Material farming and biological fabrication of cellulose fibers with tailored properties

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The use of biological systems for future sustainable production of commercially valuable materials is gaining momentum spearheaded by synthetic biology, green synthesis of functional and adaptive materials, and, more recently, material farming. Material farming is a relatively new concept. It combines "already in place" optimized biological strategies and mechanisms from higher organisms (biofactories) and chemically synthesized molecules carrying desired functionalities to yield new materials with tailored properties. It does not involve or require genetic manipulation. Cotton is a globally relevant crop and the most used fiber in the textile industry. Yet, cotton growth and fiber processing are environmentally expensive, calling for the development and implementation of medium and long-term strategies toward sustainable alternatives.

As a proof-of-concept, we combined molecular design and *in vitro* cotton growth cultures to demonstrate *in situ* biological fabrication of cotton cellulose fibers with build-in properties such as fluorescence, supermagnetism [1-3], or water-retaining capabilities. Translational research is currently being developed to modify cotton fibers in whole cotton plants toward implementing material farming as a new "bio-facturing" strategy toward a future global bio-based economy.

Further reading:

[1] Natalio, F., Fuchs, R., Cohen, S. R., Leitus, G., Fritz-Popovski, G., Paris, O., Kappl, M., and Butt, H. J. (2017) Biological fabrication of cellulose fibers with tailored properties, *Science 357*, 1118-1122.

[2] Natalio, F., Tahir, M. N., Friedrich, N., Kock, M., Fritz-Popovski, G., Paris, O., and Paschke, R. (2016) Structural analysis of Gossypium hirsutum fibers grown under greenhouse and hydroponic conditions, *J Struct Biol 194*, 292-302.

[3] Natalio, F. (2018) Future Perspectives on Biological Fabrication and Material Farming, *Small Methods*, 1800136.