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First Name: **Xiaohan** Last Name: **Yang**

Title: **Senior Staff Scientist**

Institution: **Oak Ridge National Laboratory**

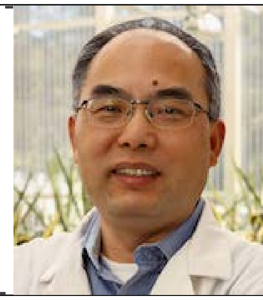
Mailing Address: **1 Bethel Valley Road**

Building 1507, Room 208

City: **Oak Ridge** State: TN Zip Code: 37831-6407

Country: USA

Country Code: 1 Phone: (865) 241-6895



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Email: yangx@ornl.gov Website: https://www.ornl.gov/staff-profile/xiaohan-yang

Education:

PhD: Cornell University

MS: Huazhong Agricultural University BS: Huazhong Agricultural University

General Areas of Expertise:

- Plant synthetic biology and genome editing, with a ocus on water-use efficient photosynthesis for sustainable food and bioenergy production in dry areas and marginal lands
- Plant genomics and bioinformatics, with a focus on genome sequencing and evolutionary genomics related to crassulacean acid metabolism (CAM) photosynthesis
- Plant-microbe interactions, with a focus on the molecular basis of beneficial symbiosis between plants and microbes

Short Bio:

Dr. Xiaohan Yang is a Senior Staff Scientist in the Biosciences Division at Oak Ridge National Laboratory (ORNL). He has more than 70 publications including papers in Nature, Nature Biotechnology, Nature Genetics, Nature Plants, Nature Communications and Genome Research. His current research focuses on crassulacean acid metabolism (CAM) that is a biological innovation allowing plants to thrive in water-limited environments such as arid deserts and areas with a pronounced seasonal drought. Dr. Yang leads a research team at ORNL to engineer CAM using synthetic biology approach for the purpose of improving water-use efficiency of bioenergy feedstocks. His team develops new tools for synthetic biology research, such as high-throughput assembly of various DNA parts into genetic circuits, precise temporal control of plant gene expression using optogenetics approaches, and in-planta stacking of a large number of genes into a single genomic locus. He leads the international efforts to sequence the genomes of two important CAM models (Agave and Kalanchoe). Also, his research team has done pioneering work in the discovery of plant small secreted proteins involved in the plant-fungus symbiosis.

Five Representative Publications:

1. Yang X, Hu R, Yin H, Jenkins J, Shu S, Tang H, Liu D, Weighill DA, Yim WC, Ha J et al. (2017) The Kalanchoë genome provides insights into convergent evolution and building blocks of crassulacean acid metabolism. Nature Communications 8: 1899. doi:10.1038/s41467-017-01491-7
2. Abraham, PE, Yin H, Borland AM, Weighill D, Lim SD, DePaoli HC, Engle N, Jones PC, Agh R, Weston, DJ et al. (2016) Transcript, protein and metabolite temporal dynamics in the CAM plant Agave. Nature Plants 2: 16178.
3. Liu D, Hu R, Palla KJ, Tuskan GA, Yang X (2016) Advances and perspectives on the use of CRISPR/Cas9 systems in plant genomics research. Current Opinion in Plant Biology 30: 70-77.
4. Yang X, Cushman JC, Borland AM, Edwards EJ, Wullschleger SD, Tuskan GA, Owen NA, Griffiths H, Smith JAC, De Paoli HC et al. (2015) A roadmap for research on crassulacean acid metabolism (CAM) to enhance sustainable food and bioenergy production in a hotter, drier world. New Phytologist 207: 491-504
5. De Paoli HC, Tuskan GA, Yang X (2016) An innovative platform for quick and flexible joining of assorted DNA fragments. Scientific Reports 6

FEWSTERN Symposium 2017 Presentation Title and Abstract:

Genetic Improvement of Crop Water-Use Efficiency and Yield for Sustainable Production of Food and Biofuels on Degraded and Non-Arable Lands

The dwindling supply of surface and ground water resources resulting from urbanization, increasing human population and changes in global climate imposes great challenges on the global security of water, food and energy. Because crassulacean acid metabolism (CAM) features CO_2 uptake through open stomata (specialized pores in the leaves of plants) at night when temperature is lower and stomatal closure during the daytime when temperature is higher to reduce water loss caused by evaporation, CAM photosynthesis plants (e.g., Agave, Kalanchoe) have much higher water-use efficiency (WUE) than C3 (e.g., rice, wheat) or C4 (e.g., corn) photosynthesis plants. Also, the temporal “CO_2 pump” in CAM plants can reduce the energy loss caused by photorespiration mediated by RUBISCO and consequently increase the grain and biomass yields. Currently there is an emerging interest in exploitation of the potential of CAM plants for food and bioenergy production. CAM provides an excellent opportunity for engineering both enhanced WUE and photosynthetic performance into C3 crops. Our research seeks to engineer CAM machinery into C3 photosynthesis crops using synthetic biology approach. To achieve this goal, we first identify biobricks from the CAM plant genomes. Then we assemble the biobricks into the CAM genetic circuits and engineer them into three C3 plant species (e.g., Arabidopsis, tobacco and poplar). This research has the great potential for increasing crop yield, reduce the water-consumption for crop production, and bioenergy/bioproduct, and consequently, making significant contribution to the water-food-energy security nexus.