Improved animal welfare with PollenPlus®-hybrid rye

Rye in pig feed

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Learn more about how farmers improve pig fattening with rye, Dr. Richard Grone.

Simply scan the adjacent QR code with your smartphone to watch!

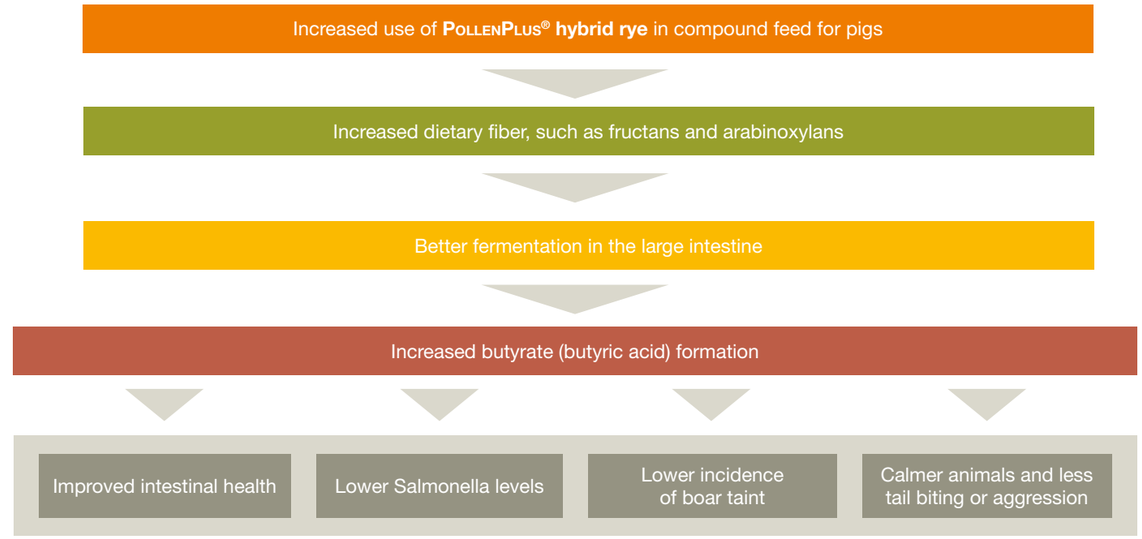
Contents

Rye in feeding

Latest findings on the use of rye in modern pig feed

Feeding concepts for fattening pigs are often primarily based on wheat, triticale or corn. The latest research shows that the use of high levels of rye in diets for fattening pigs has various advantages in relating to its high-fiber content (fructans and arabinoxylans).

Improved animal welfare with rye feed



Own representation (KWS LOCHOW, 2020)

Other positive effects of rye feed:

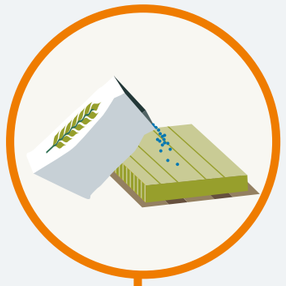
- High energy content
- Highest grain phytase activity
- Lysine-rich amino acid profile
- High daily gains
- Great carcass quality
- Improved animal health and welfare
- Product safety due to low Fusarium susceptibility
- Increased palatability
- Reduced ergot risk with PollenPlus® hybrid rye

Healthier pigs with rye feed

Rye breeder

"By breeding PollenPlus® varieties with stable ergot defense, we contribute to high feed safety."

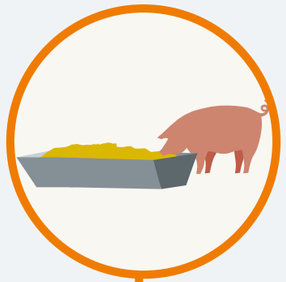
Dr. Andrés Gordillo
Head of Breeding hybrid rye,
KWS Cereals



Compound feed producer

“Rye’s energy and protein levels compare well with those of wheat. Its non-starch polysaccharide or fibre content is associated with additional welfare and gut health benefits. Rye has slow release of energy from the large intestine and increases satiety, which is why it has been associated with positive behavioural effects in finishing pigs and gestating sows. This effect may also be of value over the farrowing process where a continued supply of energy may help reduce the number of stillborn piglets.”

