

Redesigning European cropping systems
based on species mixtures

Intercropping for boosting organic farming in Europe

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Challenges of organic farming



1. Improve, secure and stabilise yields of organic arable crops
2. Control weeds, diseases and pests by optimising biological regulations
3. Improve protein autonomy of organic farms
4. Improve the protein content of cereals
5. Save worktime and inputs



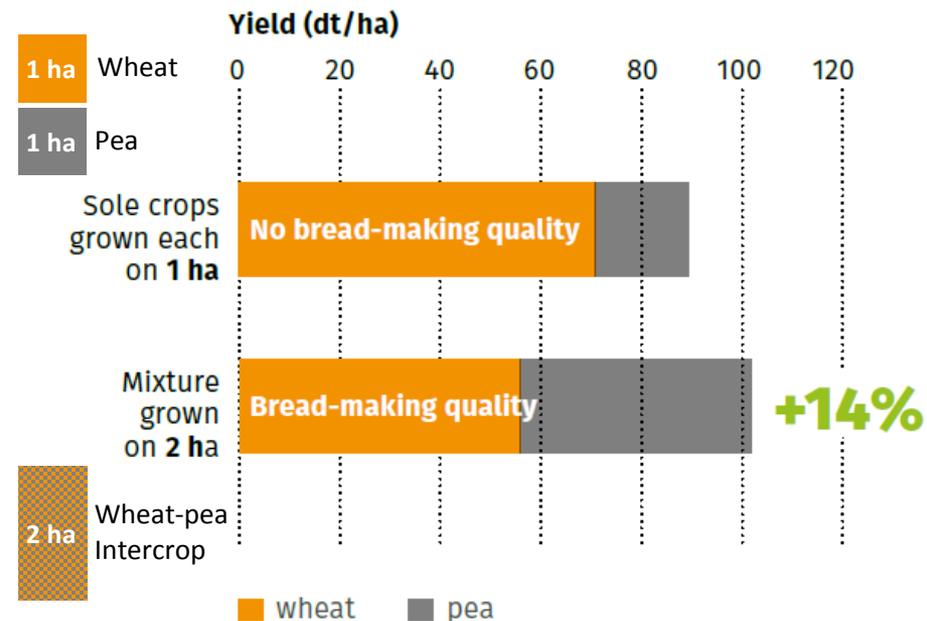
1. Improve, secure and stabilise yields of organic arable crops

Organic farming issues :

Lower yields than in conventional farming (20% on average)

Opportunities of intercropping :

- Increase yields and their stability due to complementary use of natural resources
- More stable income for farmers
- Reduction of the risk of no harvest (compensation if one crop fails)



Average yields obtained over 10 bread wheat varieties and 9 field pea varieties grown in sole crop and on the 90 corresponding mixtures (INRAE Rennes 2019 – organic farming – ReMIX Project)

2. Control weeds, diseases and pests by optimising biological regulations

Organic farming issues :

No synthetic molecules available in OF

⇒ More difficult management of plant health in OF than in CF

Opportunities of intercropping :

- Better use of natural resources and higher soil cover by the crop
⇒ Less water, nutrients and light available for weeds
- Natural regulation mechanisms (dilution effect, barrier effect, attracting or repelling partner, auxiliaries)

Weed control in lupin



Lupin pure stand

Lupin –
oat
mixture

3. Improve protein autonomy of organic farms

Organic farming issues :

Nitrogen is one of the main limiting factors in organic farming :

- Challenge of stockless organic farmers : maintain soil fertility while keeping inputs of external nutrients to the minimum
- Livestock farmers : rely on imports of protein-rich feeds

Opportunities of intercropping :

Mixtures based on legume species :

- Production of protein rich grains and fodder
- Better nitrogen autonomy



4. Improve the protein content of cereals

Organic farming issues :

