



HY SEED HYBRID RYE

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Rye. A cereal with future.

Until about 60 years ago rye had been the most important cereal in Central and Northern Europe, often referred to by our ancestors as “the grain”.

Its performance even on infertile soils and its winter hardiness proved to be very advantageous. Due to agriculture intensification and major progresses in wheat breeding rye has been pushed to weaker and less fertile soils. The cultivated rye area had steadily decreased reaching its lowest point in the late 70s. Basic plant research carried out by the University

of Hohenheim provided breeders with a very reliable genetic sterility system for breeding rye hybrids. The first high yielding hybrid varieties were approved in the mid-1980s. SAATEN-UNION is one of the two market leaders in Germany and Europe due to the hybrid rye varieties of its breeding company HYBRO Saatzucht.

SAATEN-UNION varieties provide high and stable yields on more than 280,000 hectares across Europe. Hybrid yields are up to 20 % higher compared to conventional varieties.

Thanks to intensive breeding efforts rye also has a higher yield potential than wheat and triticale. Throughout Europe the cultivation area is growing again.

Many producers are not just thinking about increasing their rye area but also consider rye as a useful and important link for future crop rotations. In particular because the unique characteristics of rye offer answers to current and future challenges in grain production: Rye is and remains a quality cereal with a future!

MyRye. Growing with rye.

Rye is cost-efficient and resource-saving! Its efficient nutrient uptake ensures highest yield even under the more stringent requirements of the new fertiliser regulation.

Its good drought tolerance helps it to withstand increasing early summer droughts. Its high resistance to many plant diseases ensures a healthy crop even after the ban of further fungicides. Rye can help to improve cost efficiency in terms of crop and animal production. Nevertheless, rye is underestimated as the econo-

mic potential is often not fully exploited – not only in respect of yield but also utilisation and marketability. In regard to use the question of the best farm-specific strategy has to be posed: Cultivation as grain crop, as forage or as wholecrop silage?

Selling, storing or feeding? Is hybrid rye more competitive than wheat or triticale? Which feed rations make sense with rye? When is wholecrop rye silage worthwhile? Against this background this guide aims to make a contribution to profitable produc-

tion and marketing of rye. Apart from crop management a clever and professional rye marketing/use offers the biggest scope for adjustments.

MyRye – growing with rye is going to analyse these questions step by step and point out operational leeways in order to achieve the best operating results possible. One is already certain: Rye has a future!

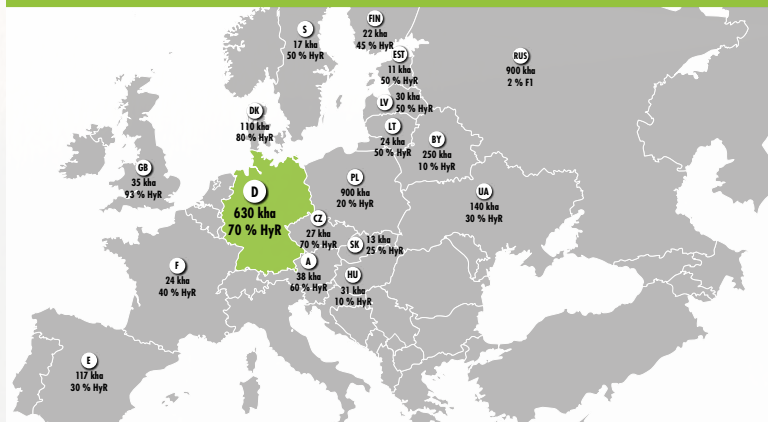
More details: <https://www.saaten-union.com/index.cfm/action/myrye.html>

Markets and market development.

In terms of area under cultivation rye plays a minor role compared to wheat, maize and rice. Crop production statistics show that rye, which is cultivated on two million hectares across Europe, only takes up about 3 % of the cultivated area.

The largest rye producers are Germany, Poland and Russia. The proportion of hybrid rye varies greatly from country to country. Hybrid market shares are very high in Germany (70 %), Denmark (80 %) and Great Britain (93 %) while they are still at a

Key Markets



much lower level in many countries of Eastern Europe. However, there is an upward trend throughout Europe.

From the years 2013 to 2018 the areas under rye cultivation were decreasing. Farmers seemed to have forgotten about many production advantages of rye. Rye was pushed to very light soils by other cereals.

Today, however, agriculture is in the process of questioning and reorienting itself. But whether conventional, integrated or organic farming – professional farming strategies should not lose sight of the actual main production objective of crop cultivation.

To achieve the highest possible yields! Awareness and also commitment of arable farmers to sustainable cultivation methods have grown. In the years 2019 and 2020 the rye production area has successively increased throughout Europe. For example, the area under cultivation in Germany has grown by 5.6 percent although the total cultivated area of winter cereals fell by 3.8 percent.

Currently, rye is the only cereal with an increasing area under cultivation. There are many reasons for this: increased use in pig feeding, shortage of feedstuff/substrate, decline in oilseed rape production as well as

the very crucial factor yield stability. Again and again, extreme weather conditions set the limits in crop production. Weather extremes are increasing and therefore the risk of crop losses or even crop failure.

Hybrid rye is by far the most efficient cereal achieving the highest yields with limited water and nutrient supplies at the lowest pesticide input. The use of rye is very versatile. Many advantages suggest that in future rye should be cultivated again on loam soils.

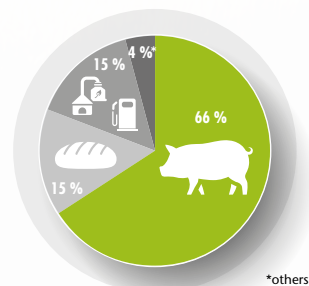
More details: <https://www.saaten-union.com/index.cfm/article/9979.html>

Use of Rye. From being a weed to being a multitalent.

Rye offers excellent prospects today and in the future. Today, rye cannot just be marketed as healthy cereal for bread-making but also as animal feed and raw material for the bioenergy production and the production of spirits (vodka/Korn liquor).

Today and in the future rye cultivation helps to preserve agrobiodiversity as well as to lengthen crop rotations and by protecting natural resour-

Use of rye



ces to support sustainable agriculture – cost-efficient and resource-saving!

Due to its undisputed positive nutritional value approx. 20 % of the rye is used for bread-making. About 15 % of the rye harvest is used for bioenergy. Thanks to its rapid juvenile development rye plays an important role in regard to biomass production and to extend crop diversity of crop rota-

tions with energy crops. Rye is also an excellent and in particular a cheap component for the bioethanol industry or as wholecrop for feeding. Rye for animal feed takes the biggest share with approx. 60 % of the market segment. Apart from the economic aspects rye is a healthy and sustainable feedstuff.

Use of Rye as Animal feed

A degree of reluctance seems to persist towards a high rye ratio in the diet. Older observations report that higher proportions of rye in the feed ration leads to a decrease in feed intake, joint ill and a change in faeces consistency. Today, numerous trial re-

sults have shown that this reluctance is unreasonable because, among other things, breeding has achieved that bitterness plays a minor role in today's varieties.

