

# Harvesting and separating crop mixtures: yes we can!

## About ReMIX

The goal of the ReMIX project, funded by the EU's Horizon 2020 Programme, is to exploit the benefits of intercropping to design more diverse and resilient arable cropping systems. Together with farmers, ReMIX has designed productive, diversified, resilient and environmentally friendly cropping systems that are less dependent on external inputs. Intercropping delivers high quality food and sustainable returns to the farmer.

## The EU's Farm to Fork Strategy

aims to make our food systems fair, healthy and environmentally-friendly. It has set the ambitious targets of reducing the overall use and risk of chemical pesticides by 50% and reducing nutrient losses by at least 50%. Intercropping, the cultivation of two crops in the same field, is a promising solution that can help achieve these objectives. However, technical solutions are needed for harvesting intercrops and separating mixed grains after harvest. Policy makers should support investment in appropriate technology in order to considerably expand the capacity of farmers and collectives to separate and clean grain produced in intercrops.



## The twofold challenge of harvesting and separating grains

Intercropping or the simultaneous cultivation of at least two species in the same field can contribute to achieving the ambitious policy objectives of the Farm to Fork Strategy. Uptake by farmers is limited, despite the known benefits of species mixtures for grain production, especially in low input systems. One of the main obstacles is the difficulty in harvesting and subsequently separating the products. It is not usually possible to sell the harvest as a grain mixture for human consumption. The grains need to be separated and the end-product needs to meet high quality standards in terms of level of broken grains or impurities. However, the greater the degree of separation, the higher the associated cost. The feasibility of separation depends mostly on the species in the mixture but also on the settings of the combine harvester during harvest. The challenge is to maximise economic performance by optimising both harvesting and sorting for each species mixture, which needs to separate grains very precisely to achieve the highest market value of the intercrop.

## Solutions for separating mixed crops

1

### Harvest can be greatly improved for legumes sensitive to lodging

First of all, intercrops can reduce grain legume lodging at maturity compared to the sole crop (**Fig. 1**, as shown by Viguier et al. in 2018). This maintains the shoots relatively upright allowing the combine harvester to cut these efficiently.



**Fig. 1.** These pictures highlight that spring wheat in intercrops (below) reduces lentil lodging at maturity compared to the sole cropped lentil (above) allowing the combine harvester to pick up most shoots by maintaining plants relatively upright (Viguier et al. 2018).

## 2

### Harvest should not be a lock-in in the future

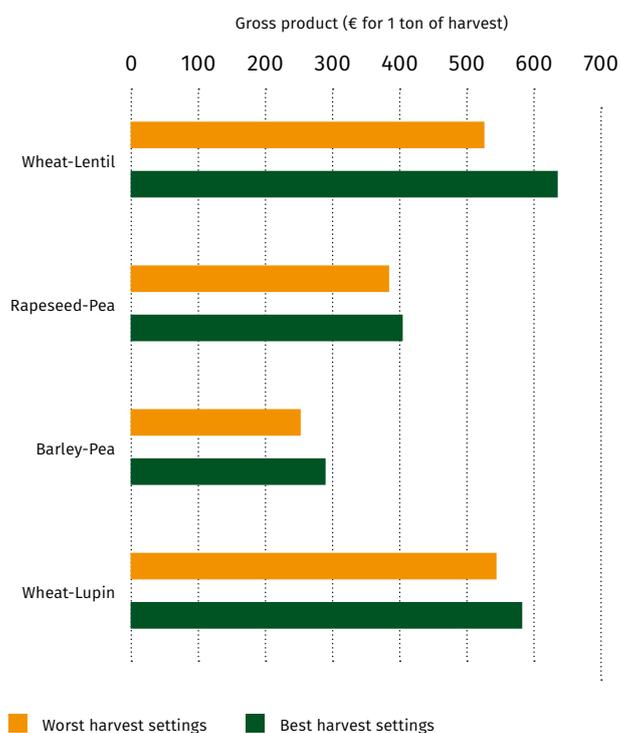
ReMIX has tested harvesting settings using an AGCO classical combine harvester in order to evaluate the efficacy for various species mixtures on-farm (**Fig. 2**).



**Fig 2.** Harvest of a wheat-lupin mixture in Denmark with a Laverda M410 combine harvester from AGCO Group (14/08/2020, Picture from Hans Henrik Pedersen).

We demonstrated that with the right settings of the combine harvester, even with a delay of a few days in the grain maturity of the species mixture, the losses as well as amounts of impurities and broken grains can be limited and the gross product improved. **Fig. 3** illustrates the gross product and the gain provided by optimized harvester settings.

#### Harvest settings impact the gross product



**Fig. 3:** Gross product after grain separation between the worst and the best harvester settings.

## 3

### Grain separation after harvest is the key and provide added value

ReMIX has tested the feasibility of separating the products using a vibrating cleaner SVD 100 from Etablissements Denis in order to evaluate the efficacy for various species mixtures on-farm (**Fig. 4**).

