Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

Genotypic response to multiple abiotic stresses: Nutrient densities and stability

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Abstract

Eleven genotypes of *Carthamus tinctorius*, *Cicer arietinum*, *Glycine max*, *Triticum* spp. (*aestivum* and *durum*), and *Zea mays*, respectively producing oil, proteins, oil-protein, carbohydrates-protein, and carbohydrates as the main biochemical seed components (Products) were subjected to four combinations of abiotic stresses imposed by manipulating planting dates and population densities (Management). Each genotype was planted in three replicates in RCBD on the same land area for three consecutive years as an additional edaphic stress [Phase I], followed by three more years in a crop rotation [Phase II]. Annually, three random plants per genotype and replicate were sampled at vegetative and physiological maturity stages. All samples were assayed for 10 nutrients, using LECO analyzer and ICP instrument. Temporal variation in nutrient density and stability were estimated using several multivariate statistical methods. Validation coefficients of determination [Q²] increased steadily from 25 [Phase I] to 53% [Phase II]. Invariably, Sulfur, Phosphorus, Zinc, and Copper, in decreasing order, were most important in determining the amount of explained variance. Abiotic stress significantly increased nutrient densities in 32, decreased it in 46, and did not affect it in 22% of the 50 nutrient-Product combinations. Temporal variation of nutrient densities decreased in 48, increased in 34, and remained stable in 18% of these nutrient-Product combinations. Carbon:Nitrogen ratio, as covariate, impacted nutrient densities, and stability of all nutrients; increased in carbohydrates, protein, and oil-protein; and decreased in oil. Nutrient densities averaged over Products discriminated between Phase I and Phase II [91.1 vs. 96.0% correct classification]. Discrimination between Products decreased from 73.5% in Phase I to 62.5% in Phase II. Carbohydrates, oil, carbohydrates-protein, and oil-protein, in decreasing order, exhibited the largest misclassification. Largest variation in nutrient densities was explained by Year x Product (Phase) [10-73%], followed by Year x Genotype (Products x Phase) [9-25%], thus illustrating the

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dynamic nutrient response to abiotic stress.

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Peer-review under responsibility of the organizing committee of the Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

Keywords: Abiotic stress; nutrient density; nutrient stability; validation models

References