Tropentag, September 11-13, 2024, hybrid conference

"Exploring opportunities ...
for managing natural resources and a better life for all"

Breeding that integrates soils and cropping systems: The key to boosting climate adaptation

Sieg Snapp[1], Jeffrey Herrick[2], Powell Mponela[3], Matthew Reynolds[4], Eva Weltzien[5], Mainassara Zaman-Allah[6]

[1] *CIMMYT, Sustainable Agrifood Systems, Mexico*
[2] *State Department, Food Security, United States*
[3] *CIMMYT, Nepal*
[4] *CIMMYT, Physiology and Remote Sensing, Mexico*
[5] *University of Wisconsin-Madison, Agronomy, United States*
[6] *CIMMYT, Global Maize Program, Zimbabwe*

Abstract

Recent articles have highlighted the importance of plant breeding for climate adaptation and prioritised specific traits for selection. What is often overlooked is the soil context, as agricultural expansion moves onto steep slopes that are highly erodible and degraded. Soil organic matter loss reduces soil moisture availablity, exacerbating the impacts of droughts. Food security is at risk, which adapted crops can help mitigate. We present here a strategy to use edaphic information, as the missing ingredient in efforts to breed crops for the future.

The strategy includes the following: First, locate crop variety trials on soils that are representative of the type and health of soils where the crops are produced, including soils with low infiltration capacity, and poor water and nutrient availabiity.

Second, as a corollary to above, monitor soils at trial sites, including documenting soil parent material, texture, fertility and soil organic matter content as part of the metadata for each crop trial site. Failure to do so makes it nearly impossible to quantify crop response by soil type, and to determine if yield gaps are due to differences in environment (including crop management), genotype and the interaction.

Third, priorisation of crop traits which have long-term soil health benefits such as root system mass, solubilisation of phosphorus, nitrogen fixation and nitrification inhibition. For centuries we have bred exclusively for traits that maximise harvestable production. While this focus has resulted in tremendous improvements in crop yields, it has provided few crop options for amelioration of soil health and nutrient efficiency.

Crop breeding efforts that include on-farm screening are becoming wide spread, and a relatively inexpensive indicators of soil status could be integrated. For example, crop residues can be quickly quantified with image analysis, and rapid field assessments of soil organic carbon and soil aggregate stability can predict soil function. Satellitebased phenotyping has breeding plot-scale resolution for RGB and vegetative indices (and more indices will follow). In sum, we propose to improve crop breeding efforts through quantification of soil properties, and through selecting for plant properties that ameliorate soil health

Keywords: Climate adaptation, crop improvement, on-farm, root traits, soil health

Contact Address: Sieg Snapp, CIMMYT, Sustainable Agrifood Systems, Texcoco, Mexico, e-mail: s.snapp@cgiar.org