However, two limiting factors in rye cannot be denied. One is the high proportion of non-starch polysaccharides (NSP) which are difficult to digest and the other is the susceptibility to infection with the ergot fungus *Claviceps purpurea*. Thresholds for ergot and mycotoxins are considered in regard to using rye in human as well as in animal nutrition in order to control toxicity risks. It is prohibited to exceed the statutory

maximum level of 1 g per kg of cereal grain. Compared to wheat and barley rye has significantly lower levels of the Fusarium toxins deoxynivalenol and zearalenone. Having taken these limiting factors into account the DLG (German Agriculture Society) issued recommendations on the use of rye in the year 2006 (see tables).

An increasing rye use beyond the DLG recommendations has clearly been noticeable again for some time past. New results have shown that specific components of the rye's NSP fractions have to be reevaluated. Just as in human nutrition these also have significant positive effects on

intestinal health in pigs. Thus, rye is an ideal fibrous component of the feed ration which has a higher dietary fibre and fructan content than any other cereal providing more satiety and well-being in the pig. (see “Advantages in feeding”). Besides animal welfare aspects rye can also help to save feeding costs and to reduce nitrogen inputs into the environment (see “Projects: UK Feeding Project”).



Feeding Pigs	
	up to... % rye within feeding ration
Fattening pigs ¹	
28 - 40 kg LW (pre-grower)	30
40 - 60 kg LW (grower)	40
60 - 90 kg LW (pre-finisher)	50
> 90 kg LW (finisher)	50
Sows	25
Farrows	
up to 15 kg LW	10
from 15 kg LW	20

¹ If in liquid feeding frothing occurs the rye proportion should be reduced. Possibly the problem can be also reduced by adding vegetable oil. If triticale is additionally used the rye proportion should be reduced by one third of the triticale proportion due to the high NSP content (e.g. if the finisher diet contains 30 % triticale it is recommended not to exceed a rye content of 40 %).

Feeding Cattle	
	up to... % rye
Calves	0 in colostrum feed
	5-8 in calf starter feed ¹
Heifers	40 in concentrate
Beef cattle	20 in concentrates (max. 1 kg rye/day)
Dairy cows	40 in concentrates (max. 4 kg rye/day)

¹ Currently higher values cannot be validated due the lack of trial results.

Feeding Poultry	
	up to... % rye ¹
Laying hens	20
Pullets	15
Chicks	0
Cockerels	0
Broilers (finisher)	5
Fattening turkeys	
< 5 weeks	0
> 5 weeks	5
Ducks, fattening geese	
< 3 weeks	0
> 3 weeks	5

¹ The values refer to feed mixtures without NSP degrading enzymes. If higher amounts are used the use of suitable NSP degrading enzymes

Use of Rye for Bread-making

With increasing popularity of organic food rye has also been rediscovered by the German kitchen. The intense, aromatic taste is typical for baked products made with rye flour. Rye and multigrain breads extend the selection in bakeries enormously. Germany is known for its wide range of breads in which apart from wheat rye still plays a major role. Rye is characterised by grains low in gluten (low gluten content) but high in fibre (high pentosan content) providing a relatively dark and mineral-rich flour.

The proteins in rye are highly soluble in water. But although rye also has

gliadin and glutenin molecules the proteins do not form gluten and thus, do not form a three-dimensional structure like wheat gluten during dough preparation. It is assumed that the formation of the structure is impeded by pentosans (= swelling agents and mucilages). However, at the same time pentosans are the key to baking quality by binding water and swelling up to eight times their own weight. According to their solubility in water pentosans are classified as soluble and insoluble. While the insoluble pentosans are responsible for the high water-binding capacity in the grain increasing dough yield, soluble pentosans are beneficial for

leavening, crumb texture and bread volume. Bakery products made with rye have a good water absorption which retards bread staling so that they are baked with sourdough for storing. Using sourdough as leavening agent makes rye breads, which are rather dense due to their low gluten content, more digestible.

Rye crispbread is also particularly popular. Crispbread is low in calories and has a very positive effect on the digestive tract due to its high fibre content.

Reference "Advantages of Human Nutrition"

Use of Rye as wholecrop silage

Wholecrop silage can help to bridge supply shortages, to lengthen maize crop rotations and to improve yield security of maize grown on marginal sites. Especially hybrid rye is suitable for wholecrop silage due to its low



site requirements and low production costs combined with a high yield potential.

1. Feeding

If a feed shortage is foreseeable the use of rye as wholecrop or for grain production can be decided on comparatively short-term. The so called dual-purpose hybrids are characterised by their high crop density, good tillering and good health as well as delayed senescence. For this purpose a variety like SU Performer is recommendable. Reference: <https://www.saaten-union.com/index.cfm/action/varieties/cul/6/v/124.html>

General recommendations on the proportion of wholecrop silage in feed rations depend on the energy content and can be up to 20 % for beef production, 10 kg DM/day for dairy cows and 20 % of DM uptake of beef cattle over 200 kg. Thus, it is essential to determine the nutritional value by analysis and not to rely on tabular values.

Latter often underestimate the energy content. In general wholecrop rye shows a lower energy content than wheat. This mainly derives from the unfavourable grain: straw ratio of rye. Therefore, wholecrop rye is mostly used for feeding early dry cows and

SEED HYBRID RYE

big heifers. Commonly beef cattle and lactating cows need energy contents way over 6 MJ NEL/kg DM, which limits the use of wholecrop rye. Wholecrop rye can also be an alternative for bigger farms which introduce a third feeding group for late lactating cows.

Another possibility is to combine wholecrop silage with grass silage. Wholecrop silage delivers rumen available starch to the feed ration and a low (partly also negative) ruminal-nitrogen balance (RNB) so that the very high RNB of grass silage can be decreased by wholecrop rye. The starch of the wholecrop rye delivers

readily available energy to the rumen and the grass silage fast protein.

2. Bioenergy

Cereals and maize are well established in the bioenergy production and all cereals are suitable. Apart from using cereal grains for the bioenergy production using ensiled cereals is the most important form of use. There are some aspects which seem to make sense to using rye in particular. Rye has the lowest site requirements and at the same time the highest yield potential. A distinction is made between cultivation as a main crop (wholecrop rye silage) or as a catch crop (forage rye) following a prece-

ding crop such as maize. Therefore, using hybrid rye for wholecrop silage is highly recommendable but as forage crop not profitable. As wholecrop rye is often grown on cooler and drier



sites lower yields than forage maize are common practice. Nevertheless, wholecrop rye silage pays off due to lower production costs. A slightly lower wholecrop rye silage methane yield compared to forage maize only has to be assumed if the crop is harvested too late and therefore has already been lignified. From an agronomical point of view, an early wholecrop hybrid rye harvest date is advisable, especially in regard to the subsequent crop. At the beginning of June there is still a wide range of subsequent crops possible. A later harvest date clearly limits the options.

