



# How to improve Einkorn varieties?

## Problem

Einkorn producers grow a limited number of varieties and are looking for a wider diversity. Seed companies are not yet interested in this crop due to the narrow niche market and the fact that few, if any, breeding programs are devoted to it.

A participatory einkorn breeding program can easily be implemented to meet the needs of actors in the value chain. If you're a farmer or a consumer: don't hesitate to integrate or to require a participatory breeding program in your territory! Here is the step-by-step program.

## Solution

Participatory breeding programs are being implemented in some places (mainly as part of the DIVINFOOD project) to take into account not only the wishes of the producers, but also those of millers, bakers, other processors, and consumers at the territorial level.

There is also a huge diversity of genetic resources still stored in European einkorn genebanks.

## Benefits

Einkorn is the oldest domesticated wheat and is prized for its rich nutritional profile, including higher protein and essential nutrient content than modern wheat. It is easier to digest and less likely to cause inflammation, making it a good option for people sensitive to gluten. What's more, einkorn's resistance to harsh growing conditions makes it a valuable crop for sustainable agriculture.

The interest of participatory breeding is that a collective may create their own varieties and select the best adapted to their local micro-climatic environment. The objectives may be diverse and sometimes contradictory. The interest of the participatory approach is to target a "custom breeding" program for a specific environment. The term "environment" recovers not only climate, soil and cropping systems, but encompasses the processing, marketing, economy, social, cultural and regulation components.

Breeding requires patience. To speed up the process, the collective may prefer mass selection to pedigree selection, in order to obtain a population that can evolve in the field. When comparing einkorn pure lines and populations, people say they prefer populations that are more resilient and robust than pure lines.



Photos 1 and 2 : French et Algerian farmers, researchers, students and citizens evaluating einkorn in south of France (left © D. Desclaux, INRAE, right: © C.Shigo, INRAE)

## Applicability box

### Theme

Breeding for einkorn in low input conditions

### Reference conditions

Arable systems

### Application time

Year-round

### Period of impact

Long-lasting

### Equipment

Pool of genetic resources

### Best in

Organic and low-input systems

## Practical recommendation

The objectives of the breeding program must be participatory, meaning that all stakeholders can present their constraints and wishes, in order to jointly define relevant variety “ideotypes”. In Southern France, participants are looking for varieties with high vigour and plant height to compete with and smother weeds. They are also looking for cold-resistant varieties that can grow quickly and achieve satisfactory yields. Some are interested in long-cycle varieties that can cover the soil for a long period and be harvested after the other cereals that are grown on the farm. Others prefer early maturing varieties that complete their cycle before the heat. Concerning the sowing, farmers want varieties that can be sowed early (September), sprout quickly and cover rapidly the soil. Others prefer to sow later. Another important criterion is the grain size (big grains are required) and, above all, its ease of threshing. Indeed, einkorn grains are hulled and post-harvest dehulling is a very costly operation. Maintaining einkorn's nutritional properties, such as its high carotenoid and protein content, is also a key priority. As this species is not subject to pest attack and is very robust, it does not require specific pathogen resistance programs.

**Creating variability** requires access to relevant European einkorn collections.

The breeding scheme for self-pollinated crops generally involves several key steps:

- **Choice of parent lines:** the aim is to choose two parents to cross that exhibit the desired traits. This requires first the evaluation of the collected genetic resources.
- **Emasculation:** the anthers are removed (by hand) from the flowers of one parent plant to prevent self-pollination.
- **Pollination:** pollen from the second parent plant is collected and transferred to the emasculated flowers of the first parent plant.

This step can be done in farmers' field by the farmers themselves, but it should be communicated that it takes time and requires patience. It is usually done by technicians or researchers.

**Selection stage:** Once pollination is successful, the seeds will be the first filial generation (F1) and will contain a mix of genetic traits from both parents. After growing the F1 generation, the following generations are made by self-crosses and the plants that best exhibit the desired traits may be selected at each generation. The selected plants can be backcrossed with one of the parent lines or crossed with other plants to further refine the traits.

Mass selection can also be done. In this case, a large number of plants are selected and their seeds are bulked together

**Multiplication:** Continuing the process of selection and crossing over several generations lead to the stabilization of the desired traits. This can take multiple growing seasons. This process is labour-intensive and requires careful planning and execution over several years to achieve the desired results.

**Dissemination:** Nowadays, einkorn is not listed in the European catalogue of varieties and seeds, meaning that no registration is needed for this species. Therefore, a selected variety that can be a pure line or a population may be easily disseminated through the selling or exchange of the seeds.

## Further information

### Further readings

- Hidalgo, A., & Brandolini, A. (2014). Nutritional properties of einkorn wheat (*Triticum monococcum* L.). *Journal of the Science of Food and Agriculture*, 94(4), 601–612.

### Weblinks

- Interactive map to locate and access the main European einkorn collections:  
<https://divinfood.gogocarto.fr/map#/carte/@50.93,0.09,4z?cat=all>

## About this practice abstract and DIVINFOOD

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This practice abstract is elaborated in the DIVINFOOD project, based on the EIP AGRI practice abstract format.

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**.

DIVINFOOD – “Co-constructing interactive short and mid-tier food chains to value agrobioDiversity IN healthy plant-based FOOD” is supported by the European Union.

**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](http://www.divinfood.eu)

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