Genotype mixtures as a tool to develop sustainable agriculture? Elucidating the mechanisms that drive genotypic interactions in crops
Hélène Fréville, Pierre Roumet, Nicolas Rode, Marie-Helene Muller, Aline Rocher, Muriel Latreille, Jacques David

▶ To cite this version:
Hélène Fréville, Pierre Roumet, Nicolas Rode, Marie-Helene Muller, Aline Rocher, et al.. Genotype mixtures as a tool to develop sustainable agriculture? Elucidating the mechanisms that drive genotypic interactions in crops. 2. Joint Congress on Evolutionary Biology, Congress of the European Society for Evolutionary Biology (ESEB), Aug 2018, Montpellier, France. 1 p., 2018. hal-02787331

HAL Id: hal-02787331
https://hal.inrae.fr/hal-02787331
Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Genotype mixtures as a tool to develop sustainable agriculture? Elucidating the mechanisms that drive genotypic interactions in crops

FRÉVILLE H. (1), ROUMET P. (1), RODE N. (1, 2), MULLER M. H. (1), ROCHER A. (1), LATREILLE M. (1), DAVID J. (1)
(1) UMR AGAP, Montpellier FRANCE
(2) UMR CBGP, Montpellier FRANCE

Introducing genetic diversity within fields has been proposed as a way to take better advantage of ecological processes and develop more sustainable agrosystems with reduced chemical inputs. Indeed, beneficial effects of mixing varieties have been reported in the literature. However, lower performance of mixtures has also been documented. Negative interactions among genotypes may result from (i) kin selection that operates at the group level whenever interacting individuals are related, (ii) indirect genetic effects where the phenotype of an individual depends on the genes of its social partners. These mechanisms remain poorly explored in plants. In agriculture, it is well established that the phenotype of a plant is affected by the phenotype of its conspecific neighbors. Thus, social interactions are the rule. Moreover, human practices have decreased within-field genetic diversity, leading to high relatedness among plants. Because agriculture has been maximizing group performance and human selection has occurred among groups of related individuals, human selection may have acted as kin selection in crops. Kin selection may explain poorer performance of varietal mixtures compared to monocultures, whenever individuals express phenotypic plasticity in response to their genetic relatedness to neighbors and reduce competition with their kin. This can happen with kin discrimination whereby helping behavior is preferentially directed towards kin.

Using durum wheat as a model species, we conducted an experiment where plants were grown in groups of five with different levels of genetic relatedness, to test whether kin discrimination and IGEs may explain poorer performance of genotype mixtures. Our results do not support the occurrence of kin discrimination and reduced competition towards kin. Instead, group fitness was mostly driven by competitive interactions between genotypes, as evidenced by a negative correlation between direct genetic effects and indirect genetic effects.

Overall, our study calls for extending evolutionary approaches to address pressing issues in agriculture.