Berkley J Walker

Berkley Walker is an Assistant Professor in Plant Biology at Michigan State University, USA. He leads a research lab which focusses on understanding how photosynthesis interacts with plant metabolism, with the aim of developing more efficient and nutritious crops.

Tell us about your background. How did you first become interested in plant science and photosynthesis?

My route to photosynthesis research was not direct! I was always going to go into business. I founded a granola bar company in high school and continued running it in college. I picked Microbiology as a major since it was interesting to me, and I figured it would give me technical expertise for a future job at a biotech company. After graduation, my experience running a granola bar company set me up to work as a product manager for a company that made instrumentation to test the properties of water in food and pharmaceutical products. While working in the marketing department I realized that the scientists in the company were having much more fun than I was and I decided this would be a better path for me. The company was located near Washington State University, and I basically went door to door to see which labs seemed to be the most interesting to work in. I loved the community of plant scientists and the integrative thinking required to think about photosynthesis research.

What is your lab working on currently?

My lab focuses on understanding how photosynthesis interacts with plant metabolism across many biochemical and physiological scales. Photosynthesis drives life on this planet by providing the oxygen, food and energy required to support "higher" life forms – including us humans. With increasing population, and accompanying changes in consumption and climate, it is vital to understand how photosynthesis will respond to these greater challenges and to explore opportunities to hack it to produce more food, fuel and fiber more sustainably. Research in our lab therefore focuses on resolving the biochemical, cellular and canopy-level mechanisms that determine photosynthetic fluxes of energy, carbon and oxygen with the end goals to better model plant responses to climate change and to engineer more efficient and nutritious crops.

What does a typical day look like for you?

My typical day involves waking up, helping the kids get off to school, then biking to work. I dedicate two days a week to meeting one-on-one with those in my lab, and the rest of the week is split between meetings, teaching, emails, and writing. Sometimes I get to help troubleshoot a piece of equipment or help set up a new experimental apparatus, but those days are becoming further apart.

Above: Berkley pauses from taking leaf punches for metabolic or enzymatic analysis to smile for the camera. *Below (second page):* Berkley tightens some fittings on the gas mixing system for the tunable diode laser. (Image credits: Chelsea Mamott).

What do you most enjoy about your work?

There have only been a handful of days since leaving my job as a product manager that I have not been excited to go to work. Of course, there are long-term challenges (see below) that can cloud a career in academic science, but I look forward to the actual day-to-day tasks that I have on my calendar. I enjoy the variety of tasks the most, along with the general liberty to pursue the path I think is best. If I want to think about big-picture concepts and directions, I can work on a grant application. If I want to focus on a specific problem or interpreting a specific dataset, I can work on a paper with a student or a postdoc. If I want to catch up on the latest results from other labs, I can read a paper. If I want to improve my department or teaching, I can work on committee assignments or revising course content. While the temptation is to feel overwhelmed by so many choices and feel that you are not doing your best by not doing them all, I have learned to accept the fact that I will never be able to do everything 100% and instead be happy for any contribution I can make

What do you find most challenging?

One of the biggest challenges I feel is the responsibility to those who I train and teach. The students and postdocs in my lab work hard to help elevate the profile of the lab and I want to make sure that they are prepared for their future careers as a result. This is especially a challenge within an academic research environment that does not explicitly train scientists for all the jobs that are out there. I feel the same pressure in my teaching, "Is my lesson content giving students value relative to their tuition fees?" This is especially true in the US where tuition even at State run schools can be ~$15,000 per semester!

What is your lab hoping to work on in the future?

The connection between photosynthesis and downstream metabolism, especially pathways related to plant and human nutrition. There has been a lot of focus on recent successes in improving photosynthetic efficiency, but it is easy to forget that malnutrition is just as important a problem in many areas as starvation. I have also recently been interested in how photosynthesis needs to adapt to changing demands from synthetic pathways.

> "One of the biggest challenges I feel is the responsibility to those who I train and teach"

We assume that photosynthesis will always be able to supply the carbon and energy that we need for whatever pathway we plug into it, but that may not always be the case.

What advice would you give to aspiring scientists in this area?

Become the captain of your ship, especially regarding the training you need to get the job of your dreams. The PhD training is not designed to train you in skills that are marketable, only in skills that are publishable. Inform your decisions on labs to work in, research projects to start, and specific approaches to take by scouring job postings in your field and sector of interest. This is applies whether you are interested in industry, academic or government jobs. That being said, I would recommend always selecting supportive mentors over promising projects.

Who are your scientific heroes?

Harry Nyquist, a Swedish-American electrical engineer at Bell Labs. Bell Labs was the research lab for AT&T and scientists there invented the transistor, solar panels, cellular phones and fiber optic communication. But Harry Nyquist did not invent any of those things, although he had several great discoveries of his own. Harry Nyquist's claim to fame is that when the patent lawyers of Bell Labs determined what made some researchers so much more productive in terms of patents than others, they found the common thread was that they all had lunch with Harry Nyquist. Harry Nyquist asked great questions that brought out the best in others.

Selected Publications from SEB Journals.

Bao H, Morency M, Rianti W, Saeheng S, Roje S, Weber APM, Walker, BJ. 2021. Catalase protects against nonenzymatic decarboxylations during photorespiration in *Arabidopsis thaliana*. Plant Direct 5, e366.

Betti M, Bauwe H, Busch FA, Fernie AR, Keech O, Levey M, Ort DR, Parry MAJ, Sage R, Timm S, Walker B, Weber APM. 2016. Manipulating photorespiration to increase plant productivity: recent advances and perspectives for crop improvement. Journal of Experimental Botany 67, 2977–2988.

Fu X, Walker BJ. 2022. Dynamic response of photorespiration in fluctuating light environments. Journal of Experimental Botany 74, 600-611.

Walker BJ, Cousins AB. 2013. Influence of temperature on measurements of the CO_2 compensation point: differences between the Laisk and O_2-exchange methods. Journal of Experimental Botany 64, 1893-1905.

Zamani-Nour S, Lin HC, Walker BJ, Mettler-Altmann T, Khoshravesh R, Karki S, Bagunu E, Sage TL, Quick WP, Weber APM. 2021. Overexpression of the chloroplastic 2-oxoglutarate/malate transporter disturbs carbon and nitrogen homeostasis in rice. Journal of Experimental Botany 72, 137–152.