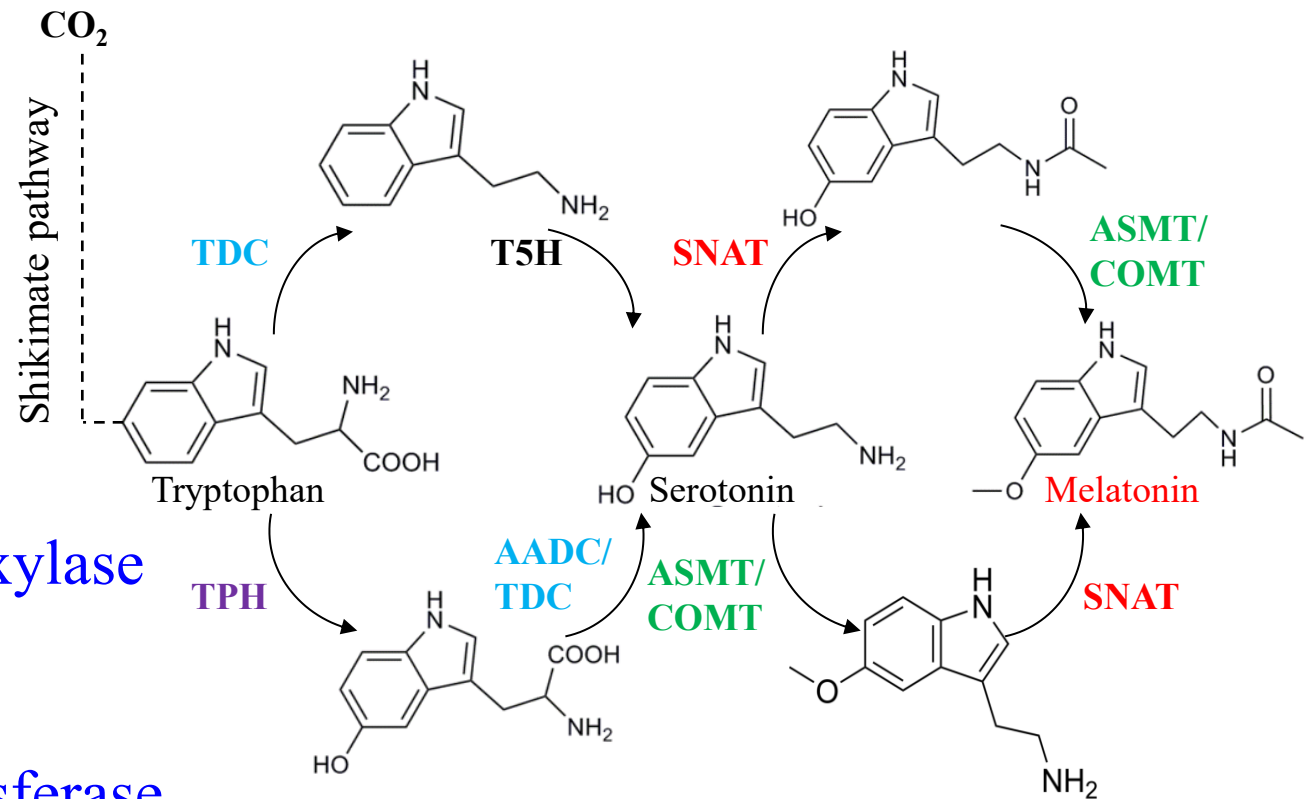
AADC: aromatic amino acid decarboxylase

T5H: tryptamine 5-hydroxylase

SNAT: serotonin-N-acetyltransferase

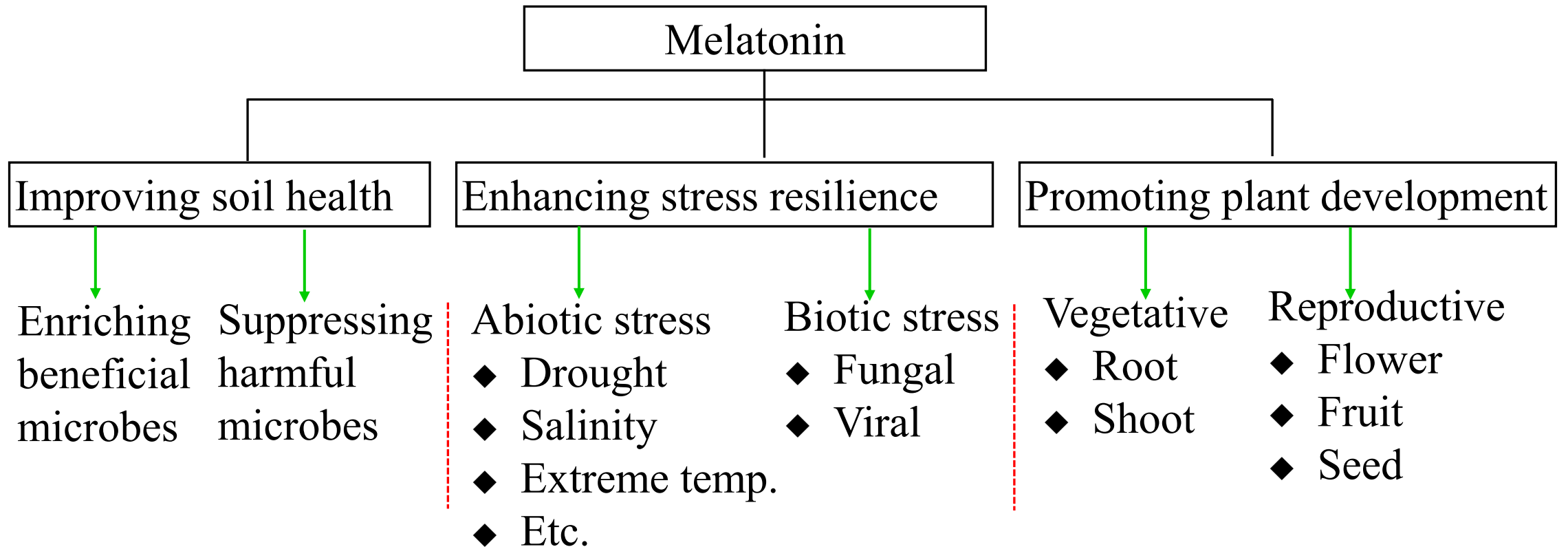
ASMT: N-acetylserotonin methyltransferase

