Title:	Systems genomics approaches provide new insights into Arabidopsis thaliana root growth regulation under combinatorial mineral nutrient limitation
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Abstract:	The molecular mechanisms by which plants modulate their root growth rate (RGR) in response to nutrient deficiency are largely unknown. Using Arabidopsis thaliana accessions, we analyzed RGR variation under combinatorial mineral nutrient deficiencies involving phosphorus (P), iron (Fe), and zinc (Zn). While -P stimulated early RGR of most accessions, -Fe or -Zn reduced it. The combination of either -P-Fe or -P-Zn led to suppression of the growth inhibition exerted by -Fe or -Zn alone. Surprisingly, root growth responses of the reference accession Columbia (Col-0) were not representative of the species under -P nor -Zn. Using a systems approach that combines GWAS, network-based candidate identification, and reverse genetic screen, we identified new genes that regulate root growth in -P-Fe: VIM1, FH6, and VDAC3. Our findings provide a framework to systematically identifying favorable allelic variations to improve root growth, and to better understand how plants sense and respond to multiple environmental cues.
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