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Agroecological approaches to mitigate increasing limitation of corn yields by water availability

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Abstract

A key strategy for climate change adaptation in the rain-fed northern Corn Belt is to decrease cropping system vulnerability to changes in precipitation patterns by building resilience. Using 50- year of county level yield and environmental data from Iowa and Ontario, we first demonstrate that sensitivity of corn yield to precipitation, particularly in July and August, has increased over the past five decades despite no changes in precipitation patterns. This can be attributed to steady improvement in corn yield potential and so plant water demand since the mid-20th century and removal of non-water constraints to crop production. Such vulnerability of corn-based cropping systems to water limitations is of increasing concern as climate change models predict higher summer temperatures and year-to-year variations in precipitations in this region. As suggested in the ecology literature, increasing agroecosystem temporal and spacial diversity is one of the key management strategies to deal with impending weather variability. Using yield and environmental data from a 30-year long-term rotation and tillage trial in Ontario, we show that diversification of short corn-based rotations using small grains and forage crops increases corn yield stability and resilience to both limiting and excess soil moisture[1]. We also demonstrate the importance of conservation tillage and measured the impact of rotation and tillage history on plants ability to access water resources, plant available soil water and their combined effects on timing of physiological water stress and grain yield when drought occurs at reproductive stages. Our results emphasize the growing importance of developing strategies for managing soil moisture in rain-fed regions and the significance of agroecological approaches to develop hardy agricultural systems and protect food and feed production against the upcoming extreme weather events.

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