COMT: caffeic acid O-methyltransferase



Frontier in Plant Science, 2024, 15, 1492036.

Versatile melatonin functions



Melatonin enhancing peanut development

Peanuts are not only a globally important oil and food crop, but also a pathway to a resilient and sustainable future.

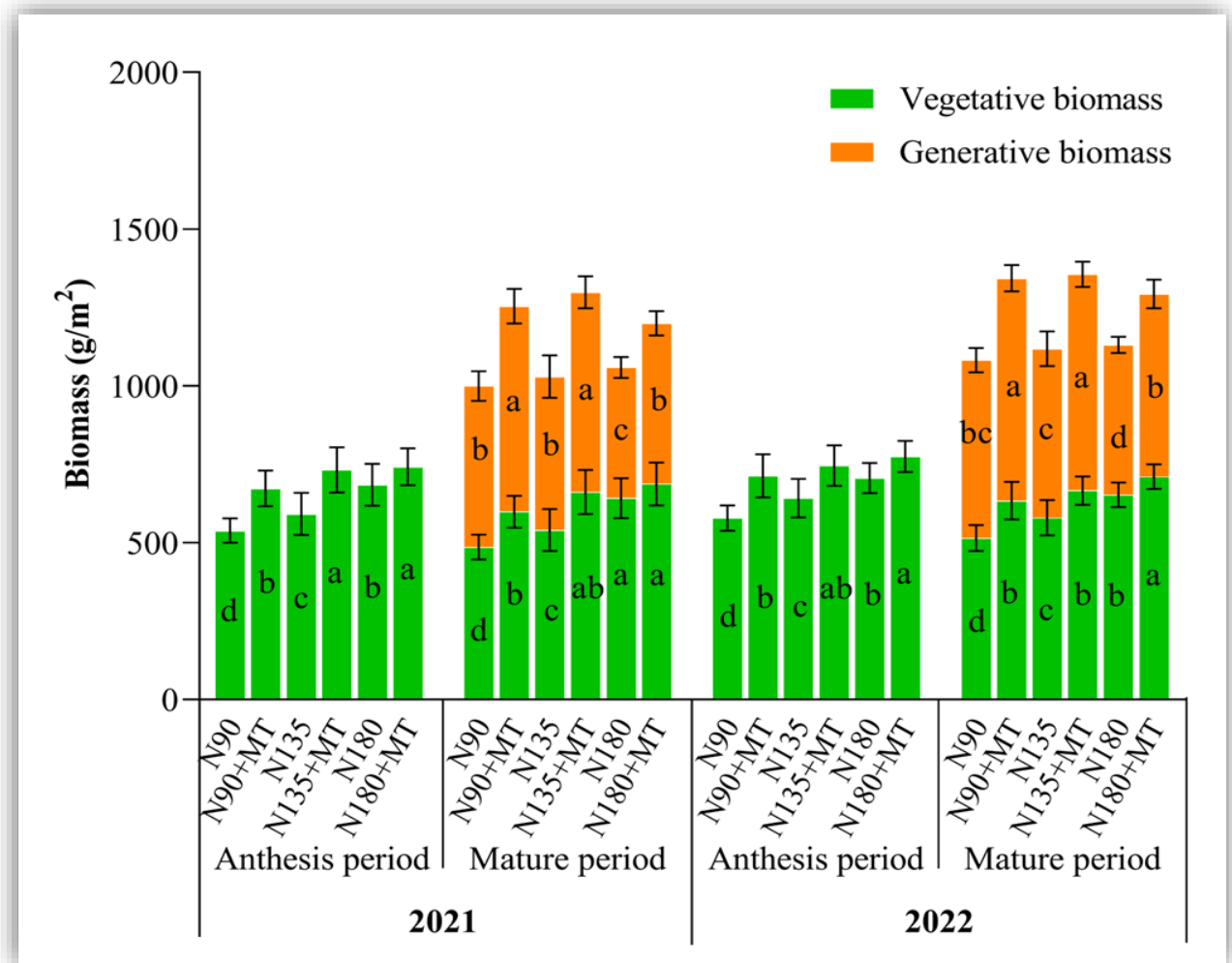


Melatonin enhancing peanut development



Melatonin enhancing peanut development

- ◆ At anthesis, Melatonin significantly increased vegetative dry matter across three N levels and in both years.
- ◆ At maturity, Melatonin enhanced grain mass per plant by 26.35% (N180), 29.07% (N135), and 22.41% (N90) vs non-MT.
- N180, N135, N90, respectively, mean 180, 135, 90 kg N /ha
- Treatment: peanut seeds were dressed in 0.5 µmol/L melatonin
- Field experiments