More details: <https://www.saaten-union.com/index.cfm/article/10296.html>

Use of Rye as Bioethanol

In Germany a market for bioethanol has only existed since the year 2004 and it is still the largest ethanol market in the EU, followed by France and Spain. An EU directive on biofuels aims to increase the proportion of fuels from renewable raw materials up to 20 % in the year 2020. Bioethanol plants offer an alternative marketing opportunity for cereals. However, the raw material has to fulfill specific requirements: Cereals for ethanol production must contain mainly starch and less protein and cell wall components.

Cereals that are rich in starch, such as wheat, triticale and rye, are especially

suitable for bioethanol production. In particular due to the limited cultivation alternatives on the light sandy soils of Brandenburg the use of rye as a bioethanol raw material is economically very interesting. In Schwedt, Brandenburg Verbio produces in the second largest German plant with an annual capacity of 200,000 tons bioethanol mainly from rye.

Use of Rye as Alcohol

Rye is of great importance to the luxury food and drink segment. In the past, rye was also used for beer production. Today, it is important for the production of spirits, especially vodka. In contrast to other cereals



rye is ideal for this purpose as it has a sweet and pleasantly mild taste. Rye beer had been widely brewed until the 15th century. However, due to its high

pentosan content rye tends to show starch gelatinisation. Economical wort production is difficult and requires additional time for the brewer. Therefore, barley and wheat have taken the lead. In terms of taste rye beer cannot be compared to conventional beers.

Depending on the type the taste is slightly more grainy, often having a hearty flavour similar to pumpnickel bread and the froth is darker and more coarse-pored. Rye beer is offered among others from Paulaner ("Paulaner Roggen"). Pumpnickel-Porter is also a rye beer. In the broadest sense "kvass", which is drunk in Slavic countries, can also be considered as rye beer.

In contrast to rye beer not malt is used as a source of starch but rye bread. Therefore, it is also known as bread drink.

Rye whisky is a whisky distilled from a mash containing rye. It is mainly produced in North America. In the United States law requires that the grain mash contains at least 51 % rye in order to be labelled as rye whisky. In recent decades with the advent of single malts and the whisky market becoming more diverse rye whisky has also made a comeback. In the original recipes of many classic whisky cocktails, such as the Manhattan Cocktail, rye is used as ingredient in the form of whiskey.

Use of Rye as Shampoo/Cosmetic

The grain and especially the husk of rye is rich in natural care substances, which can be found in most shampoos. Besides many minerals and amino acids it contains vitamins which are important for the hair care and strengthening.

They smoothen it, bind moisture and support the regeneration of irritated or stressed scalp. Therefore, rye flour shampoo is especially suitable for sensitive skin and even baby skin. Further advantages: It is extremely inexpensive and does not even require any plastic packaging. All you need to wash your hair is rye flour

(type 1150), water, a small bowl for mixing and a whisk or shaker. The freshly prepared rye shampoo is applied by massaging the flour mash



into the damp hair leaving it sit for a short while. Than it is rinsed thoroughly with warm water. Rye also makes a small appearance in the cosmetics industry as a facial skin surface smoother. Its sugars are said to make wrinkles less visible and to firm the skin long-term.

Therefore, rye is preferably used in facial care products that are supposed to achieve a quick effect. Rye is rich in lysine. This amino acid plays an important role in anti-aging cosmetics. If on a skin care product the name "Secale Cereale Seed Extract" is part of the ingredient list rye has been used as an ingredient.



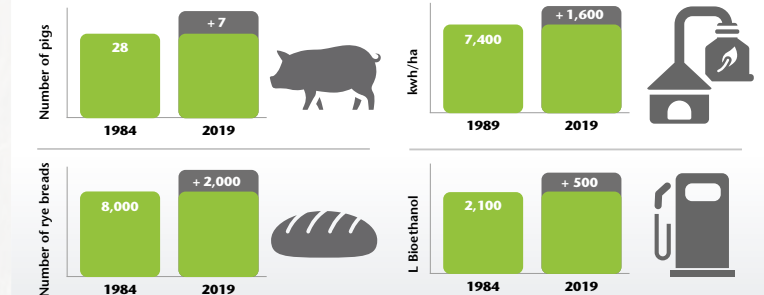
Breeding and breeding progress.

In the age of climate change, the future growth drivers will not be as much fertilisation intensity, plant protection or agricultural machinery but more plant breeding and digitalisation.

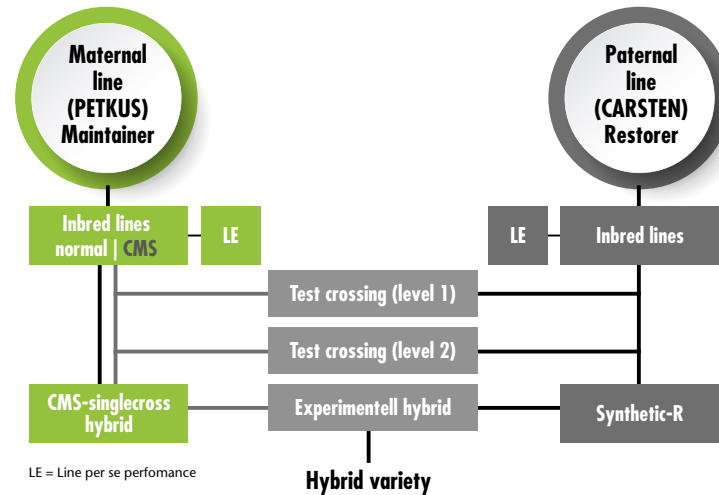
Especially in regard to rye cultivation breeding new high yielding varieties is the most important factor influencing yield, efficiency and profitability. Hybrid rye breeding is a success story. A hybrid variety results from targeted crossing between a small number of inbred lines, which are intensively selected for their self-performance

Breeding Progress

More from 1 ha of hybrid rye



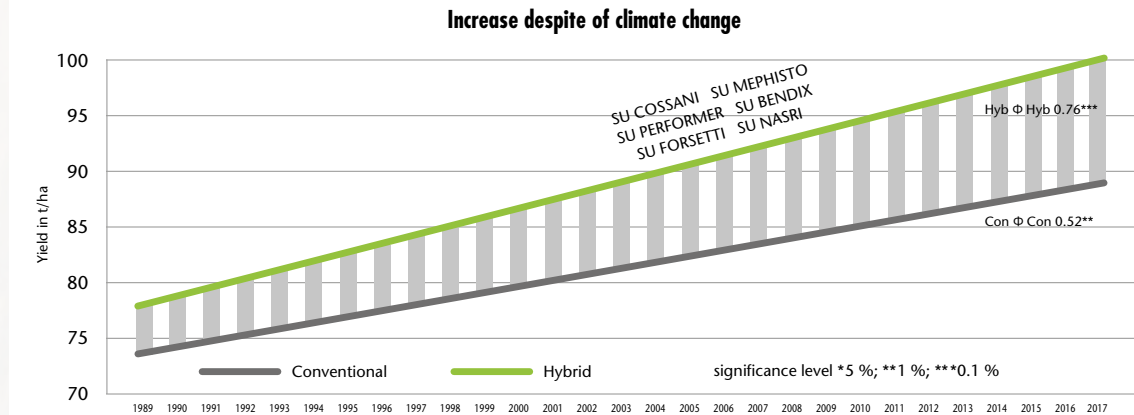
Breeding Hybrid Varieties



and their ability to combine. The seed parents are taken from the Petkus and the pollen parents from the Carsten gene pool. Until a variety is marketable the breeding process takes about 10 years.

