GYSM S3 O1

Development and Performance of Sustainable, Bioinspired Fatty Acid Based Coatings for Multi-Functional Crop Protection

Niv Ben-Arie*, Iryna Polishchuk*, Franziska Tauber+, Coralie Schneider+, Markus Rueckel+, Matthias Kellermeier+, Boaz Pokroy*

** Department of Materials Science and Engineering, Technion - Israel Institute of Technology, 3200003 Haifa, Israel*

+ Material Science, BASF SE, RGS/B-B007, Carl-Bosch-Strasse 38, 67056 Ludwigshafen am Rhien, Germany

Global warming poses a growing threat to agriculture by exposing crops to elevated temperatures and prolonged droughts, reducing yield and quality. In nature, to withstand environmental stress, plants have evolved superhydrophobic surfaces, such as those of lotus leaves, that serve as protective barriers regulating water loss and surface wettability, while also providing self-cleaning and pathogen-repellent protection, UV-shielding, and temperature-regulating functions[1–3]. However, superhydrophobicity is rare in nature, and most cultivated crops lack such natural defenses, particularly under the pressures of climate change. A novel solution to address this challenge is SafeWax, a bio-inspired superhydrophobic coating composed of sustainable materials, such as fatty acids, which are dissolved in different solvents[4]. This sprayable coating can be applied to the plant surfaces, rendering them superhydrophobic[5]. Our studies demonstrate that due to its unique physical properties, the coating offers multi-functional protection. Its enhanced near-infrared reflectance enables passive surface cooling, lowering leaf temperature of up to 4.5°C. Furthermore, the coating exhibits high intrinsic capacity to absorb UV radiation, enabling sunburn protection, while ensuring no interference with photosynthesis with up to 95% light transmittance in the visible spectrum. The coating's superhydrophobic nature also prevents surface water accumulation and promotes efficient dew collection, offering a supplemental water source under harsh drought conditions. Finally, we confirmed the coating's high stability following exposure to varying thermal and weathering stressors simulating dynamic real-world environmental conditions, and validated its protective performance on model plant surfaces. Together, these features position SafeWax as a sustainable multifunctional solution for improving crop resilience to heat, drought, and other environmental stresses.

[1] Schreuder, M. D., Brewer, C. A. & Heine, C. Modelled influences of non-exchanging trichomes on leaf boundary layers and gas exchange. *J. Theor. Biol.* **210**, 23–32 (2001).

[2] Holmes, M. G. & Keiller, D. R. Effects of pubescence and waxes on the reflectance of leaves in the ultraviolet and photosynthetic wavebands: a comparison of a range of species. *Plant Cell Environ.* **25**, 85–93 (2002).