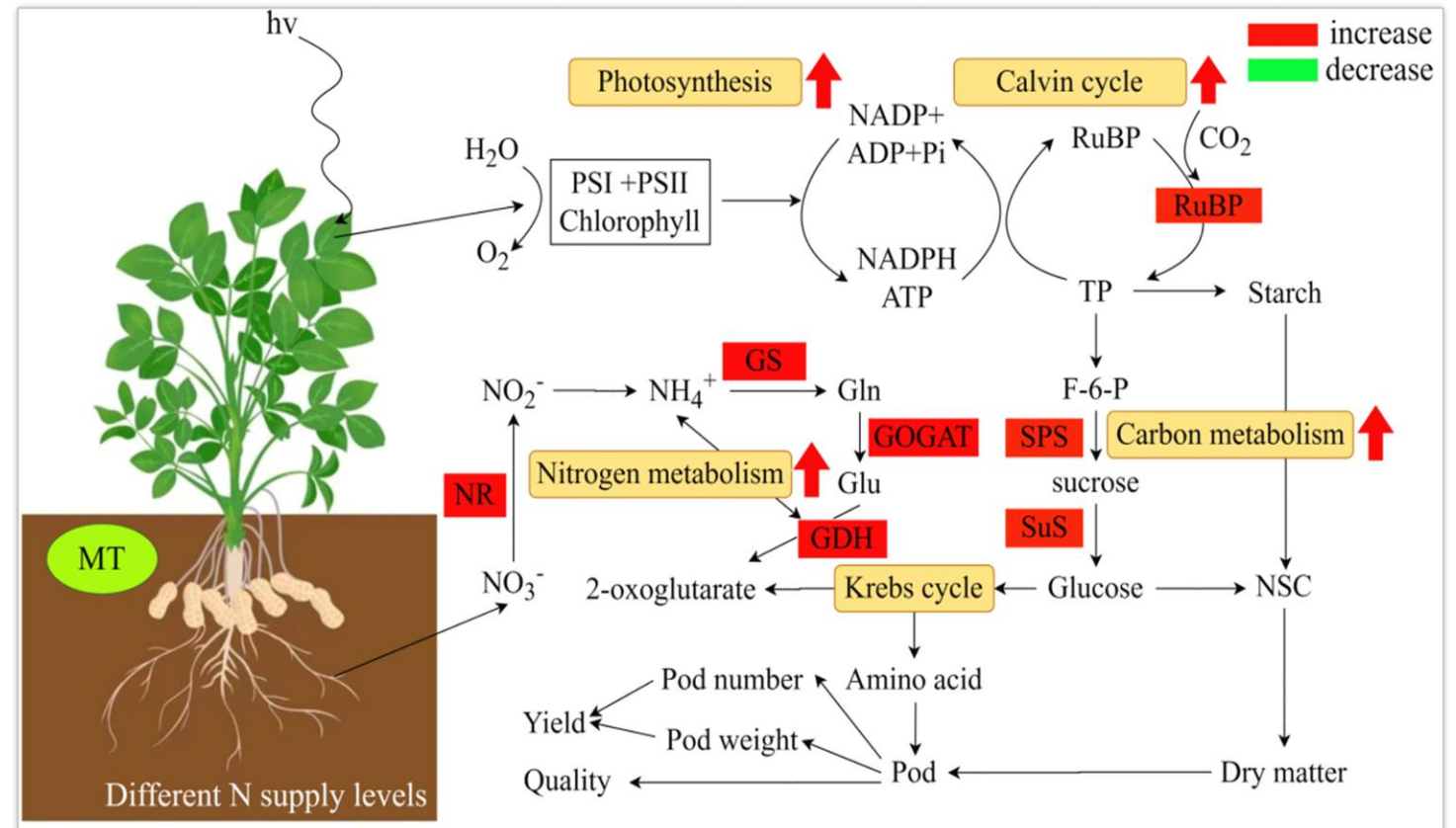
Mechanism1 of melatonin enhancing peanut development

Melatonin

- ◆ Improve photosynthesis
- ◆ Enhance the synthesis and transformation of C metabolism
- ◆ Increase the absorption and utilization of N metabolism
- ◆ Finally increasing both peanut yield and quality