Due to targeted use of heterosis the annual breeding progress of hybrid rye is about 1 % – this is unique in cereal breeding. Rye is particularly well suited for the hybrid method because of its flowering biology as cross-pollinator. Thanks to hybrid breeding the breeding company HYBRO was able to accelerate the yield breeding progress without any loss in quality or susceptibility to disease.

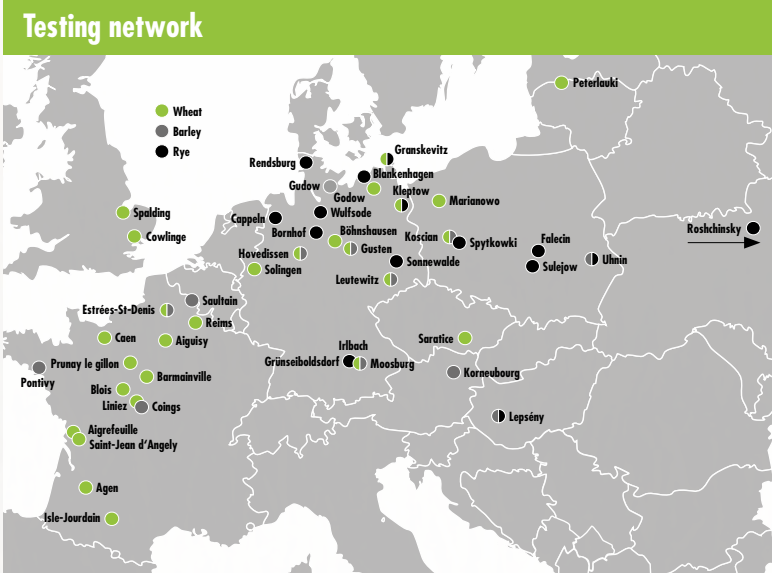
Breeding Progress Hybrid vs. Conventional



Source: Friedrich Laidig et al., Breeding progress, variation, and correlation of grain and quality traits in winter rye hybrid and population varieties and national on-farm progress in Germany over 26 years, *theor Appl Genet* (2017) 130:981-998

On the contrary, the varieties have been improved in regard to foliar health and have a higher sprouting resistance. Therefore, it can be expected that the yield advantage of hybrid rye compared to conventional rye will increase even further in the future.

Breeding progress expressed in simple numbers means that since the introduction of hybrids of one hectare hybrid rye 7 more pigs can be fed, 2000 more bread loaves baked or 500 l more biofuel can be produced. Furthermore, 1600 kWh more electricity can be produced. This is approximately the annual electricity consumption of a one person household.



On 16 international sites SAATEN-UNION breeds, selects, tests and produces hybrid rye seed, among others in Kleptow, Wulfode and many other German sites as well as in Poland, Russia, France, Italy and Hungary.

Because of an extensive network of breeding trials comprehensive information on new candidates can already be collected before they go for registration. It covers various countries, growing regions and soil qualities. Like that varieties can be selected suitable to a specific environment and to achieve the desired breeding objectives. Depending on the use different requirements are

demanded of the plant or grain. As a result, breeding objectives are sometimes very contradictory and breeding programs very extensive

and diverse. For example, while the pentosan content is indispensable for the baking quality of rye they are less desirable in feeding.

	Grain rye			Whole crop	Forage rye
	baking	feeding	ethanol		
Vigorous growth	O	O	O	O	++
Yield	++	++	++	+/-	O
Dry matter yield	O	O	O	++	++
T.K.G./hectolitre weight	++	++	++	+/-	O
Hagberg falling number	++	+	+/-	O	O
α-amylase	--	+/-	++	O	O
Pentosan content	++	--	--	O	O
Crude protein level	+/-	++	--	+/-	O
Starch content	+	++	++	+/-	O
Starch yield	+/-	+	++	+/-	O

Production in a perfect process.

Seed processing takes place with breeding partners and selected production companies on ten sites in Germany.

Both breeding and seed production of hybrid varieties is significantly more complex than of conventional varieties. As hybrid seed is produced by cross-pollinated plants it has to be produced anew every year. In order to meet the minimum distance of 1000 meters required for pre-basic and basic seed production the production takes mainly place in count-

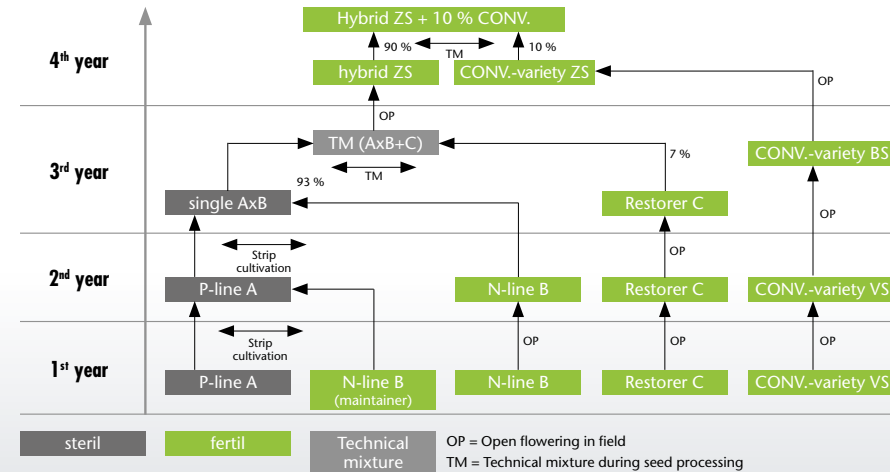
ries in which there is no/hardly any commercial rye cultivation (France, Hungary, Italy).

Each hybrid consists of 3 hereditary components. On the seed parent side it is the Petkus circle, while the pollen parent is the Carsten circle. Line A is present as male-sterile line as well as male-fertile line (maintainer line). For propagation both are planted in alternating stripes. For the production of basic seed A and B are crossed and then for the production of certified seed (AxB) is crossed with pollen

parent C. In order to increase the crop's pollination and thus to reduce ergot infection risk 10 % conventional rye is added to the sales product.



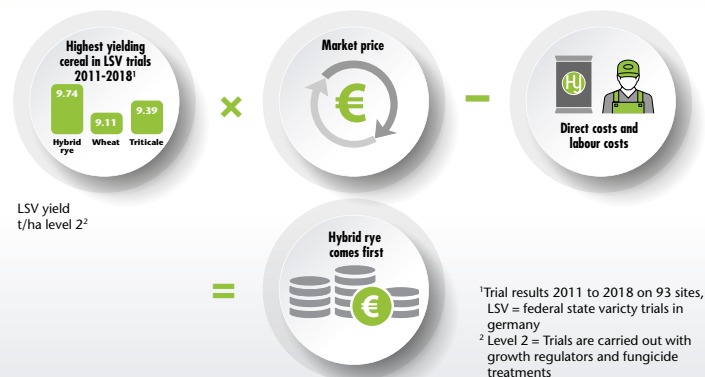
Production



Often more economical.

