Photosystem I stabilization by MTU decouples yield from nitrogen inputs and much more

Mgr. Jaroslav Nisler PhD.

Yield stagnation, nitrogen (N) dependency and stress-driven losses remain major constraints in agriculture. Here we show that targeting Photosystem I (PSI) represents an unexplored physiological lever for improving crop productivity and resilience under field conditions. MTU, an ultra-low-dose (0.5–1.0 g ha^{-1}) PSI-stabilizing biostimulant (Nisler et al., 2023), was evaluated as the product Status® in more than 150 field trials conducted between 2019 and 2025 across Europe, North America and Morocco. Across major arable crops, Status® increased grain yield by 10–20% under favourable conditions and by 5–10% under drought-affected environments, accompanied by improved agronomic NUE. Mean grain protein yield increased by 14% under reduced N fertilisation (40 kg N ha^{-1}), which did not cause yield or N export penalties, corresponding to avoided emissions of 294 kg CO_2e ha^{-1} (≈20% reduction in fertiliser-related emissions). To explain these field responses, we identified light regimes under which MTU enhances photosynthetic performance in wheat under semi-controlled environments. Importantly, MTU effects extend beyond N optimisation. In sunflower, the negative effects of herbicides were eliminated. In citrus under saline stress, sodium accumulation in leaves was reduced by 50%, accompanied by improved plant performance. In cotton, Verticillium-induced yield losses were mitigated by 40%. Across these systems, MTU consistently maintained higher photosynthetic activity (10–20%), pointing to a central role of PSI stabilisation in responses to both abiotic and biotic stresses. Using radioactively labelled MTU, we further investigated its half-life, metabolism, transport, and tissue and cellular localisation, providing new insight into its hit-and-run mode of action.

CAS, Institute of Experimental Botany

Isotope laboratory

Email: nisler@ueb.cas.cz

https://ueb.cas.cz/en/contacts/list-of-employees?id=2063&s=nisler-jaroslav-1