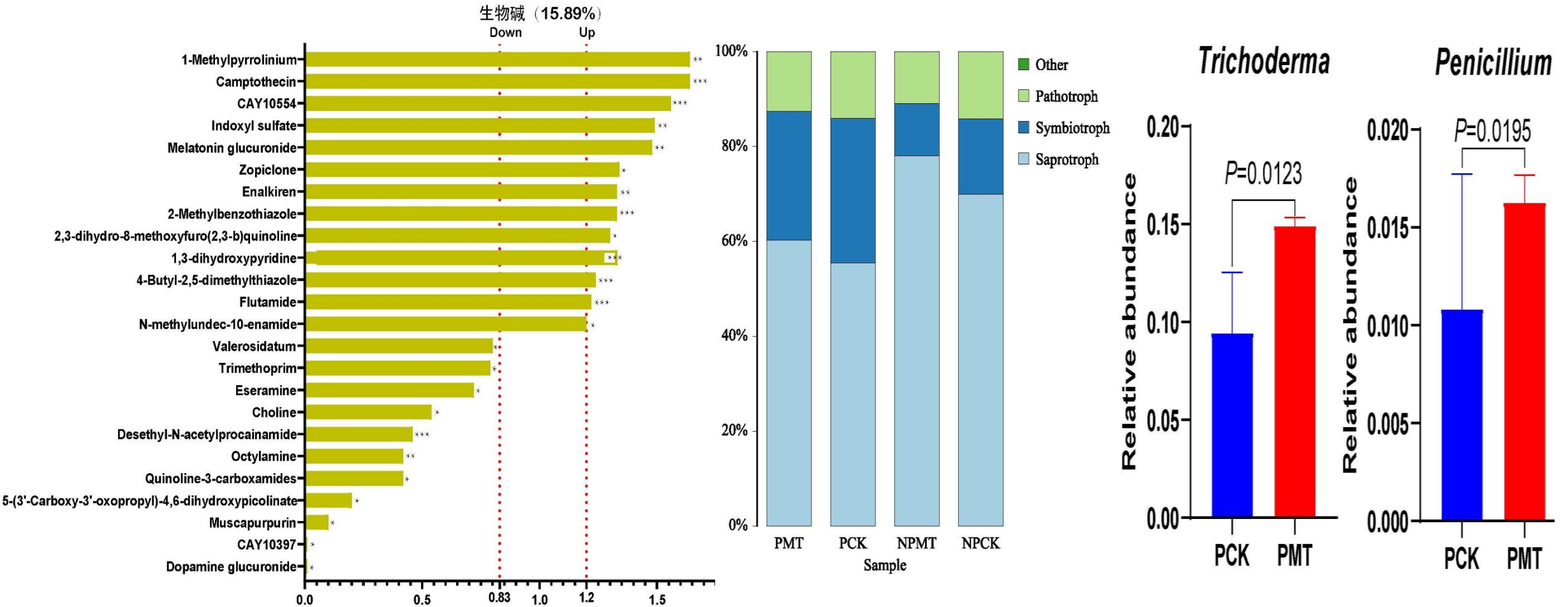
NR: nitrate reductase; GS: glutamine synthetase; GOGAT: glutamate synthase; GDH: glutamate dehydrogenase;

RuBP: ribulose-1, 5 bisphosphate carboxylase/oxygenase; SPS: sucrose phosphate synthase; SuS: sucrose synthase



Melatonin affects soil metabolomics and microbiome

e.g. a majority of alkaloids increases, which can inhibit Pathotroph and enhance Saprotrroph such as *Trichoderma* and *Penicillium*