Rye is often the only economically viable alternative crop on less fertile and sandy soils. But also on average to high yielding sites, the question of the most economical winter cereal arises again and again. Rye is not only the most withstanding and stress tolerant cereal but as hybrid variety is even able to keep up with wheat on loam soils in terms of yield and profitability. In practical farming the perception shows a different picture. The reasons are obvious: Traditionally rye “feels at home” on the lightest sites. However, rye does not

Economy



get the chance to exploit its full yield potential on these sites. Especially in drought years, water supply is the main problem on sandy sites putting additional pressure on the crop. To be fair, a cross-crop comparison is only possible on sites with the same soil quality and preceding crop.

It remains to be seen whether the current increase in area – due to the displacement of winter wheat and/or triticale – is the beginning of a rye comeback or not. Fact is that perennial LSV (federal state variety trials) results impressively prove the yield superiority of rye. On comparable sites in regard to soil quality

LSV¹ evaluation WR, WTI, WW 2016-2019

	t/ha level 2 ²				t/ha level 2 ²
	2016	2017	2018	2019	2016-2019
	18 sites	23 sites	26 sites	27 sites	94
WR	9.18	9.27	8.18	9.43	9.02
WTI	8.99	8.96	7.30	9.05	8.57
Diff.	2 %	3 %	11 %	4 %	5 %
	t/ha level 2 ²				t/ha level 2 ²
	2016	2017	2018	2019	2016-2019
	19 sites	17 sites	17 sites	16 sites	69
WR	9.27	9.43	8.46	9.00	9.04
WW	8.45	8.58	7.29	7.99	8.07
Diff.	9 %	9 %	14 %	11 %	11 %

¹ Federal state variety trials of Germany

² Trials are carried out with growth regulators and fungicide treatments

and preceding crop rye shows across Germany a mean yield increase of 11 % compared to wheat and of 5 %

compared to triticale. Compared to second wheat rye succeeds up to 20 % higher yields.

Profability calculation for soils with medium yield expectations

		Price/yield adapted by SU			
		Conventional rye	Hybrid rye	Winter wheat	Triticale
Yield	t/ha	4.3	5.6	5.0	4.8
Price	€/ha	14.2	14.2	16	15
Output	€/ha	611	788	800	720
Subsidies	€/ha	255	255	255	255
Direct costs	€/ha	259	352	368	342
Seed	€/ha	28	70	71	61
Fertiliser	€/ha	122	147	154	141
Crop protection	€/ha	54	54	76	60
Operational costs	€/ha	270	263	266	260
Machinery costs	€/ha	101	106	107	105
Labour costs	€/ha	37	39	40	39
Drying, sorting	€/ha	8	10	9	9
Gross margin (-permanent labour costs) (including subsidies)	€/ha	336.6	428	421	373

Data collection for farm management and economic evaluations of agricultural production systems in the federal state of Brandenburg (LVLf 2016).

Of course yield is only one side of the story. At the end of the day only the gross margin counts. The data basis for the calculations is provided by the “Data Collection for Farm Planning and the Economic Evaluation of Agricultural Production Methods” of the Ministry of rural development, environment and agriculture of the federal state Brandenburg (LELF). With a special focus on sites with 29 to 36 soil points (German soil classification) it becomes clear that hybrid rye can be an economic alternative.

At first glance on the basis of gross margin (– permanent labour costs) (DAL) wheat seems to be clearly

ahead. However, the LELF assumes between wheat and rye a very big difference in price and a small difference in yield. The long-term average price difference between bread-making rye and wheat is about 22.0 EURO/t (AMI). Based on the LSV result evaluation a yield advantage of 11 % can be assumed. If these figures are adjusted it becomes clear that hybrid rye is also on loam soils on a par with wheat.

More details: <https://www.saaten-union.com/index.cfm/article/10424.html>

Marketing Strategy

For several years now agricultural enterprises have experienced the im-

pact of market globalisation. In major crops such as oilseed rape and wheat domestic market prices have long ceased to be determined solely by local market conditions.

Rye, however, still remains predominantly a regional product. The global exchange of goods and thus, its significance for price formation is still of great importance.

Consequently, a production that clearly exceeds human consumption quickly leads to decreasing prices. Rye is increasingly accepted as animal feed. There is a constant demand for rye as foodstuff as it is very popu-

lar amongst consumers. Those who want to process and eat rye flour are also prepared to spend more money. If there is a shortage in supply the wheat price is no longer the benchmark and the consumer is prepared to pay prices above wheat level. Consequently, rye prices cannot always be quoted on the basis of the wheat price. A reliable prediction is not possible. Various market analyses can help to form one's own opinion.

Marketing planning is not all about maximising sales. It is about choosing marketing and use strategies that cover costs and ensure liquidity. Especially as there are many possibilities to

use rye the question of the best farm-specific utilisation strategy arises.

Feeding or Selling

Like anything else, when goods are sold there are advantages and disadvantages to every marketing strategy. Timing of sales depends very much on operational factors like liquidity, risk and storage capacity. Rye is often sold at harvest due to lacking storage capacity. There is no sales volume risk but there is the risk of price volatility. Prices at harvest are often affected by harvest conditions. Storing rye should be considered if storage facilities are available. Livestock farms have to decide whether

to feed or sell their home-grown rye or to purchase rye for feeding. There is a simple method to approach this topic – the calculation of the reference value (value for money according to Löhr). The calculation of the exchange value refers to energy density and the first limiting amino acid, the digestible lysine as well as the current market price.

Example: At a wheat market price of 180.0 Euro/t the exchange value of rye is 175.5 Euro/t. At this price rye is equivalent in regard to the main feed value characteristics. If the market price is higher rye should be sold. The average price difference is rather at 20

to 30 Euro/t. In pig fattening it makes sense in any case to feed home-grown rye in order to save feed costs.

The rye calculator helps with the decision: SAATEN-UNION offers a new digital service: With the SU-Rye Calculator pig farmers can check very easily the economic value of different crop rotations and feeding strategies.

The Rye Calculator (more details: <https://www.saaten-union.com/index.cfm/action/myrye.html>) recommends farm-specifically how the rye harvest can be optimally used taking into account profitability, livestock and sustainability.

Components	Feed Ration before	Feed Ration after
Rye	0 to	401 to
HP soy meal	50 to	52 to
Wheat	500 to	232 to
Barley	250 to	116 to

For the same energy and pc-Lysin content a higher or lower feed amount could be possible.

Your benefit with more rye (example calculation):

Saved feed cost	-6.3 %	You Save: 9,335€
Lower N intake	-5.0 %	You Save: 824 kg N
Lower P intake	-2.9 %	You Save: 186 kg
Fibre for animal welfare	+1.9 %	You increase: 1 kg

Farmers can save even more P and N with free Amino acids.

