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"Filling gaps and removing traps
for sustainable resource management"

Can Intercropping Increase Climate Resilience of Smallholder Dryland Cropping Systems? Insights from Experimentation and Modelling

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Abstract

With the potential threat of more frequent climate extremes putting semi-arid crop production in jeopardy, there is a need to establish more resilient cropping systems. Intercropping is often practised by farmers in such regions, but to what extent and how can it be a viable option for future conditions? As field testing complex adaptation strategies in well-controlled environments is often difficult, we opted for a different approach: combining experimentation and modelling. A field trial was run in semi-arid India over a two-year period (2015 & 2016) in the dry season. These trials tested a split-plot designed experiment with four replicates, assessing the performance of sole versus intercropped stands, with two densities (30 cm & 60 cm between row spacing), and three drip irrigation treatments (severe stress, partial stress, and well-watered). Under low rainfall conditions, results showed that total grain yields were in-line with the irrigation treatments applied. Intercropping pearl millet led to a significantly lower total grain yield in comparison to the sole equivalent. Pearl millet achieved 1.1 t/ha when intercropped and 2.5 t/ha when grown as a sole crop. Cowpea yielded 0.8 t/ha when intercropped, and 0.8 t/ha as a sole crop. From this study, we can conclude that even when temperatures exceed 43°C crops produce reasonable yields when irrigated. In terms of pearl millet production, sole as opposed to intercrop cultivation could be more suitable. Such experiments during the dry season are arguably an opportunity for testing cropping strategies under extreme but real-world conditions.

Subsequently, we used the above-described detailed data in conjunction with the agro-ecosystem model APSIM. Linking such experimental data with models is important to evaluate models that can be applied to explain and quantify the performance of such systems. Model performance was satisfactory and reproduced the effects of density, irrigation and year on the variables chosen. Plant height proved to be crucial for model evaluation. Simulation experiments were conducted to further evaluate plant densities, as well as genetic traits. Our combined approach is capable of improving intercropping strategies, through understanding the processes that determine interactions between specific environments and management practices.

Keywords: Cereal-legume intercropping, climate-smart, model improvement, sensitivity analysis

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