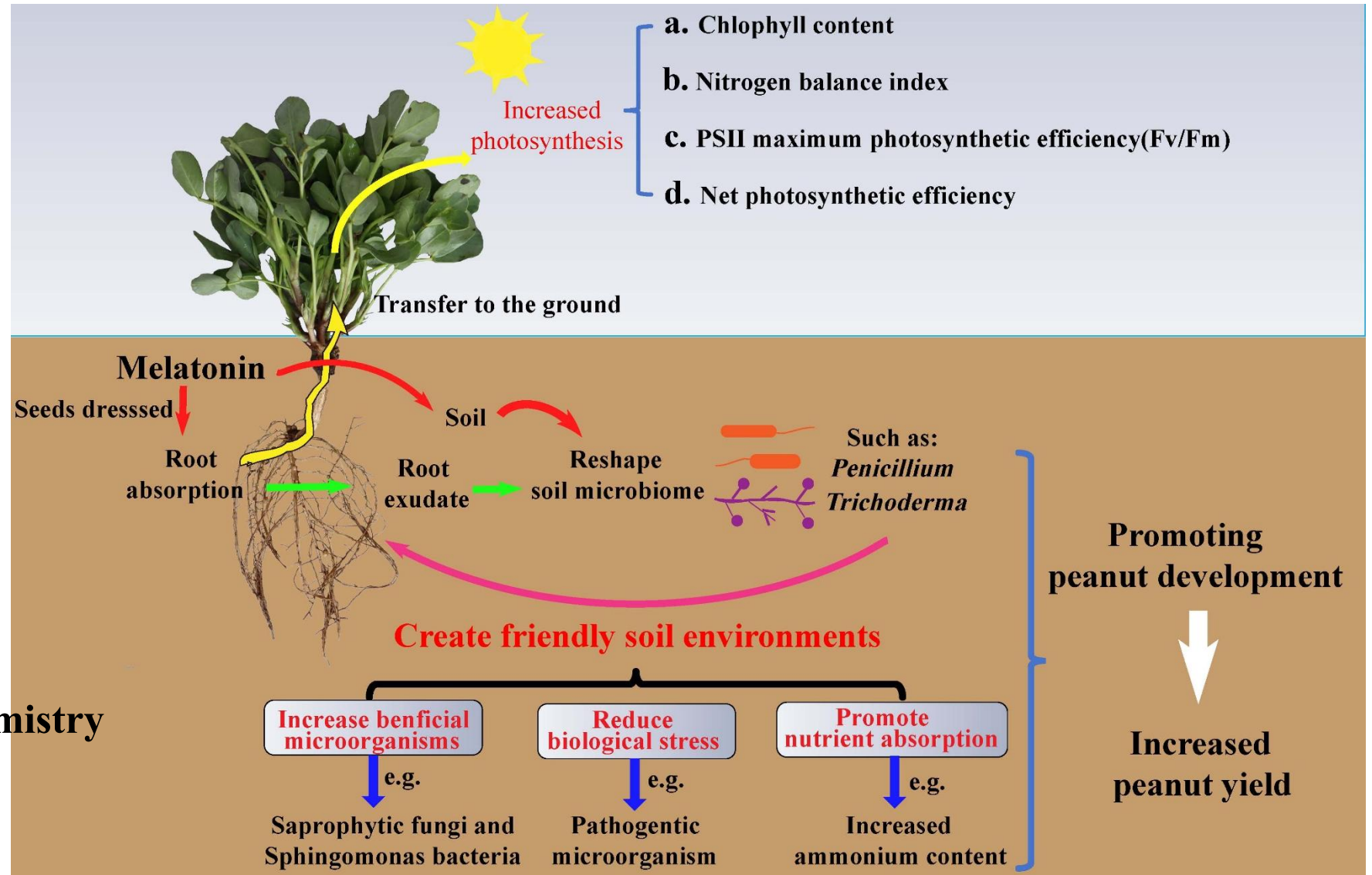


Mechanism2 of melatonin enhancing peanut development

Melatonin

- ◆ reprograms soil microbial community
- ◆ creates friendly soil environments
- N fertilizer: 67.5 N kg/ha
- Treatment: peanut seeds were dressed with 0.5 $\mu\text{mol/L}$ melatonin
- Pot experiments

Plant Physiology and Biochemistry
2025, 218: 109307.



