Rootstock x environment interaction shapes shoot system phenotypic variation in grafted 'Chambourcin'

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Abstract (250 words)

Recent advances in phenomics and transcriptomics have the enhanced capacity for understanding how clonally propagated perennial crops like grapevines respond to their environments seasonally and over the course of multiple years. Because most grapevines are grafted, above-ground grapevine traits reflect scion genotype and its interaction with the local environment. In addition, traits expressed by the scion reflect rootstock genotype and how that rootstock is interacting with its environment seasonally and across years. To investigate rootstock x environment interaction on shoot systems in grafted grapevines we characterized comprehensive phenotypic variation in an experimental vineyard in Mount Vernon, Missouri, USA where the grapevine cultivar 'Chambourcin' is growing on its own roots and is grafted to three different rootstocks ('1103P', '3309C', 'SO4'). This set of four combinations is replicated 72 times in a randomized block experimental design with an irrigation treatment. Over the course of three years we quantified leaf elemental concentration, leaf transcriptome, leaf metabolome and epigenome, among others. Analyses in the 'Chambourcin' vineyard reveal extensive and dynamic phenotypic variation in 'Chambourcin' that reflects complex interactions among rootstock genotype, irrigation, season, and year. Specific effects of rootstock genotype on gene expression and elemental concentration were detected and vary with season and year. Variation in ion concentrations is also influenced by leaf position along the vine. This comprehensive, multi-year project demonstrates the importance of root system variation for shoot system morphology and suggests future exploration of rootstock genotypic diversity might offer a novel source of variation for shoot system phenotypic manipulation.

Keywords: grafting, phenotyping, transcriptomics, epigenomics, ionomics