Saving Costs

	Price € per t soybean meal	420		320		
	Price € per t wheat	160	180	200	220	
Exchange value	Rye €/t	156.0	175.5	194.8	214.0 ➡	btw. 4-6 €/t
	Barley €/t	150.7	168.8	185.4	203.5	
	Triticale €/t	165.6	184.9	201.5	220.8	

Saving Costs

Exchange value according to Löhrl: Energy density (MJ ME/kg) and SID-lys (g/kg) remain equivalent in regard to the main feed value properties.

Grain or whole crop?

In the case of feed shortage wholecrop rye silage can be a lucrative option. The question if this year rye is used for silage or harvested is mainly influenced by market prices, the gross margin (– permanent labour costs) of the cash crop, farm individual costs for the alternative use as wholecrop and the purchasing price of forage. Wholecrop rye silage can be valuable roughage if forage harvesting and ensiling were carried out according to good agricultural practice.

For more information and further details please check the online article at: <https://www.saaten-union.com/index.cfm/article/10423.html>

Costs of Silage Use (Hybrid Rye)

Index	Unit	Whole-crop silage
Yield	silage t/ha	35.0
	t DM/ha	12.0
	NEL MJ/kg	5.8
Opportunity costs	€/t	4220
Direct costs	€/t	4600
Operational costs	€/t	5800
Costs incl. opportunity costs	€/t silage	42
	€/t DM	122
	Cent/MJ NEL/t	71

Source: LELF, KTBL self-estimation

Purchase Price and Transport Costs

Index	Unit	Price level maize silage ø		Price level maize silage harvest 2018		
		low	high	low	middle	high
Purchase price	€/t silage	25.0	32.0	35.0	45.0	55.0
Quality	DM-content %	32	32	32	32	32
	GJ NEL/ha	6.5	7.1	6.5	6.5	6.5
Transport distance	km	10	10	10	10	10
Transport costs (0.2 € per t/km)	€/t	2.0	2.0	2.0	2.0	2.0
Costs of maize silage purchase	€/t silage	27.0	33.0	37.0	47.0	57.0
	€/t DM	84.4	103.1	115.6	146.9	178.1
	Cent/MJ NEL/t	54.84	73.22	75.16	95.47	115.78

Source: LWK Niedersachsen, self-estimation



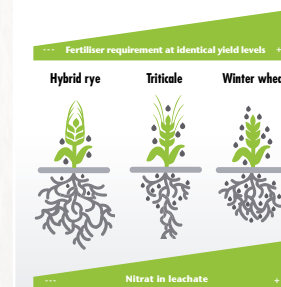
Cultivation Advantages.

As hybrid rye is very withstanding it is often grown on light soils. However, it also achieves competitive yields on better yielding soils. Due to its good root penetration hybrid rye requires less water and nutrients compared to other cereals. This is a benefit particularly in regard to new fertiliser regulation. Furthermore, rye has lower demands on plant protection.

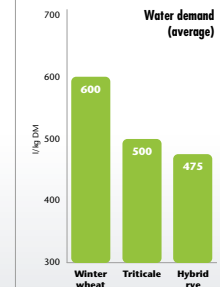
Nearly all arable crops are suitable as a preceding crop for hybrid rye. In practice, however, rye often follows

Benefits of Growing Rye

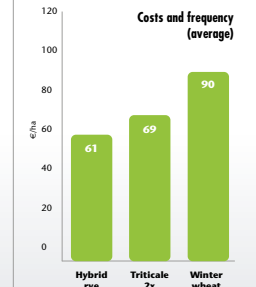
Nutrient efficiency



Water efficiency



Pesticide applications



HU SEED HYBRID RYE

cereals or silage maize as the good effect of broad-leaved preceding crops is used for the more demanding wheat. Therefore, on arable farms and on higher yielding soils the cultivation of rye has been clearly reduced in recent years. On the one hand, this effected biodiversity and on the other hand it effected the cultivation of foliar healthy cereals. In general, focusing on short crop rotations increases production costs.

On arable farms rye is mainly grown in the crop rotation as second cereal crop or continuous cropping. Livestock farms often grow forage maize as a preceding crop to rye.

On sandy soils soil quality is usually the limiting factor. Therefore, due to the lack of profitable alternatives to rye crop rotations are limited.

For sowing hybrid rye seed rates between 150 to 250 germinable grains/m² have proven successful. Economical-



ly, maximum yield can be achieved between 180 to 200 germinable grains depending on sowing date and soil conditions. Optimal planting depth is at 2 to 3 cm.

Reference: <https://www.saaten-union.com/index.cfm?m=aussaat>

Hybrid Rye Agronomy Guide

Cultivation suitability depending on preceding crop		Sowing date and seed rate**			Sowing depth
Preceding crop	Suitability	Drilling date	Seeds/m ²	Units/ha	cm
Winter oilseed rape*	++	End of Sept. to 10th of Oct.	160 – 190	1.6 – 1.9	2 – 3
Legumes*	++				
Potatoes*	++				
Wheat	+	10th of Oct. to end of Oct.	190 – 220	1.9 – 2.2	
Triticale	0				
Barley	+				
Rye	0	End of Oct. to 10th of Nov.	220 – 250	2.2 – 2.5	
Forage maize	+				
Grain maize	+				

*Favourable preceding crop but luxury as other following crops can make better use of the preceding crop.

++: best suitability, 0=medium suitability

**Average

Hybrid Rye Agronomy Guide

Nitrogen fertilisation: Emphasis should be placed on starter application.

Fertilisation	Common practice	*Alternative splitting
Starter application	100 kg/ha – N _{min} 0 to 30	**170 kg/ha – N_{min} + 20 kg S/ha
Stem extension (GS 30/31)	70 kg/ha – N _{min} 30 to 90	/
Flag leaf application (GS 37/39)	/	/

* Favourable splitting, fertiliser is dissolved in soil before spring and early summer drought respectively – good experiences in practice.

** Use of stabilised N fertiliser or slurry/fermentation residues

Note: consider fertiliser requirement calculations

Plant growth regulator

Necessity	2 nd application if required
GS 31/32: 1 l CCC/ha + 0.3 l Moddus/ha Alternative: 0.6 kg Prodax/ha	A second application could be necessary on better sites. Field checks!

Fungicide treatments

Depending on disease pressure
In general one treatment at GS 39/40 is sufficient. (Note: Choose fungicides with a good protective performance!)

