A trait-based approach to understand and predict the performance of arable annual mixed crops.

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One of the challenges in low-input annual arable mixed crops (i.e. species and variety mixtures) is to determine which species / varieties go well together to improve overall system performance.

Theories coming from community ecology suggest that two ecological processes are particularly involved in mixed crops performance by improving resource use efficiency [1]. Niche complementarity can be quantified by the distance between target functional traits between two plants. Phenotypic plasticity can be quantified by the variance of target functional traits between cropping environments (including crop management). We aim to apply this ecological theory in an agronomical context by calculating these complementarity and plasticity metrics to predict crop yield of various mixed crops in different environments.

A plant trait database on wheat and pea mixtures was built, gathering ten experiments with various management practices over six years, localized in two French sites (Angers, Toulouse). Plant traits were measured dynamically (crop height, aerial biomass, nitrogen content) to quantify crop growth and development over key phenological stages and at harvest (yield, grain quality) to quantify crop performance.

Together with environmental (climate and soil) indicators we considered both trait by trait and multi-traits methods to analyze performance variability.

[1] Litrico and Violle (2015). Trends Plant Sci. 20, 604-613.