Dr Steve Jagger
Senior Pig Nutritionist ABN, AB Agri Ltd



Pig farmer

"We have been using rye feed on our farm for many years with high performance levels. We use 25% rye in the finisher diets. So far, rye has been attractive to us as self-mixers because of its yield stability and N efficiency at low input concentrations. However, the latest scientific findings also show that rye has added value in feeding."

Philipp Sohnrey
Farmer from the district of Göttingen, sows in a closed loop herd system with self-breeding

Rye grower

"I choose hybrid rye because I have been harvesting stable and high yields for years and the ergot defense of the PollenPlus® varieties is simply excellent."

Enrico Richter
Farmer from the district of Märkisch-Oderland,
430 ha hybrid rye under cultivation

Feed consultant

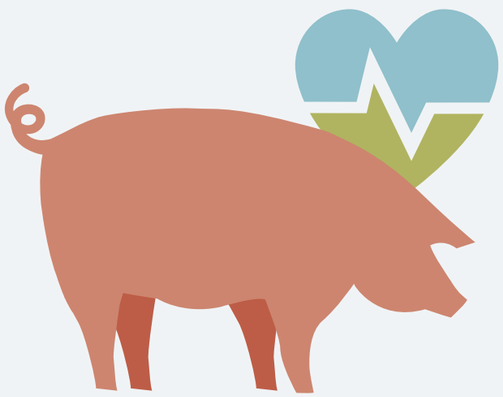
"We have been using rye successfully for many years in our consulting pool. None of the farms have problems with Salmonella."

Dr. Uta Klußmann
Pig Advisor Beratungsring Hannover-Land e.V

Veterinarian

"Feed components have a significant impact on animal health. In practice, rye has proven particularly effective in Salmonella control."

Dr. Sebastian Bunte
Veterinarian,
Tierarztpraxis Dr. Erpenbeck, Glandorf



Pig marketer

"High levels of rye in pig feed ensure greater animal welfare and better health throughout the production chain – from piglets to fattening pigs."

Wilhelm Behrens
Pig Trader Viehvermarktungsgemeinschaft Aller-Weser-Hunte eG

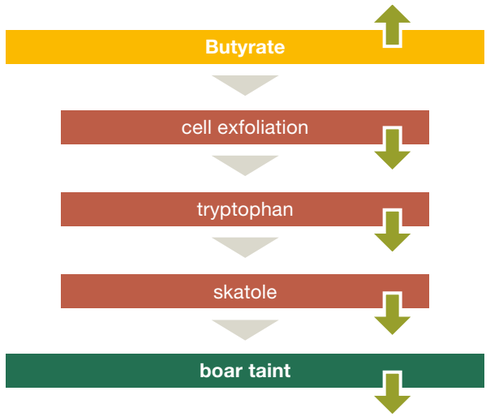
Fructan and arabinoxylan levels in rye increase butyrate formation

Cereal type (88% TM)	Energy (MJ ME/kg)	Protein (%)	Crude fiber (%)	Fructan (%)	Soluble arabinoxylan (%)
Wheat	18.5	13.7	2.1	1.0	1.4
Barley	18.7	12.3	4.2	0.6	1.0
Rye	18.4	**11.7**	1.8	**2.9**	**3.1**
Triticale	18.4	12.4	2.1	0.6	1.3
Fermentation to:			⬇ **Acetate**	⬇ **Butyrate**	⬇ **Butyrate**

(Rodehutscord et al. 2016, modified from KWS LOCHOW, 2020)