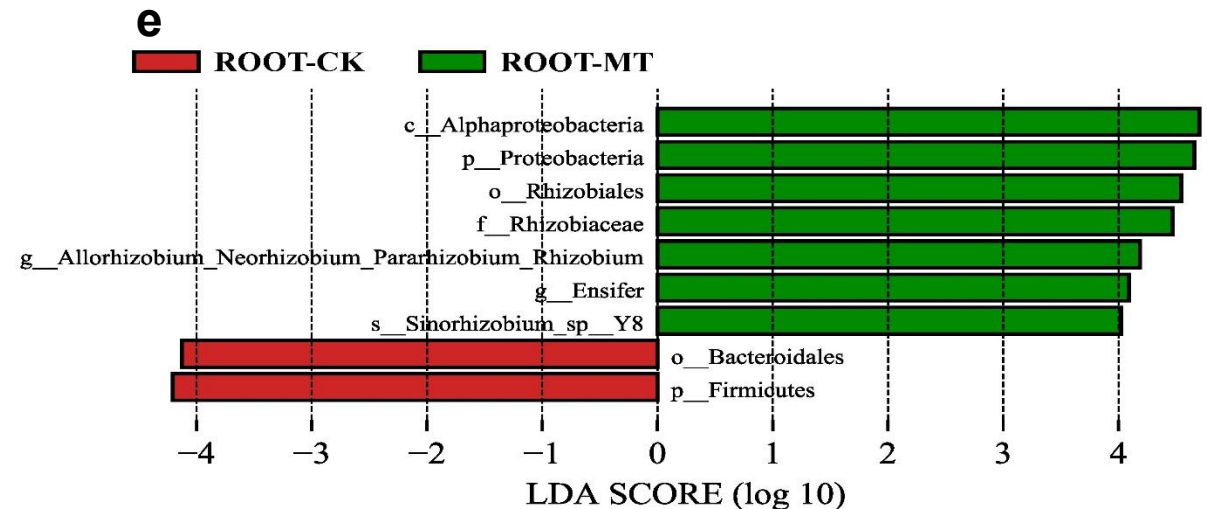
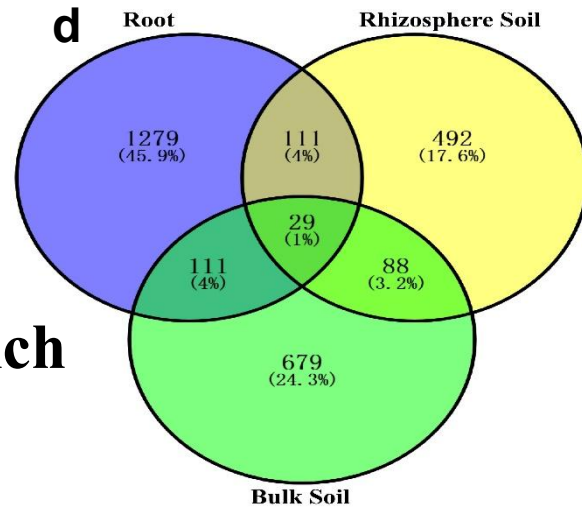
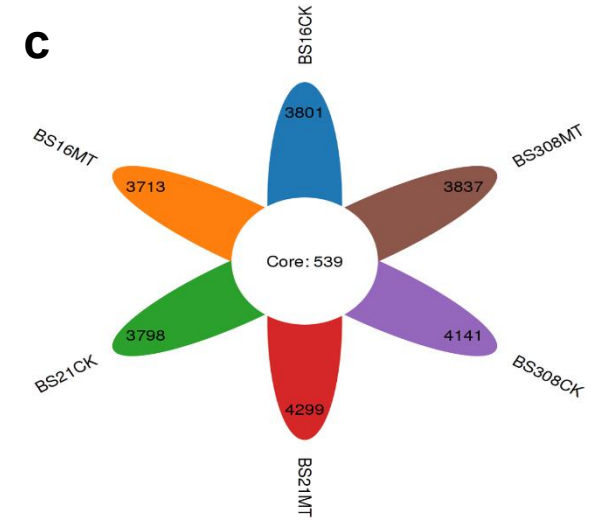
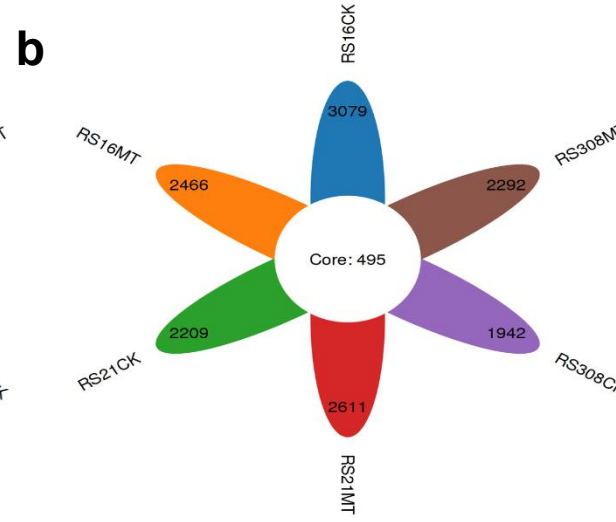
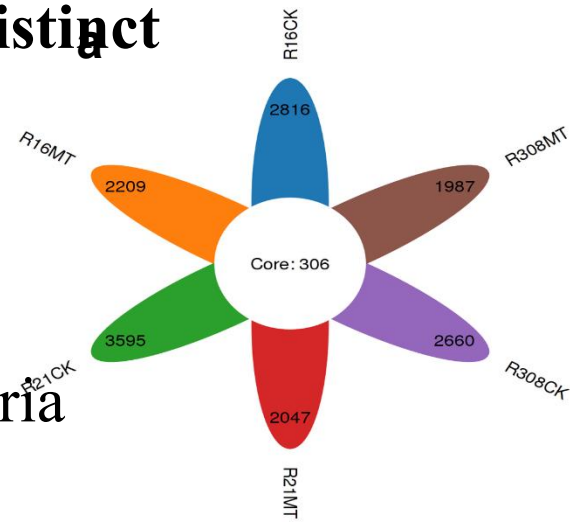
Melatonin affecting root bacteria microbiome