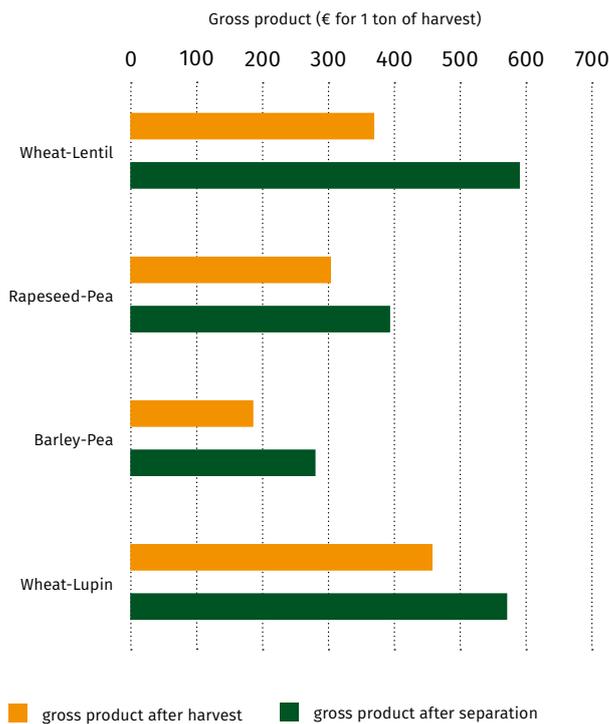


**Fig. 4.** Vibrating cleaner SVD100 from Etablissements Denis used to demonstrate the feasibility of the separation of species mixture and the resulting economic benefit (Picture from Patrick Bourachot)

Therefore, after optimizing the settings of the combiner harvester, a single sorting with classical sorting equipment seems to be sufficient for mixtures of grains with very different sizes such as rapeseed-pea, barley-pea or wheat-lupin.

**Fig. 5** illustrates the gross product and the gain provided by grain separation and cleaning for four types of species mixtures, with the highest gain for wheat-lentil due to the high price of lentil for the human food market.

### Separation improves the gross product



**Fig. 5:** A single step which separates grains and removes most of the impurities allows the gross economic product of all mixtures to be increased compared to that directly after harvest.

For lentil-wheat mixtures that have similar grain sizes requires at least a second separation step and the use of a more efficient separator (optical ones) to meet food quality standards.

Our work demonstrates that sorting and cleaning grain mixtures after harvest is key for increasing the marketable value of harvested grains, which allows the grains to be sold for human food with higher economic returns than for animal feed.

ReMIX has shown that species mixtures can be economically profitable when optimising harvesting and sorting. This confirms that species mixtures are a promising solution for farmers willing to move towards a more agroecological agriculture. However, the cost of grain separation remains a very important factor to consider, which is a key challenge to address in the future.

## Policy recommendations

The difficulty of harvesting and separating crop mixtures grown for grain production is an obstacle preventing the widespread adoption of intercropping but much can already be achieved with existing equipment.

1

### Public authorities should support:

- » Technical research aimed at identifying the best combinations of equipment and settings for harvesting and sorting;
- » Innovation development for designing combine-harvesters more suited for species mixtures;
- » Training of advisors and farmers to improve their practical knowledge of using these complex machines in order to optimize their settings;
- » Investment in combine-harvesters domain in a context where more and more farmers use subcontractors for harvesting their intercrops.

2

### Public support is needed to:

- » Promote the development of low-cost grain separators of different sizes allowing rapid and efficient sorting of small and large grain volumes, either for use on farm or by large-scale grain collectors and buyers.
- » Encourage their purchase by farmers, farmer's collective and grain buyers.

3

### Four priorities to support

Finally, knowledge and solutions for better harvesting and grain sorting of intercrops needs to be made available to all actors in the agri-food chain. We suggest the following four priorities that public authorities should support:

- » Development of farmer's collectives for the use of agricultural equipment;
- » Big cooperatives to reorganise their infrastructure to encourage the use of intercrops;
- » Redesign of agri-food chains to adapt their requirements regarding the "purity" of products from species mixtures and to develop new products that don't need total grain separation;
- » Adapt norms of impurities, as much as reasonable for food security, to allow products from intercropping to enter the value chain in a significant way.

## Authors

- » **Laurent Bedoussac**  
ENSFEA  
INRAE France
- » **Elina Deschamps**  
INRAE France
- » **Lisa Albouy**  
INRAE France
- » **Patrick Bourachot**  
Etablissements DENIS France
- » **Alastair Morrison**  
AGCO A/S Denmark
- » **Bram Moeskops**  
IFOAM Organics Europe
- » **Christine Watson**  
SRUC United Kingdom
- » **Eric Justes**  
CIRAD France

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This project has received funding from the **European Union's Horizon 2020 Research and innovation programme under Grant Agreement N. 727217**. This communication only reflects the author's view. The Research Executive Agency is not responsible for any use that may be made of the information provided.