Science Societies

Research update: bean roots

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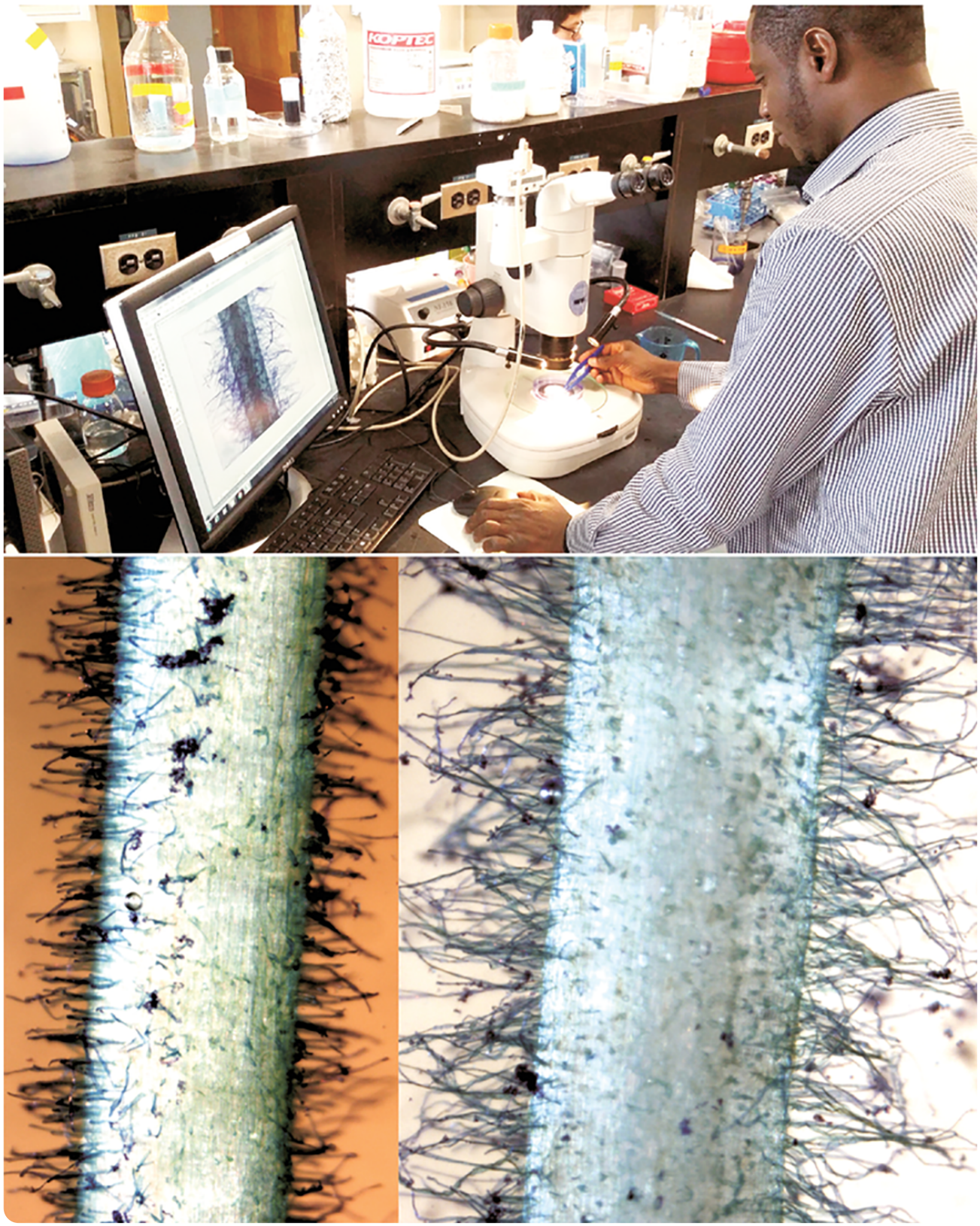

Top: Saba Mohammed measures cowpea root phene from different growth stages, scoring root system architecture phenotypes of field-grown cowpea plants at the Roots Lab at Penn

State. Bottom: Contrasting root hair length observed among cowpea genotypes after 14 days of growth on germination papers. On the left, root hairs are short and dense while on the right, root hairs are long and dense. Photos courtesy of Saba Mohammed.

Back in January 2021, we told you about **a phenotyping method called "shovelomics"** that's helping plant breeders select for an (ordinarily) overlooked portion of the common bean: its roots. The Roots Lab at Penn State is back again, along with collaborators at Ahmadu Bello University and the International Institute of Tropical agriculture, with a **new study** in *Crop Science* detailing root phenotyping in cowpea.

Like common bean, cowpea is frequently grown by subsistence farmers in poor soils, under drought stress, and with little access to inputs. Cowpea yields for these farmers average 600 kg ha^{-1}—one fifth the plant's genetic yield potential of 3,000 kg ha^{-1}. But cowpea is a gifted grower even under minimal water supply as long as it has an adequate amount of phosphorus. Researchers wanted to see if they can breed a plant that more effectively scavenges phosphorus and water from the soil by selecting for root architecture.

Though a well-trained scientist can use shovelomics and phenotype roots fairly quickly, it relies on selection of mature plants. The Roots Lab's new study sees researchers evaluating 14-day-old seedlings for specific root architecture and then planting seedlings out and seeing how the root systems of full-grown plants compare.

The team discovered that certain phenotypes were related to shallow soil exploration, which favors the uptake of phosphorus. Selecting for seedlings with longer taproots

and a larger number of basal and lateral roots may help create an adult root system with both depth to reach deep water sources and the ability to scavenge shallow-soil phosphorus. Plus, they found that selecting for longer root hairs with higher densities can help plants combat drought stress.

Now, with a better understanding of how a seedling's root system corresponds to the developed plant's root architecture, researchers can make selection decisions in the lab long before they plant out whole populations in the field. This study lays the groundwork for a selection method scientists could adapt and potentially apply to a variety of different agronomic crops.

Dig Deeper

For more detail about phosphorus, shovelomics, and common bean, check out the original *CSA News* article, "Breeding Beans for Better Roots" here: **https://doi.org/10.1002/csan.20369**.

Read the new *Crop Science* study from the Roots Lab, "Phenotyping Cowpea for Seedling Root Architecture Reveals Root Phenes Important for Breeding Phosphorus Efficient Varieties" here: **https://doi.org/10.1002/csc2.20635**.

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