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Lily Sanborn

Washington University in St. Louis

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PRECIPITATION AND $\delta^{13}\text{C}$ VARIATION IN PEARL MILLET

Lily Sanborn

Mentors: Rachel Reid and Alex Bradley

Accurate paleodietary reconstruction requires a baseline of $\delta^{13}\text{C}$ 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 ($\delta^{13}\text{C}$) 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 $\delta^{13}\text{C}$ 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 $0.43 \text{ m}^3/\text{m}^3$, $0.21 \text{ m}^3/\text{m}^3$, and $0.16 \text{ m}^3/\text{m}^3$, respectively. Using a generalized linear model, I found that seed $\delta^{13}\text{C}$ was significantly positively correlated with water availability, such that $\delta^{13}\text{C}$ was enriched by $0.21 \pm 0.04\text{‰}$ for each $0.1 \text{ m}^3/\text{m}^3$ increase in soil moisture. As the precipitation- $\delta^{13}\text{C}$ 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 $\delta^{13}\text{C}$. Investigation of potential explanations for the observed relationship between accession and $\delta^{13}\text{C}$ provided indication that adaptations to local environment could be a strong contributing factor. These findings highlight the role of regional differences in dictating $\delta^{13}\text{C}$ variability in millet and reaffirm the need for continued investigation of C_4 responses to environmental change.