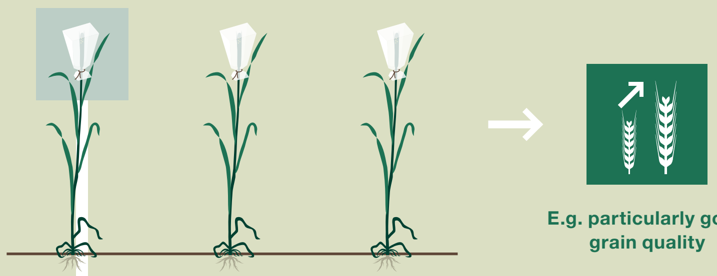
Hybrid breeding

More stable, more robust, **more resilient**

Process using hybrid rye as an example

The aim of hybrid breeding is to produce high-yielding and resistant hybrids. These are created by crossing two inbred lines that combine well with each other.

A × A
Pool A



Selfing

Rye is a cross-pollinator by nature – pollen is carried by the wind from one plant to the next and pollinates it. Inbred lines are created by pollinating plants with their own pollen to obtain lines that are as homozygous as possible. The desired traits are fixed as a result of this homozygosity. To enable this, a paper bag is tied around the ears of the selected rye plant before it flowers. This shields the plant from foreign pollen, meaning the plant pollinates itself (selfing).

Combination of inbred lines

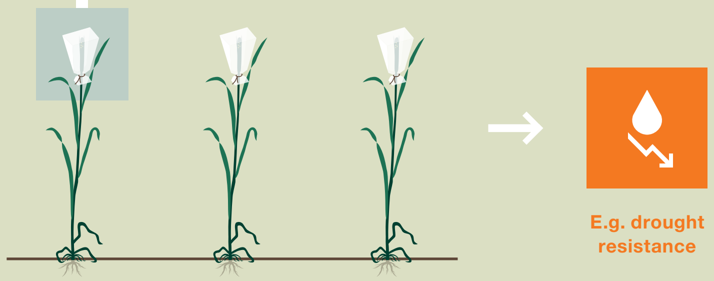
If two inbred lines are to be combined in the field, the mother line must be pollen-sterile, i.e. it does not produce fertile pollen. In the case of rye, cytoplasmic male sterility (CMS) is used for this purpose. CMS is a naturally occurring male sterility. Fertility in the hybrid is then restored with restorer genes in the father line. Consequently, the hybrid will produce fertile pollen again so that grain can be harvested.

A

×

B

B × B
Pool B

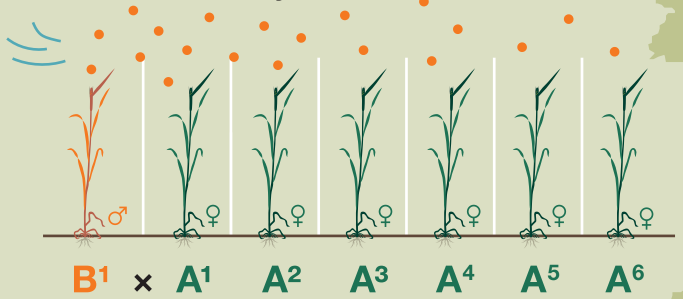


The best possible combinations for strong hybrids

Breeders of hybrid plants use genetically divergent pools. Pool A, for example, contains mother lines that guarantee high grain quality, while pool B contains father lines that have good drought resistance. To keep on improving these lines for the desired traits in the hybrids, lines from the respective pool (i.e. A × A and B × B) are constantly crossed with each other.

In order to develop the best-performing hybrids, it is necessary to find the best-performing combinations from pool A and pool B.