No synthetic nitrogen in OF

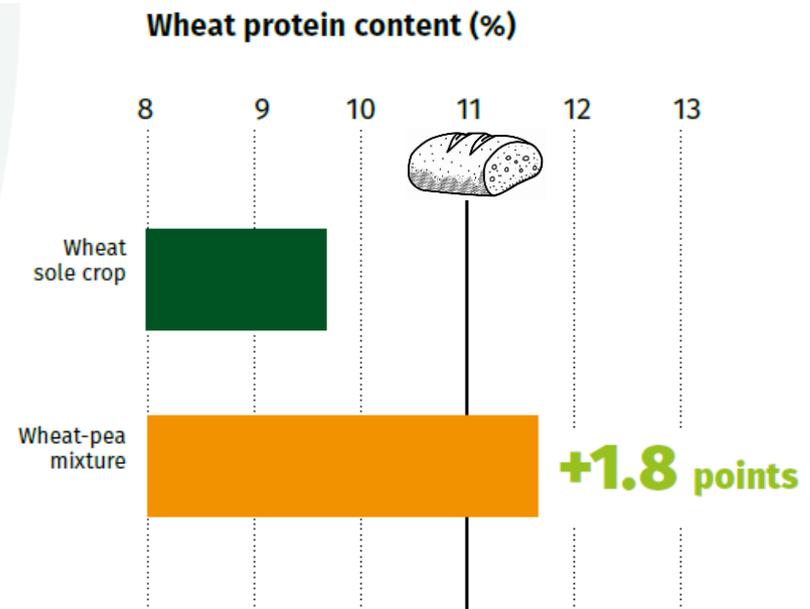
⇒ limited amount of nitrogen available to the non-leguminous plants

Modern cereal breeds need high amounts of N for high protein content and good baking quality

Opportunities of intercropping :

Higher protein content of wheat mixed with a leguminous crop :

- No competition for N between the two crops (fixation of atmospheric N by the leguminous crops)
- Lower seeding densities of wheat and thus higher quantity of N available per wheat plant



Wheat protein content obtained over 10 bread wheat varieties in sole crop or mixed with James field pea variety (INRAE-IGEPP France 2019 – organic farming – ReMIX Project). The 11% threshold is commonly used in the calculation of the market access indicator for common wheat varieties for use in human food (breadmaking)

5. Save worktime and inputs

Organic farming issues :

More time to monitor weeds, diseases and pests in OF than in CF
Several mechanical weedings required during the growing season
⇒ Higher working time and fuel consumption

Opportunities of intercropping :

- No (or limited) external N or plant protection products needed
- No mechanical weeding
- Cultivation operations limited to sowing and harvest

But additional costs (seeds, sorting)



Mechanical weeding

- Regular increase of cereal-legume mixtures, mainly in OF
- But still a minor practice despite the many ecosystem services it provides
- Species mixtures must be a pillar of the Farm-to-Fork Strategy, in particular in OF where few inputs are used
- Policy and financial support is needed to favour their adoption by a large number of farmers



1. Use farm subsidies to boost intercropping

- Favour intercropping by European farm subsidies of the Common Agriculture Policy
- Terminate CAP rules preventing intercropping
e.g. Rules for species proportions that are not agronomically relevant
- Resolve contradictions in the rules and administrative barriers
- Set up a promotion programme to disseminate technical information for agricultural advisors and (organic) farmers.



2. Develop sorting techniques, outlets and markets

Issues :

Difficulties to find a trader that accepts species mixtures

Lack of supply chain in the case of minor or new crop

Difficulties to find a buyer who will want to bother with small quantities

- Grain traders need to adapt their logistics and invest in sorting equipment
- Public authorities should:
 - support the investment in new logistics
 - stimulate the development of new markets



3. Support breeding programmes for intercropping

Issues :

Little advice on which variety suits best farmer conditions

No specific varietal selection: varietal choice is based on the traits of cultivars grown in sole crop

Performance of varieties in mixture is not necessarily predicted by their performance as sole crop

- Encourage breeding programmes for intercropping
- Traits relevant for intercropping should be considered for registration of new cultivars
- Agricultural advisory services should support farmers in selecting the right cultivar and designing their intercropping system.



4. Stimulate co-learning and on-farm experiments

Issues :

No standard recipe for intercropping : the performance of species mixtures depends a lot on the growing conditions, especially in OF

- Farmers need to be actively involved in research
- Better knowledge resulting from co-learning between farmers, researchers and farm advisers
- Capitalize on the know-how of farmers to allow them to take ownership of new practices



Thank you for your attention





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PARTNERS IN ReMIX

