

Research Viewpoint USA: next frontiers in crop enhancement technology

Professors Larry Purcell and Felix Fritschi are key members of the independent Plant Impact Scientific Advisory Network (SAN). Here they discuss their US-based work and their thoughts on advancing understanding of plant responses, particularly in relation to crop enhancement technologies.

1 What is the focus of your current research?

Prof Felix Fritschi

Advancing our understanding of plant responses to abiotic stress is central to my research program. My team at the University of Missouri is currently focusing on the physiology of plant adaptation to drought and heat stress specifically. Our research encompasses the study of whole-plant responses with emphasis on roots and expanding to rhizosphere and the microbiome. As crop enhancement products can help plants to mitigate the effect of abiotic stress, my membership of the Plant Impact SAN is a good fit.



Prof Larry Purcell

Like Felix, a large portion of my research is targeted towards understanding plant responses to the environment, particularly drought and nutritional stresses. Central to my lab's research is the idea that there are untapped genetic differences in germplasm collections that can be exploited to improve crop performance provided that these favourable traits can be identified and efficiently transferred. Hence, a focus of my lab's research includes developing and applying methods to screen rapidly large numbers of genotypes in stressful field environments and associating the responses among these genotypes with molecular markers that serve as 'tags' for genes that are beneficial. Identifying molecular markers associated with the beneficial genes makes it easier to transfer the genes to high-yielding, adapted varieties.



2 What do you see as the big unanswered questions in understanding plant responses to help close the crop yield gap in soybeans?

Felix

Modern agricultural science has advanced our understanding and the use of plant genetics, and has developed and promoted good management practices. Together these improvements have made a major impact on crop yields globally. I believe the next area of potential in reducing the yield gap is understanding interactions and synergies between genetics, crop inputs and management practices. How do they work together and how can we effectively utilise them to optimize yield?

For example, we know about genotype by environment interactions but we often overlook synergies between genetics, different inputs such as biostimulants, and management practices. After all, the green revolution saw use of novel genetics to improve yields but the major improvement for the grower was delivered when those new seeds benefited from an improved response to fertilisers.

Larry

I'd agree. Next, we also need to increase our understanding of the limitations to crop yields under specific environmental conditions. As Felix mentioned, the understanding of genetic, environment, and management interactions is key to overcoming yield limitations. Because there are infinite combinations of these three-way interactions, understanding *how* crop enhancement products affect the plant is critically important. I believe that advances in understanding plant responses will enable us to target technologies, such as crop enhancement products, to specific environments that will have increasingly reliable positive impacts on crop performance under common abiotic stresses.

3 What do you see as the next frontier in the development of crop enhancement technology?

Felix

I can see many opportunities for this novel technology. Research so far is promising as a way to sustainably enhance yields, potentially reduce the use of other inputs and cut costs.

However, we need to understand more about the mode of action of biostimulants so that we can target their use effectively. Then we can minimise risks and maximise the chances of beneficial outcomes. Work is underway and key developments will come from understanding physiological responses to these new inputs. But I am keen to learn how environmental conditions are affecting those interactions too.

Larry

This is a developing area and I too can see real opportunities ahead. One of the biggest but simplest benefits of crop enhancement products in my view is ease of application. They can be paired with current production practices. This means that application costs are eliminated and any economic impact is a win-win for the farmer.

A potential frontier though is grower adoption and that won't happen without trust. There are a tremendous number of products on the market promising yield improvement but some have virtually no data to substantiate their claims. The best choices offer a clear, unbiased demonstration of efficacy.

Growers are bombarded with all sort of supplements, foliar fertilizers, stimulants, biologicals, and there is little scientific evidence that many of these products are effective in increasing yield. There can also be confusion over the distinction between crop enhancement products and other products that are on the market. However, whatever the label, demonstration of efficacy by unbiased scientific trials is essential to cut uncertainty for growers and build trust in this new type of input.

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