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Modern soybean breeding has indirectly created plants with larger, less plastic roots

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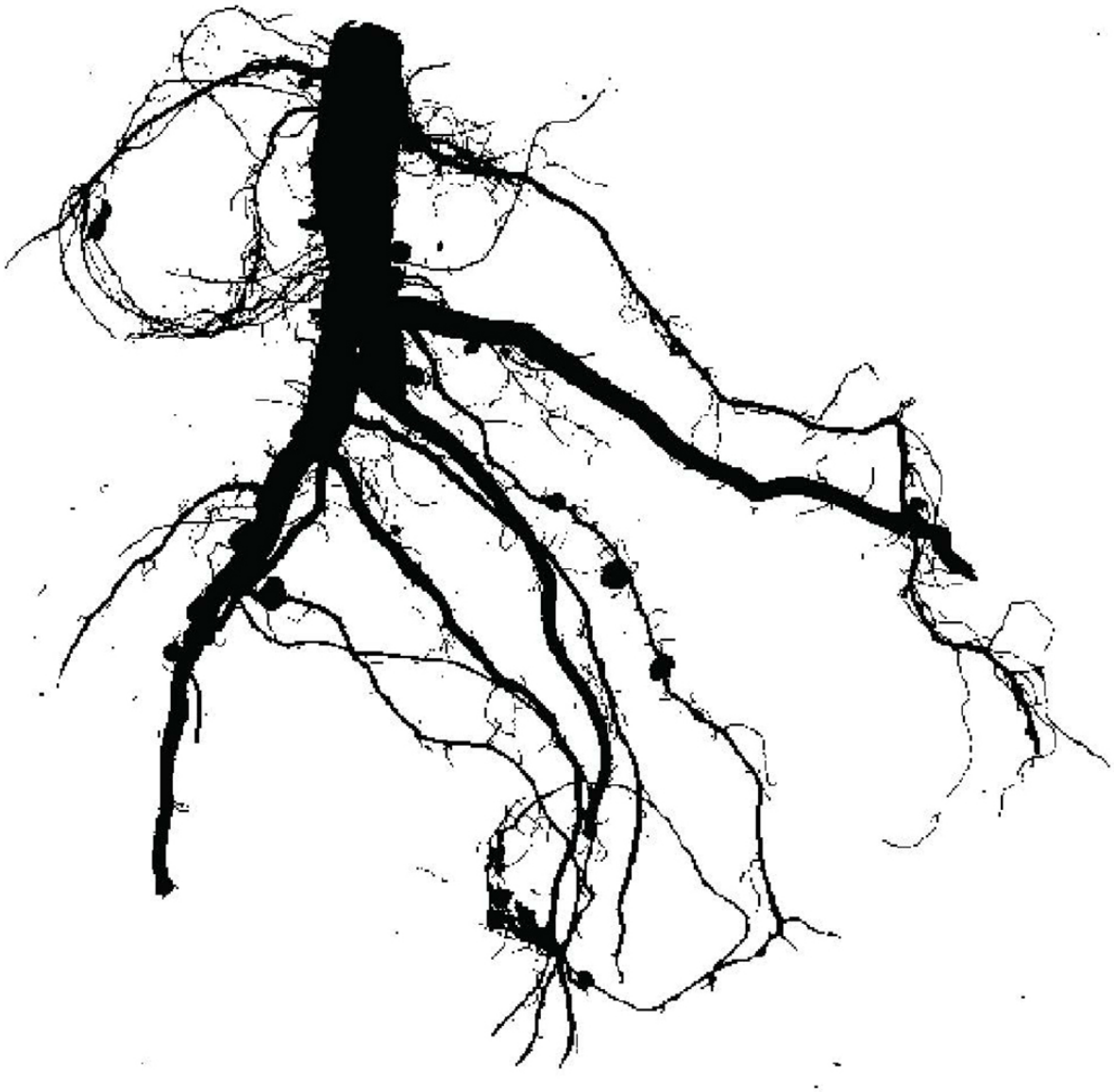

Two-dimensional (2D) imaging of soybean root system. Image courtesy of Sujata Bogati, first author on the study.

Modern crop improvement has largely focused on aboveground traits, yet root systems play a central role in water and nutrient uptake, anchorage, and stress

resilience. Characterizing how breeding has indirectly shaped root system architecture (RSA) is important as crops face more variable climate conditions. In soybean, it is unclear whether modern soybean breeding has systematically altered RSA and whether modern elite breeding lines differ from more diverse germplasm in their ability to adjust root traits across environments.

To address these questions, a team based out of Purdue University grew 24 soybean genotypes (eight elite breeding lines and 16 diverse accessions) in two contrasting soil environments. Whole root systems were sampled across three developmental stages. A total of 432 root systems were phenotyped using 2D imaging, and a subset was evaluated with a new low‐cost 3D photogrammetry method. Researchers found that elite lines generally developed larger root systems while diverse lines exhibited markedly greater plasticity, particularly in traits such as maximum taproot diameter, lateral branch length, and root tip number. Clay loam soils also reduced key root size traits by 14–23% relative to sandy loam.

These findings suggest that modern breeding has favored larger but less phenotypically plastic root systems. The findings also indicate that breeders should consider RSA in their breeding programs to improve crop health and resilience against stress.

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Bogati, S., Carpenter, J., Jung, J., Schafer, S., Danao, J., Woods, E., Song, Q., Kantar, M., Ma, J., & Wang, D. R. (2025). Divergence of root system plasticity in soybean between modern breeding lines and diverse germplasm accessions. *Crop Science*, 65, e70190. https://doi.org/10.1002/csc2.70190

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