A × B Test hybrids

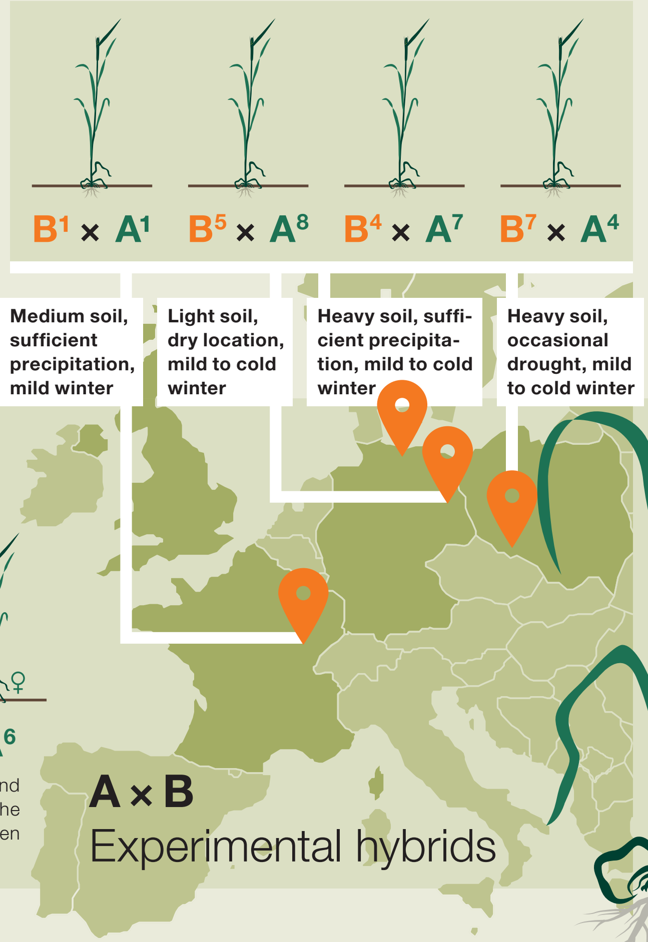


Lines are grown in isolation in the field (e.g. between plastic walls) and arranged downwind so that the wind will blow the pollen from the pollinators (B) to all plants (A) in the row. The resulting test hybrids are then evaluated in multi-site yield trials in the field.

Maximum heterosis effect

The aim is to produce high-performing hybrids with the greatest possible heterosis effect (performance superiority compared to the parent lines). An important goal of hybrid breeding is therefore to maximize the combining ability between pool A and pool B – the parents of the hybrids should complement each other as well as possible. To this end, test hybrids (crosses of A × B) are grown in the field in yield trials to conduct a GCA (general combining ability) test. For example, a father line (B) is crossed with several different mothers (A) to select the best combinations. Phenotypic (visible, measurable) data and genetic data (e.g. molecular marker data) of various traits are recorded and statistically analyzed for selection decisions. From several thousand possible new lines, the field is narrowed down to a few hundred (a process that takes around two to three years).

Test locations with the most diverse possible but representative environments are selected – so that the hybrids can demonstrate their performance under different conditions.



A × B
Experimental hybrids

Different conditions at different locations

In the next step, the selection is narrowed down even further: Around 150 experimental hybrids are now created from the most promising mothers and fathers that were tested. These are the ones that have the greatest potential to become a new variety. These new hybrids are tested over one to two years at many different locations under different environmental conditions to obtain predictive data for the final selection. Decisive factors for the performance of the hybrids are not only the yield, but also agronomic characteristics such as stem stability, various disease tolerances or seed quality.

New variety

Variety testing procedure

From 150 experimental hybrids, breeding selects up to 10 candidates for the official variety testing procedure – and in the best-case scenario we end up with several new varieties each year.

Uniformity

Hybrid rye has a uniform plant height and maturation time compared to population varieties.

Less input

Hybrid rye requires fewer pesticide applications than wheat and barley, for example.

Drought tolerance

Hybrid rye consumes 20 percent less water than winter wheat.

Vitality

Hybrid rye grows more vigorously than population varieties, both above and below the soil's surface.

Adaptability

Depending on the variety, KWS hybrid rye can be grown on a wide range of soil types and qualities, including rich organic or even poor, sandy soils.