Plant protection

Rye is considered as a very healthy crop but is not completely free of diseases such as soil-borne diseases, ergot, brown rust and Rhynchosporium. Snow mould, powdery mildew, black rust and soil-borne viruses vary in their regional significance. Brown rust, Rhynchosporium and powdery mildew are the most important diseases nationwide. However, they can be successfully controlled by fungicide treatments. Thanks to plant breeding, rye varieties with good brown rust resistance are now available. Fusarium head blight susceptibility is classified as being low in rye. Premature bleaching symptoms usually only occur

on single spikelet's. Infection of complete ear rows or even of the total ear does not occur naturally in rye. Snow mould can cause considerable winterkill. Only seed-born infestation can be controlled by seed treatments. Black rust is a dangerous pathogen that can occur in Germany and Austria during hot and droughty conditions. Damages can be severe as the fungus infests the stem and thus significantly restricts water and nutrient transport. Ergot infection is problematic. Deductions are made if rye for human consumption exceeds at delivery. Only batches with an ergot content of no more than 0.05 % by weight can be marketed as baking rye without deductions;

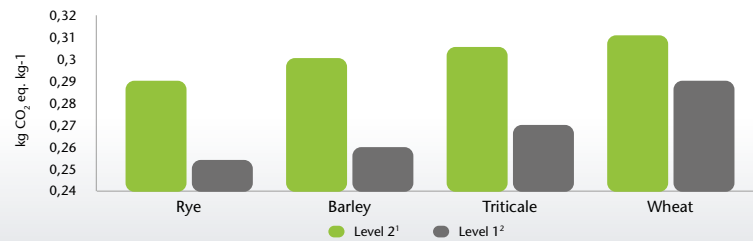
for rye as animal feed the maximum threshold is 0.1 %. Contaminated harvested crops must be cleaned. Ergot should be completely avoided in the food chain. Variety choice is only one influencing factor but in years favouring infection it is far from being sufficient to control the problem. A range of measures must be taken including appropriate cultivation measures and in particular thorough cleaning carried out by the dealers.

Reference: <https://www.saaten-union.com/ergot-classifications>

Nutrition/water efficiency

Rye is the most N-efficient cereal. Nevertheless, nutrient supply must be ensured by targeted fertilisation in order to make full use of the yield potential. Depending on yield expectations and site conditions N requirement of rye is between 130 to 170 kg N/ha incl. N_{min} . If N supply is too high rye is prone to lodging causing problems such as regrowth. According to the new fertiliser regulation (2017) for example, at an expected yield of 7.0 t/ha, 170 kg N/ha incl. N_{min} can be applied. Please take the required additions and deductions of the new fertiliser regulation into account (e. g. organic fertilisation).

CO₂ Footprint



In the year 2019/2020 for the first time we have started to carry out our own experiments on nutrient and water efficiency. For more information see "Extras".

CO₂ Footprint

The CO₂ footprint is an important tool for assessing climate impact. In a Polish study it could be shown that rye has the lowest CO₂ footprint measured by emissions resulting from intensive/extensive cultivation (level 1/ level 2)*.

*Cemdirbyste-Agriculture, vol. 103, No. 3 (2016), p. 259-266

¹ Trials are carried out with growth regulators and fungicide treatments

² Trials are carried out without growth regulators and fungicide treatments

Advantages in Pig feeding.

An increase in the use of rye has been clearly noticeable again for some time. A major driving factor is the saving of feed costs. The price differences between wheat/barley and rye are between 20 to 30 Euros/t.

Benefits for Animal Feeding



In terms of feeding value this price difference is far too big offering a leverage to save considerable cost in pig fattening.

Environmental and animal welfare are current issues and therefore it is worthwhile to have a closer look at the rye's components:

Nowadays, more than ever performance orientated feeding takes fibre into account as part of the diet formulation and uses it to optimise compound feed. Fibre is less

important to the animal as an energy and nutrient supplier but as a gut filler and substrate for benign microbes in the digestive tract. It helps to establish a favourable gut flora and improves intestinal health. Rye provides more dietary fibre than any other cereal and therefore has a beneficial effect on animal welfare and health.

Rye is an energy-rich grain crop that contains relatively little nitrogen and, with 3.0 %, has the highest lysine content in total protein and highly digestible phosphorus predestining rye for N- and P-reduced final fattening feed mixtures. If pigs take up less



crude protein and phosphorus their metabolism and organs are less stressed improving the animal's health. At the same time a better feed conversion reduces the amount of produced slurry which also contains less N and P. The latter is especially interesting for farmers with a high stocking rate and little land – less slurry has to be disposed of elsewhere.

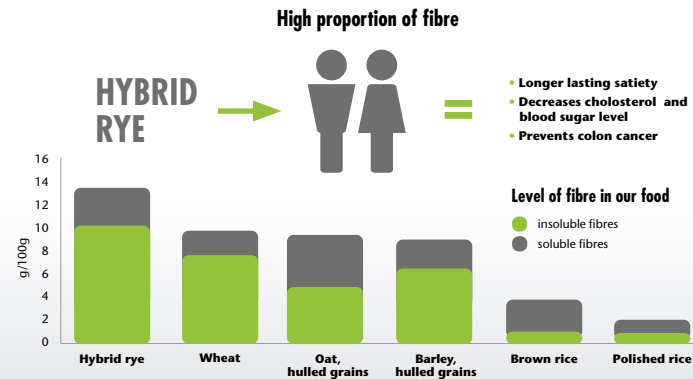
More information:
<https://www.saaten-union.com/index.cfm/article/9978.html>
<https://www.saaten-union.com/index.cfm/article/10019.html>
<https://www.saaten-union.com/index.cfm/article/10317.html>

Advantages Human nutrition.

Scandinavian scientists of the Nord-Food programme, which was launched in 1993, showed that rye has cancer-protective properties. Rye bread has a preventive effect on prostate, breast and colon cancer and can thus play a key role in human and animal nutrition and contribute to intestinal health.

The study specifically highlights lignan and dietary fibres. Compared to other cereals rye is characterised by a high lignan* content and a particularly favourable ratio of soluble (27 %)

Benefits of Growing Rye



*Lignan= a secondary metabolite which is needed for the formation of lignin.

and insoluble (73 %) fibres. Dietary fibres are to a large extent indigestible food components which occur predominantly in plant-based foods and are only metabolised by bacteria in the large intestine. Thereby, the acetic acid acetate and short-chain fatty acids like butyrate are produced, which in turn have many positive effects on the body as described above.

However, there is a considerable lack of healthy fibre in modern diets. Humans should have a daily intake of approximately 30 grams or even better 40 grams. Diabetics should consume 40 to 50 grams per day.

In the Palaeolithic age humans probably had an approx. daily intake of 100 grams. Today, the German average amounts to maximal 18 grams.





SAATEN-UNION. Projects and Trials.

MyRye Feeding project

Using rye for pig fattening is competitive, supports animal welfare and animal health and contributes to more sustainability! A new research project, which is comprehensively presented in the following article, investigates if these positions can be validated and to which economically evaluable extent.

As part of the MyRye project, a new study which is financed by SAATEN-UNION and Elsoms Seeds investigates the value of hybrid rye in final pig fattening. The 6-month project will be

carried out and supervised by Helen Miller, Professor of Animal Biosciences at the University of Leeds. Due to millions of dollars of investment the University of Leeds now has a world-class pig research facility and is one of the best institutes in Europe in regard to research in pig nutrition, behaviour and welfare as well as production systems.

