PRACTICE ABSTRACT

DIVINFOOD
Co-constructing interactive short and mid-tier food chains to value agrobioDIVersity IN healthy plant-based FOOD

Crop association with legumes: which advantages with minor cereals?

Problem

Varietal mixture involves sowing different varieties of the same species in the same plot for their agronomic complementarity (Enjalbert et al., 2019). Special attention must be paid to the complementarity of the growth cycles of different varieties. The evolution of mixed populations is random, and predicting and controlling the mixture's composition and proportion through trait selection is complex. Also, limited information is available on the consequences of combining certain traits on productivity and the evolutionary dynamics of mixed populations (Barot et al., 2017). The processing stage can also cause problems for producers, as quality requirements imposed by millers and processors hinder the adoption of wheat variety mixtures. Depending on the market, flour quality and composition are expected to vary, which is why many millers prefer to receive single-cultivated grains.

Solution

Research efforts are underway to identify a general strategy for creating optimised varietal mixtures. To design a mixture of several varieties, it is necessary to define the specific interactions between varieties as precisely as possible, as genetic diversity within a cultivated species does not always have positive effects on mixture performance.

To design effective varietal mixtures, efforts should focus particularly on the ability of multiple genotypes to interact and associate. Relative yields and variety competitiveness are estimated to reduce inter-varietal complementarities (Fig. 1)

Benefits

Varietal mixtures are valued for their robustness and their improvement in crop production without increasing inputs (Gaudio et al., 2019). They have been primarily studied to limit the spread of airborne diseases and they stabilise yields in the long term, despite climatic uncertainties.

By combining sensitive varieties with tolerant ones, the resulting mixture can better resist local pathogens while remaining productive.

Through interactions and complementarity created between varieties, increasing genetic diversity in fields can improve overall yield stability and reliability in unstable environments as is often the case where minor cereals are sown.

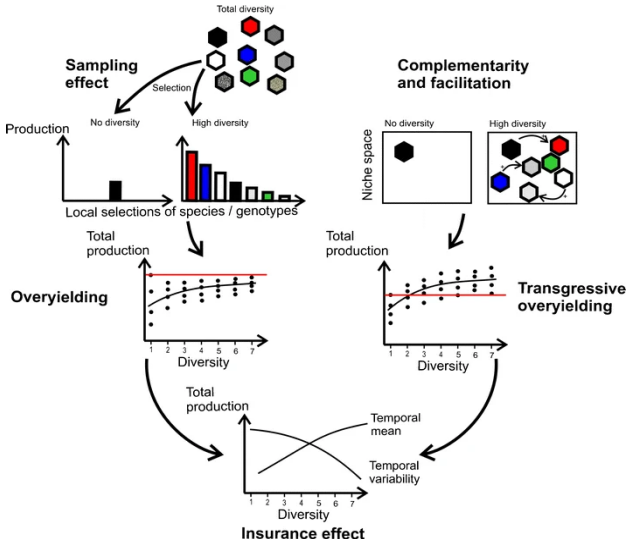

Figure 1 General description of the mechanisms through which biodiversity influences plant production (Barot *and al.*, 2017) - in the top left part of the figure, the two frames represent the total niche space. Hexagons represent species or varieties. In the histogram, each bar represents a species or variety. The red horizontal lines denote the maximum production of varieties growing in pure stands (only one species or one variety).

Practical recommendation

It is recommended to develop two complementary strategies to optimise variety mixtures by fostering the ecological mechanisms leading to a positive relationship between biodiversity and ecosystem functioning, and its stability over time, i.e., sampling and complementarity effects.

In the "trait-blind" approach, the design of high-performance mixtures is based on estimations of the mixing abilities of varieties. While this approach is operational because it does not require detailed trait knowledge, it relies on heavy experimental designs to evaluate mixing abilities .

The trait-based approach is particularly efficient to design mixtures of varieties to provide particular baskets of services, but it requires building databases of traits for crop varieties and documenting the relations between traits and services.

The evaluation of mixtures' performance is required in real economic, social, and agronomic contexts. (Barot *et al.*, 2017)

Further information

Further readings

Barot, S., Allard, V., Cantarel, A. *et al.* Designing mixtures of varieties for multifunctional agriculture with the help of ecology. A review. *Agron. Sustain. Dev.* 37, 13 (2017). https://doi.org/10.1007/s13593-017-0418-x

Enjalbert, J. *et al.* (2019) 'Mélanges variétaux et mélanges plurispécifiques – atouts et contraintes', *Innovations Agronomiques,* [Preprint]. https://hal.science/hal-02392165.

Gaudio, N. *et al.* (2019) 'Current knowledge and future research opportunities for modeling annual crop mixtures.', *Agronomy for Sustainable Development*. https://doi.org/10.1007/s13593-019-0562-6.

About this practice abstract and DIVINFOOD

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DIVINFOOD - Co-constructing interactive short and mid-tier food chains to value agrobioDIVersity IN healthy plant-based FOOD, is running **from March 2022** to **Feb 2027.**

The overall goal of DIVINFOOD (a multi-actor, participatory project) is to facilitate the use and increase the value of Neglected and Underutilised Crops (NUCs) in food chains to foster healthier diets and more sustainable food systems.

Project website: www.divinfood.eu

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