Melatonin enrich distinct endo-root bacteria microbiota

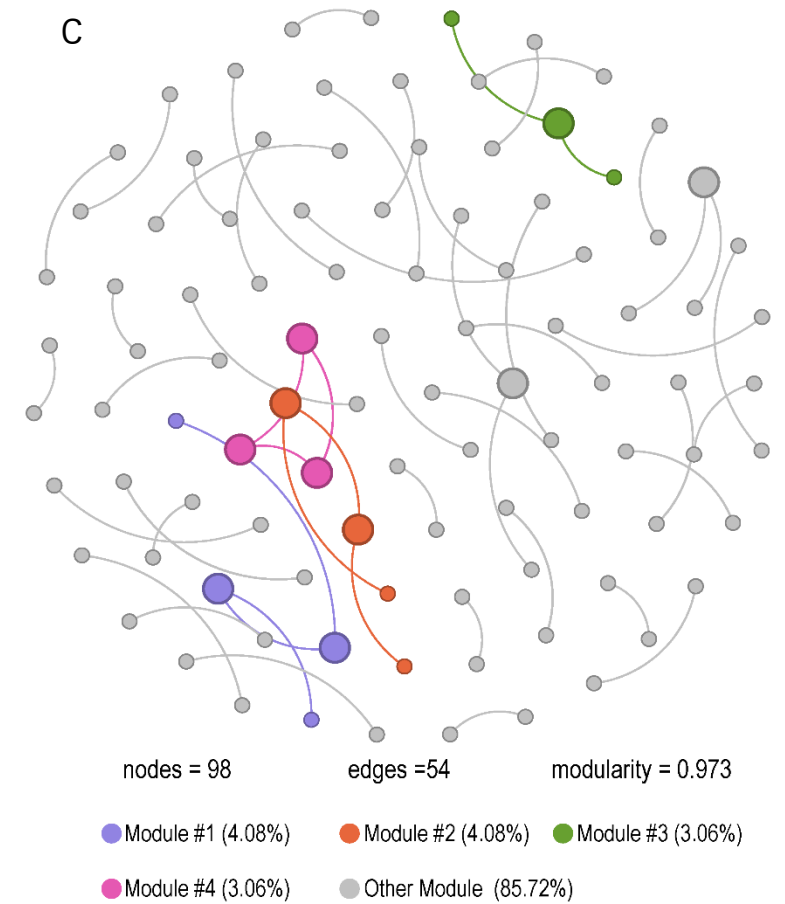
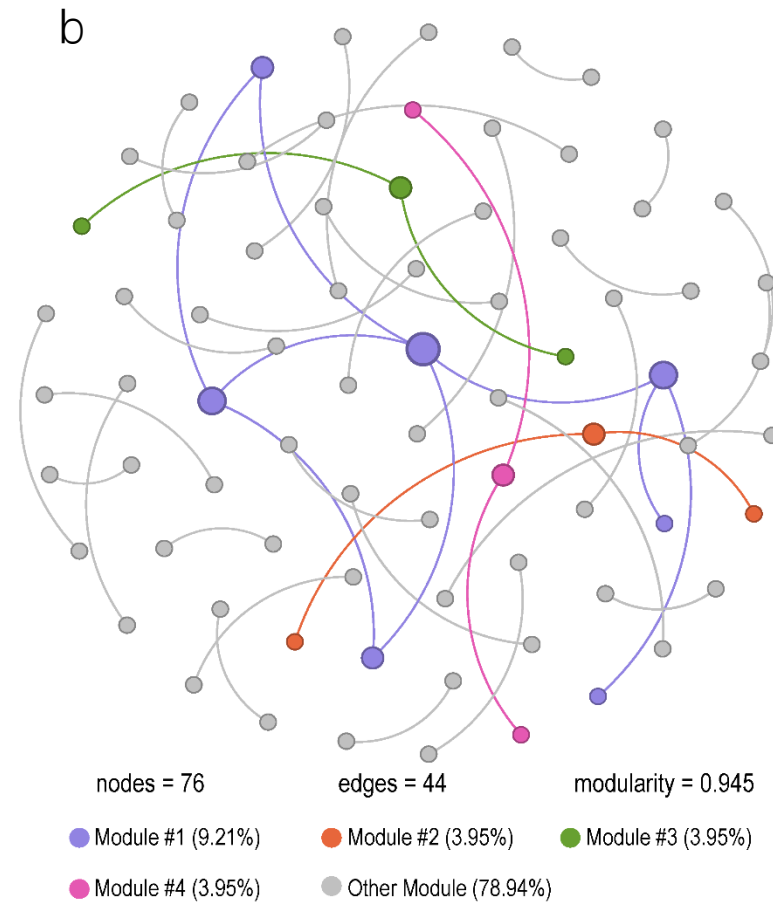
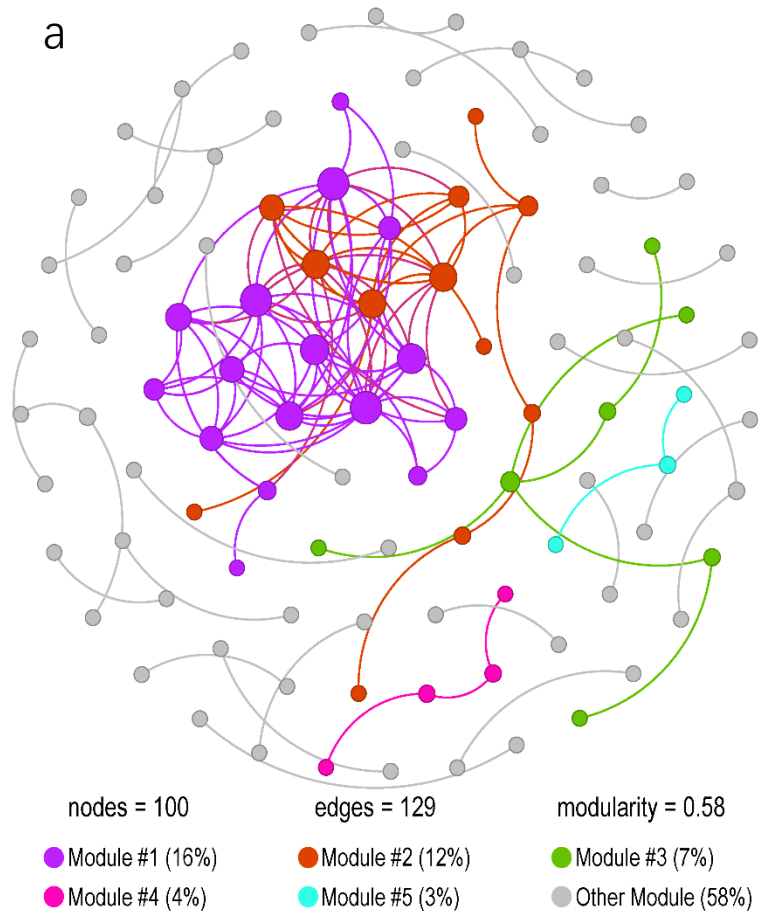
- ◆ Proteobacteria
- ◆ Actinobacteriota
- ◆ Alphaproteobacteria
- ◆ Rhizobiales
- ◆ Rhizobiaceae
- ◆ Rhizobium
- ◆ Ensifer
- ◆ Sinorhizobium