How does rye perform in regard to cost reduction, constituents and animal welfare? During final fattening, pigs consume the largest amounts of

feed. At this stage objectives such as cost-effective and sustainable feed use are particularly important. Health risk and stress minimisation also gain in importance as losses have a greater impact.

The question is: What are the benefits of feeding rye?

1. Purchasing rye is 20 to 30 Euros/t cheaper than wheat and 10 to 20 Euros/t cheaper than barley. In terms of feeding value this price difference is far too big offering a leverage to save considerable cost in pig fattening. Home-

grown rye for animal feed saves direct and labour costs (less fertiliser, crop protection, field passes and so on).

2. Compared to other cereals rye is an energy-rich grain crop that contains relatively little nitrogen and, with 3.0 %, has the highest lysine content in total protein and highly digestible phosphorus predestining rye for N- and P-reduced final fattening feed mixtures. If pigs take up less crude protein and phosphorus their metabolism and organs are less stressed improving the animal's health. At the same time a better feed conversion reduces the amount of produced slurry which also contains less N and P. The latter is

especially interesting for farmers with a high stocking rate and little land – less slurry has to be disposed of elsewhere.

3. Fibres are a gut filler and growing substrate for benign microbes in the digestive tract as well as for the development of favourable microbial flora and resilient intestinal health. Rye has more fibres than any other cereal and therefore has a beneficial effect on animal welfare and animal health. In the large-scale project six different feeding diets are investigated, with a rye content ranging from 0-100 %. Thereby, various indicators are recorded: Feed intake, daily increase, intestinal health, nitrogen and phosphorus

reduction in slurry, animal behaviour as well as meat performance and meat body analysis.

Reference to SU BENDIX:
<https://www.saaten-union.com/index.cfm/action/varieties/cul/307/v/1608.html>



Field trial: Efficient Fertilisation of Winter rye with Farm manure

Due to its excellent root performance rye achieves high nitrogen utilisation rates from applied manure. This has already been sufficiently demonstrated in plot trials carried out by the regional authorities. However, in practice the recognition has been very little so far. For this reason, the SAATEN-UNION has carried out large-scale trials on practical farms in order to demonstrate that rye is the most predestined of all cereals for using slurry and fermentation residues efficiently. Fertilisation can be carried out to 100 % with slurry!



The aim is to produce rye at low cost without using mineral fertilisers. Furthermore, it is shown that rye is most suitable for regions which are expecting N-fertilisation restrictions in the future due to the political framework.

Plot trial: Resource efficiency of hybrid rye versus winter wheat

Which crop – rye or winter wheat – is better at managing fertiliser and water resources is investigated by further trials. For this purpose, a site was selected which offers the possibility of irrigation. In Lower Saxony, large parts of the grain cultivation area is under irrigation.

In future this will no longer be possible to the same extent according to the local water authorities. Because of the droughts in the years 2018 and 2019 irrigation quotas are going to be reduced as groundwater recharge has not taken place due

SEED HYBRID RYE

to insufficient rainfall. On marginal sites in particular winter wheat can only be produced profitably by using irrigation. This offers rye a chance for a comeback in the more classical rye growing regions.



An evaluation of hybrid rye versus winter wheat is to be carried out taking economical aspects into account.

Further Development of the “Green Revolution”

In an international alliance HYBRO would like to make rye more attractive and prepare it against the impacts of climate change. A current study makes precision tools available to use the short straw gene Ddw1 in breeding and to provide new insights into its mode of action.

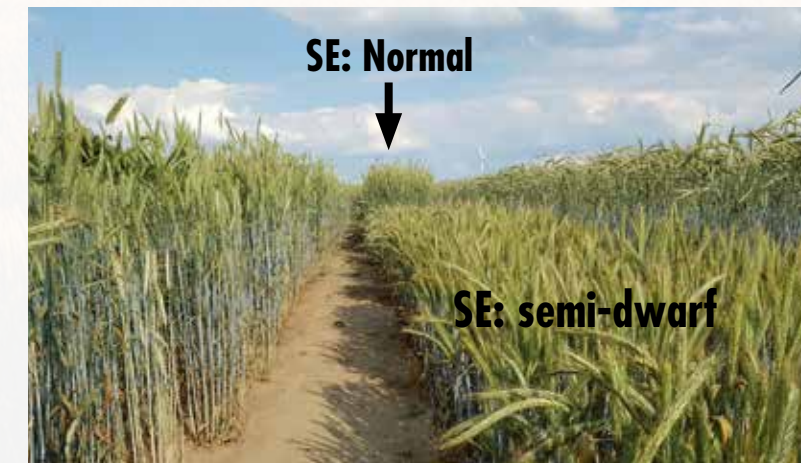
An international research consortium, to whose eleven members the HYBRO

belongs, wants to get rye ready for the future and make it more attractive. Based on its good properties such as winter hardiness, low demands on soil quality and the lowest CO₂ footprint amongst cereals the RYE-SUS project aims to improve storability and drought stress tolerance of rye. In the mid-20th century, breeding semi-dwarfs had led to an enormous yield increase in wheat, partly because short stems can carry much heavier ears without lodging. “Now, we want to introduce an equivalent short straw era in rye. Molecular data show that Ddw1 could also be a key to increasing the rye’s drought tolerance”, explains Hackauf.

According to the researcher’s plan in future chemical growth regulators can be dispensed of and energy costs for harvesting and drying are also reduced if high-performance hybrids with high ergot resistance and shortened stems are cultivated. In order to be able to predict the performance of the breeds under various climate conditions the JKI experts want to establish the first growth and development model for rye within the framework of RYE-SUS. Other features they are working on include the root system and the genetic and molecular basis of the rye’s pronounced winter har-

diness. The RYE-SUS project receives funding from the research and innovation programme “Horizon 2020”

of the European Union under Grant Agreement No. 771134.





Future: In the end it is a race.

Boldly spoken, after its “industrialisation” crop production is facing now “bioeconomy”. This involves closed loop agriculture, resource protection, biological regulation and genetic diversity. Decline scenarios cannot be drawn from that! Those are usually wrong as adaption opportunities and technical innovations are underestimated. Future yield development is not destiny but the result of positive and negative effects of which some can be influenced! At the end it is a race! So far it is not foreseeable how much climate change and production

restriction will influence yield – in regard to the “red zones” pessimism prevails at the moment.

A crucial factor will at the end be if by comparison the breeding progress – and thus factor productivity – is bigger or smaller. However, optimism is more appropriate looking at the development on field plots and in laboratories. This applies in particular to hybrid rye. Ongoing breeding projects are already announcing a leap in development for the near future: New hybrids containing the short straw

gene Ddw1 achieve higher yields due to an improved harvest index, better lodging resistance and pollination, in particular on drought-prone sites! Breeding innovation in conjunction with digitally optimised production processes can contribute to further increases in rye yield! In the past 30 years, hybrid rye has been the cereal with the greatest breeding progress in yield. The drought-tolerant and resource-saving rye could expand this pioneering role and develop into a highly economical cultivation alternative even on higher yielding sites!



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Züchtung ist Zukunft