PRECISION AGRICULTURE

Engineering the microenvironment

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Seed enhancement technologies have great potential in improving seed performance, such as by conferring disease resistance and modifying seedling emergence capabilities. Seed coating is one such technology. It involves applying external materials to the natural seed coat to improve the surface and shape for ease of handling by agricultural equipment and to deliver active ingredients such as fungicides to promote seed performance. However, current formulations used in seed coating have a number of technical challenges, including the maintenance of microbial viability for biofertilizers such as rhizobacteria (PGPRs) — symbiotic bacteria that can increase nutrient and phytohormons availability. The loss of viability is mostly due to osmotic and desiccation stress in the synthetic seed coat, and the interaction of protectant compounds with the symbiotic bacteria.

Augustine T. Zvinavashe and colleagues, from Massachusetts Institute of Technology, developed a biomaterial that can be mixed with rhizobacteria and applied on the seed surface, retrofitting current seed coating techniques to encapsulate, preserve and precisely deliver PGPRs to the soil. By following the idea that a combination of proteins and disaccharides is the key for anhydrobiosis, they develop a biomaterial for seed coating based on silk fibroin and trehalose. The micrometre-thick coating is transparent and biodegrades when exposed to water. Using *Rhizobium tropici* CIAT 899 and *Phaseolus vulgaris* as working models, they show that the silk–trehalose coating can provide a beneficial environment for the survival of these rhizobacteria, and can efficiently release them into the soil to boost seed germination and mitigate soil salinity.

This research showcases the potential use of biomaterials in seed enhancement, which provides a new avenue to engineer the seed microenvironment for precision agriculture.

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