In contrast, CK enrich

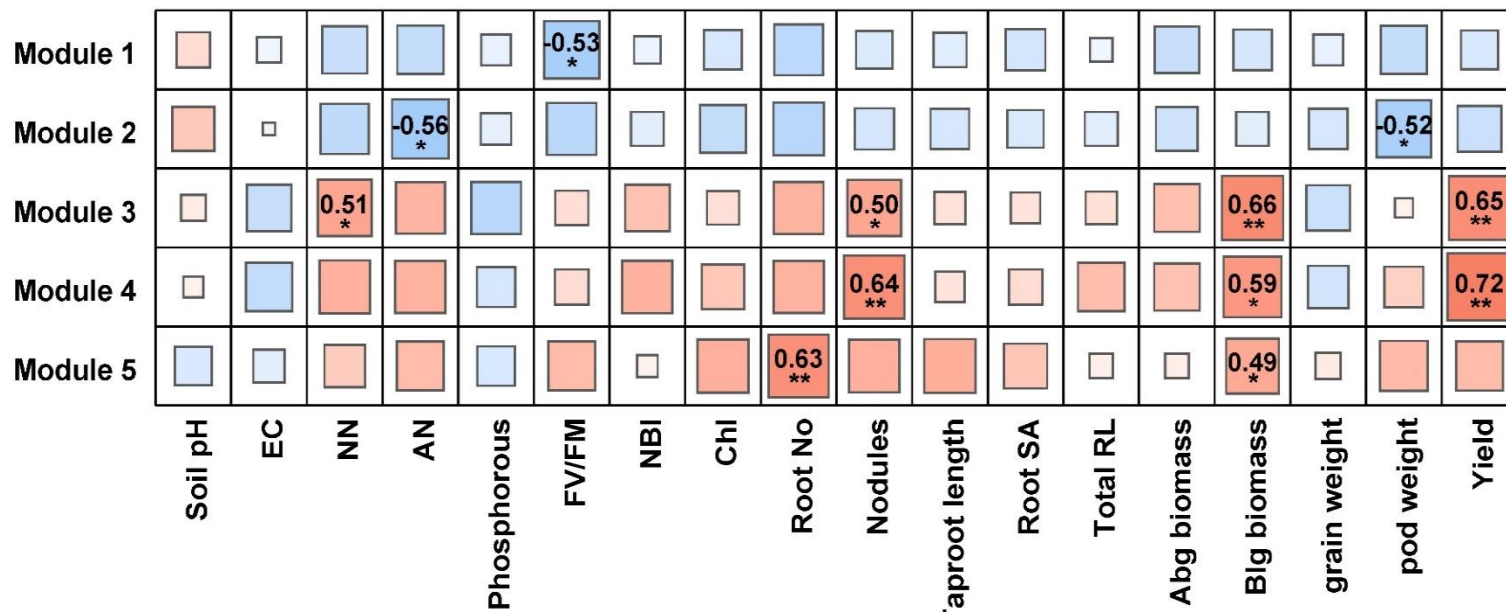
- ◆ Firmicutes
- ◆ Bacteroidales



Mechanism3 of melatonin enhancing peanut development



Mechanism3 of melatonin enhancing peanut development



- N fertilizer: 90 kg N /ha
- Treatment: peanut seeds were dressed in 0.5 μmol/L melatonin
- Field experiment
- Three peanut cultivars
- Root microbiome at maturation stage

- ◆ Module3 has significant positive correlation with NN, nodules, biomass and yield.
- ◆ Module4 has significant positive correlation with nodules, biomass and yield.
- ◆ Module5 has significant positive correlation with root number, biomass.

Nodes	Module1 (Phyla)	Module2 (Phyla)	Module3 (Phyla)	Module4 (Phyla)	Module5 (Phyla)
1	Proteobacteria	Proteobacteria	Proteobacteria	Proteobacteria	Bacteroidota
2	Actinobacteriota	Actinobacteriota	Proteobacteria	Proteobacteria	Proteobacteria
3	Proteobacteria	Firmicutes	Proteobacteria	Proteobacteria	Actinobacteriota
4	Firmicutes	Proteobacteria	Proteobacteria	Proteobacteria	
5	Bacteroidota	Bacteroidota	Proteobacteria		
6	Firmicutes	Proteobacteria	Acidobacteriota		
7	Fusobacteriota	Proteobacteria	Proteobacteria		
8	Proteobacteria	Proteobacteria			
9	Bacteroidota	Proteobacteria			
10	Bacteroidota	Proteobacteria			
11	Firmicutes	Bacteroidota			
12	Firmicutes	Firmicutes			
13	Bacteroidota				
14	Bacteroidota				
15	Bacteroidota				
16	Bacteroidota				

Acknowledgments

Supported by the Leading Talent Project in Science and Technology Innovation of Central Plain of China (214200510021); the Science and Technology Innovation Team Support Program of Henan Provincial Universities (21IRTSHN023); the Key Science and Technology Special Project of Xinxiang City (ZD2020004).

Thanks to all team members for their hard work !



Thanks for your attention

Welcome everyone to visit HIST, Xinxiang,
Henan Province, China

