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Precipitation and δ13C Variation in Pearl Millet

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Accurate paleodietary reconstruction requires a baseline of $\delta^{13}C$ values characteristic to different C_4 plant varieties that accounts for isotopic variability in response to environmental conditions. The relationship between precipitation and carbon isotope ($\delta^{13}C$) variation in C_3 plants has been well examined, though C_4 plants—which are thought to be less sensitive to environmental variables—have received comparatively little attention. This study aimed to provide an understanding of the relationship between precipitation and $\delta^{13}C$ values in the seeds of pearl millet (*Pennisetum glaucum*), a C_4 cereal. Varying degrees of water restriction were imposed on 75 millet plants from five regional accessions. Three water treatment groups were maintained at average soil moisture levels of 0.43 m^3/m^3, 0.21 m^3/m^3, and 0.16 m^3/m^3, respectively. Using a generalized linear model, I found that seed $\delta^{13}C$ was significantly positively correlated with water availability, such that $\delta^{13}C$ was enriched by 0.21 ± 0.04‰ for each 0.1 m^3/m^3 increase in soil moisture. As the precipitation-$\delta^{13}C$ relationship is contrary to the established trend for C_3 plants, these findings suggest that C_3 and C_4 plants respond differently to water stress. Responses to water treatment were not significantly different between accessions, however sample origin (accession) was a significant predictor of $\delta^{13}C$. Investigation of potential explanations for the observed relationship between accession and $\delta^{13}C$ provided indication that adaptations to local environment could be a strong contributing factor. These findings highlight the role of regional differences in dictating $\delta^{13}C$ variability in millet and reaffirm the need for continued investigation of C_4 responses to environmental change.