ETH zürich

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Mixed cropping: An alternative to monoculture in Switzerland

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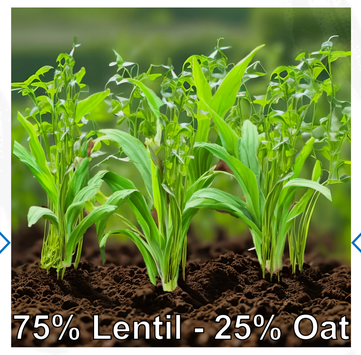
What is mixed cropping and how did we study it?

Mixed cropping is the **simultaneous cultivation of multiple species** in the same field. There are up- and downsides to it:

Lentil-Oat Mixture

Lentils
+ Fix nitrogen
+ Drought-resistant
- Low weed suppression
- Lodge strongly



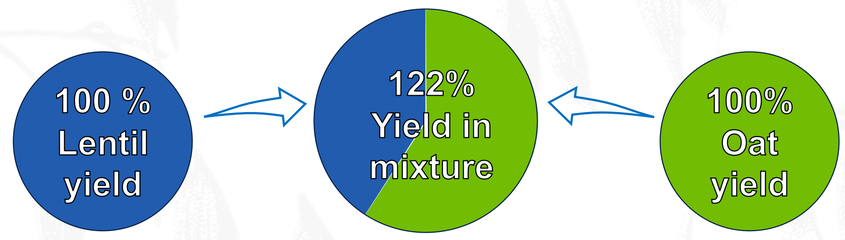
+ Lower lodging
+ More nitrogen for oats
+ Lower weed-pressure
+ Hedging function
- Different harvesting
- Competition of species

Oats
+ Efficient nitrogen use
+ Suppress weeds
+ Valuable nutrition
- Drought-susceptible

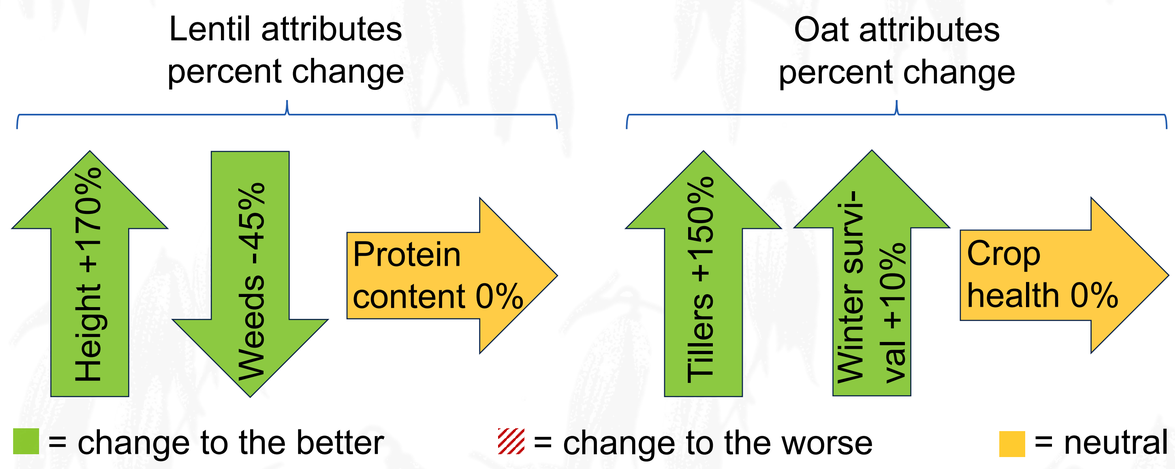
When the species and varieties match, mixing **increases** the system's **productivity** while **lowering** its **footprint**. Our experiment focused on how mixtures of oats (*Avena sativa*) and lentils (*Lens culinaris*) perform compared to their monocultures.

