Mariya Khodakovskaya, PhD

Nanomaterials: Changing the Future of Agriculture

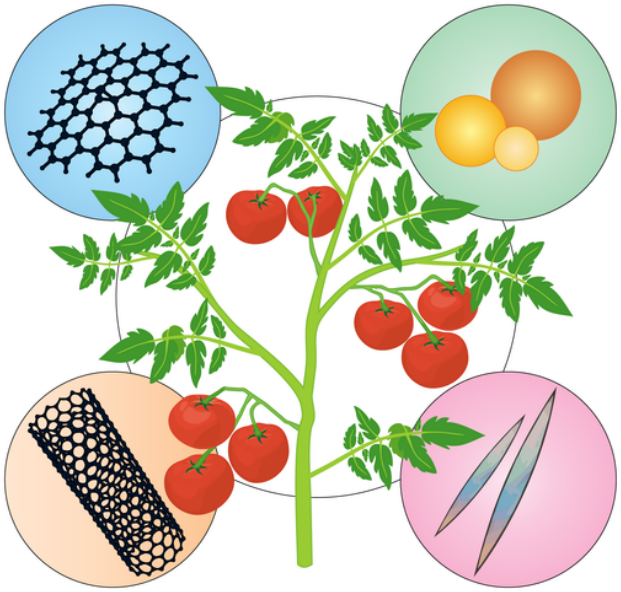
Arkansas Researcher Boosts Crop Productivity and Resilience

Dr. Mariya V. Khodakovskaya leads groundbreaking studies on enhancing crops through carbon-based nanomaterials–nano-sized structures composed of carbon atoms. Her approach is well-suited to address modern agriculture's challenges, resulting in more efficient crops that can feed a growing population. With a multidisciplinary team proficient in genetic engineering, molecular biology, and nanotechnology, Dr. Khodakovskaya leads innovative efforts to unlock the potential of nanomaterials for improving plant resilience to environmental stressors.

Dr. Khodakovskaya is a Professor of Plant Biology and Director of the Applied Science Graduate Program at Donaghey College of Science, Technology, Engineering and Mathematics, University of Arkansas at Little Rock (UALR). She is also the Founder and CEO of Advanced Plant Technologies, LLC.

The Challenge

The global agricultural industry faces unprecedented pressure to sustainably produce food for a rapidly expanding human population amidst escalating environmental challenges. According to the 2022 United Nations report, the world population is projected to increase by an additional 0.5 billion people by 2030, necessitating a 70% increase in overall food production by 2050.



Climate change has exacerbated environmental stressors, leading to significant yield losses in crops. For example, severe drought conditions in Fall 2022 affected 57% of Arkansas land—the highest in five years. Current agricultural methods struggle to cope with these challenges, with environmental stresses accounting for yield losses ranging from 50% to 70%.

Researchers have explored various approaches to enhancing crops' resilience to drought, including agrochemicals, novel breeding techniques, and genetic engineering. However, these methods often have drawbacks, such as high costs and environmental risks.

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The Solution

Dr. Khodakovskaya's research offers hope amidst these challenges. She and her team have found that carbon-based nanomaterials can enhance seed germination, plant productivity, and tolerance to environmental stresses. Studies have found that seeds treated with carbon nanotubes germinated several days early with an overall high germination rate. Likewise, fertilization with carbon nanotubes doubled the production of flowers and fruits. Additionally, plants exposed to carbon nanotubes or graphene could withstand harmful environmental conditions such as salt stress and drought for a longer time.

These results are similar to those of genetic engineering, and this approach is safe for both people and the environment. Dr. Khodakovskaya's group and collaborators from UAMS and TAMU demonstrated that a small amount of carbon-based nanomaterials absorbed by plants as a result of fertilization is insufficient to cause any toxicity in mice.

The potential applications of carbon-based nanomaterials are vast and range from improving seed germination and biomass production to protecting plants against environmental stressors like drought. Developing "Green Nano" strategies, which use biodegradable nanopolymers derived from plant sources, makes the process even more sustainable.

Next Steps

Looking ahead, Dr. Khodakovskaya's team is committed to advancing the field by establishing scalable platforms for the efficient and sustainable utilization of nanomaterials in agriculture. They hope to fine-tune nanomaterial formulations to be more effective, ensure their biodegradability, minimize environmental impacts, and foster transparent communication to build public trust in these innovative solutions.

To continue to drive nanotechnology's adoption in agriculture, Dr. Khodakovskaya needs continued collaboration with industry partners and stakeholders such as farms, food-producing companies, seed companies, and federal regulatory agencies.

Dr. Khodakovskaya's visionary leadership, coupled with UALR's cutting-edge research infrastructure and collaborative ethos, positions them at the forefront of agricultural innovation, poised to shape a more resilient and sustainable future for global food systems.

Contact

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