

Global synthesis of drought effects on food legume production

Stefani Daryanto, Lixin Wang, Pierre-André Jacinthe

Department of Earth Science

Indiana University Purdue University Indianapolis

Food legume crops play important roles in conservation farming systems, contribute to human nutrition and food security, yet in many regions of the world, their production has been adversely affected by drought. Currently, it remains unclear how the effects drought co-vary with legume species, soil texture, agroclimatic region, drought timing and intensity. To address these uncertainties, we collected literature data (1705 data points, averaged into 676 data points) between 1980 and 2014 that reported monoculture legume yield responses to drought under field conditions and analyzed this extensive data set using meta-analysis techniques. We performed unweighted analysis using the log response ratio (lnR) to calculate the bootstrapped confidence limits of those responses for each potential factor. Our results indicated that the amount of water reduction was positively related with yield reduction, but the extent of the impact varied with legume species and the phenological state during which drought occurred. Overall, field pea (*Pisum sativum*), groundnut (*Arachis hypogea*), and pigeon pea (*Cajanus cajan*) were found to experience lower yield reduction due to drought compared to legumes such as lablab beans (*Dolichos lablab*) or black grams (*Vigna mungo*). Although yield reduction was generally greater when legumes experienced drought during their reproductive stage compared to during their vegetative stage, legumes were sensitive to drought at all growth stages. Legumes planted in medium-textured soils also exhibited greater yield reduction compared to those planted in coarse- or fine-textured soils. In contrast, regions and their associated climatic factors were less associated with legume yield reduction. The study provides useful insights for legume agricultural planning and the direction of potential development of drought-resistant legume species to improve food security in the drought-prone regions of the world.

Mentors: Lixin Wang, Department of Earth Science, IUPUI; Pierre-André Jacinthe Department of Earth Science, IUPUI