Higher productivity, equal quality, good plant health

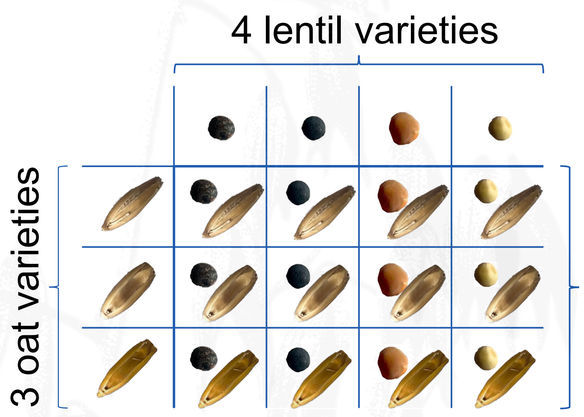
250'000 data points lead to a clear picture*: **Mixed cropping** of oats and lentils **improves most attributes**. The shortest oat variety is the best mixing partner to all lentils. **Fall-sown mixtures perform better**, given they survive winter well.



Across all mixtures, **yield is elevated by 22 percent** compared to monoculture, and by 60 percent in the best case (Beluga-Troll). The arrows below represent improvements in mixed cropping:



Design: 2 seasons x 2 years x 2 locations – 8 fields



22 treatments
6 x oat monoculture (3x fertilized and 3x not)
4 x lentil monoculture (unfertilized)
12 x pairwise mixtures (unfertilized)
4 replicates per field

Two fields were sown in fall, two in spring and repeated twice.

Fine-tuned mixed cropping improves the production

The identified ideal cropping partners (species & variety) **implemented in agriculture** reduce synthetic inputs, increase biodiversity and yields, thus **contributing to returning agriculture into the safe operating space** of our planetary boundaries. All of which is tied only to the extra effort of separating the harvested crop.


Ideal fall-sown mixture in May 2023

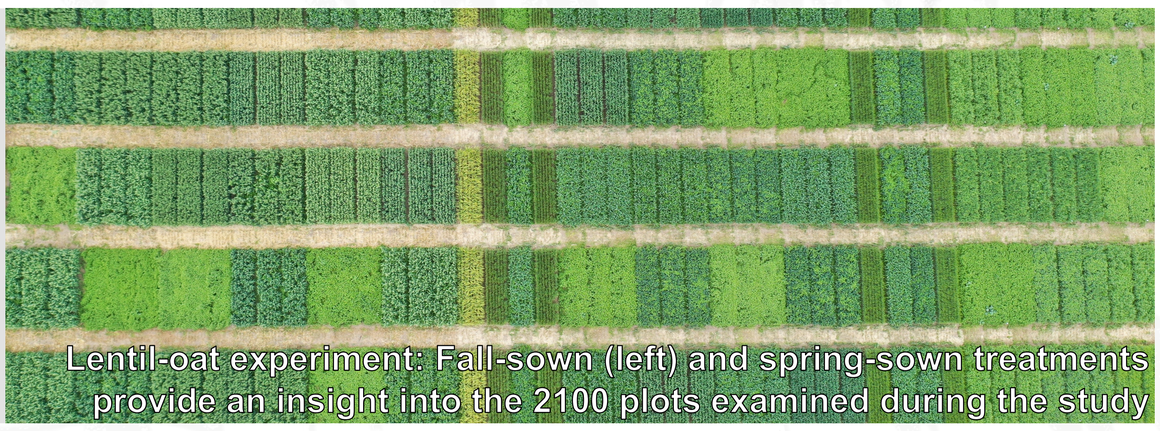
Forecasting mixing suitability based on our data trends: Plant height difference predicts mixing performance

Mixed cropping increases the systems' **tolerance to** climatic **extremes**, each crop exhibiting different response curves

This secures food production of at least one crop (hedging)

Predictors in finding the best combinations of species and varieties **lower** the **research effort**

We have observed strong **prediction power of height difference** that will facilitate crop selection in the future


Lentil-oat experiment: Fall-sown (left) and spring-sown treatments provide an insight into the 2100 plots examined during the study

Partner/Sponsor:

This study is part of the CROPDIVA project (Horizon 2020, grant agreement NO 101000847). © Pictures, Illustrations and Designs by Yannik Schlup. Lentil and oat illustrations by openart.ai, the illustrations are post-creation edited. Prompts upon request. *Some data is preliminary and the analysis of this year ongoing.