Rye digestion

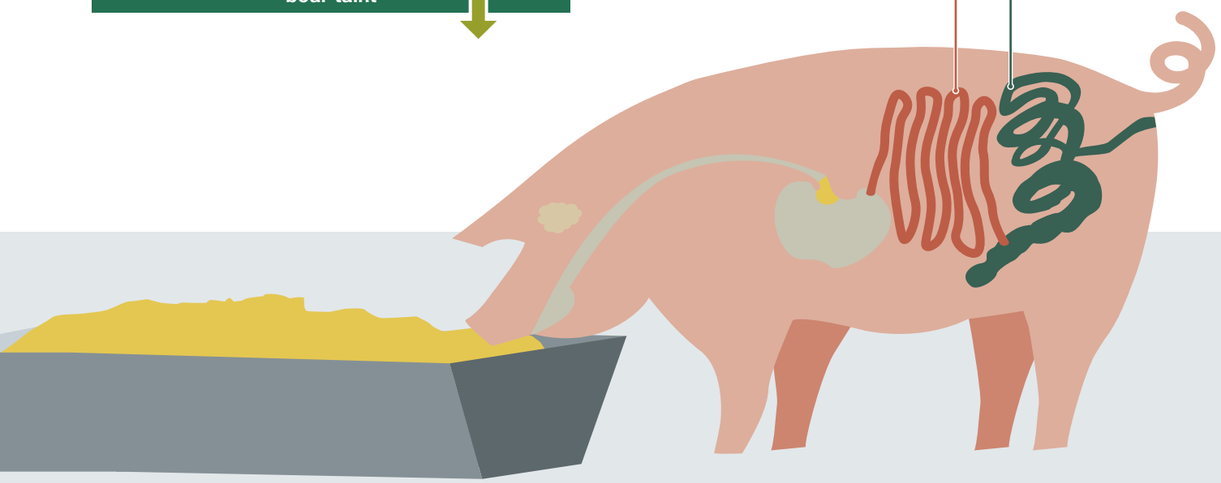
Butyrate (butyric acid) is a key product of rye dietary fiber fermented by microorganisms in the large intestine.



Butyrate determines the environmental and substrate conditions of the intestinal contents
Butyrate interacts with various microorganisms (including **Salmonella**), modifying their metabolism and reducing their pathogenic effect.

Small intestine (enzymes)
digestion mainly of starch, sugar, protein and fat

Large intestine (microorganisms)
fermentation of fructans and arabinoxylans, among other things, to mainly **butyrate**

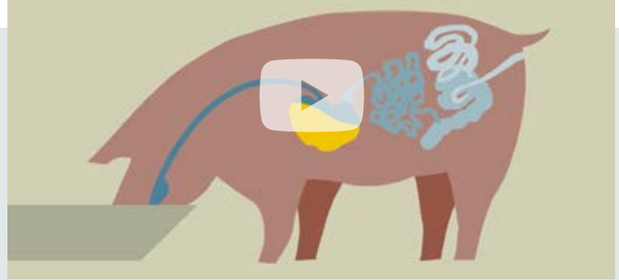


Fructan and arabinoxylan levels in rye are twice as high than in other cereals
From an animal nutrition perspective, it is the special components of rye that are not found in classical feed analysis that play a decisive role – specifically the rye fiber content and its respective **fructan** and soluble **arabinoxylan** content. The levels of these compounds are approximately more than twice as high in rye compared to other cereals. The microbial degradation products of these particular dietary fibers in rye leads to increased **butyrate** formation in the intestines of pigs. The scientific confirmation of the hypothesis that Butyrate produced in the pigs hind gut leads to reduced Salmonella levels. A key focus of the "6-R Concept" research project (see pages 12–19).

In addition, rye is characterized by a **higher proportion of essential amino acids in the protein** content relative to other cereals. Because **phytase activity** in rye is higher than in other cereals, rye feed results in higher **phosphorus digestibility**. Therefore, the use of rye in highly N- and P-reduced mixtures is advantageous.

How does it work?
The following video shows the different processes in the digestive tract of pigs and how, through increased butyrate formation, rye feed reduces the incidence of Salmonella contamination and boar taint:

Rye digestion in the digestive tract of the pig.



Watch the video here:
www.kws.com/gb/en/products/cereals/hybrid-rye/ryevolution/feeding/

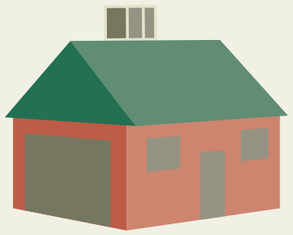
Field study on rye feed

Animal welfare is becoming an increasingly important issue for farmers. In addition to husbandry, species-appropriate animal nutrition can promote animal welfare and food quality. For this reason, Viehvermarktungsgemeinschaft Aller-Weser-Hunte eG, in cooperation with KWS Getreide, launched a field study in spring 2017 to investigate the benefits of rye in the fattening of pigs.

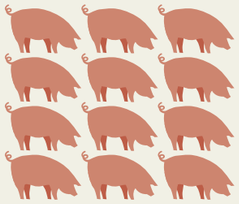
The aim of the project is to optimize the economics of fattening farms and increase animal welfare through the use of rye feed.

Key facts of the field study:

9 farms



> 117.000 animals
incl. > 46.000 boars



40% rye content
in a particular feeding concept

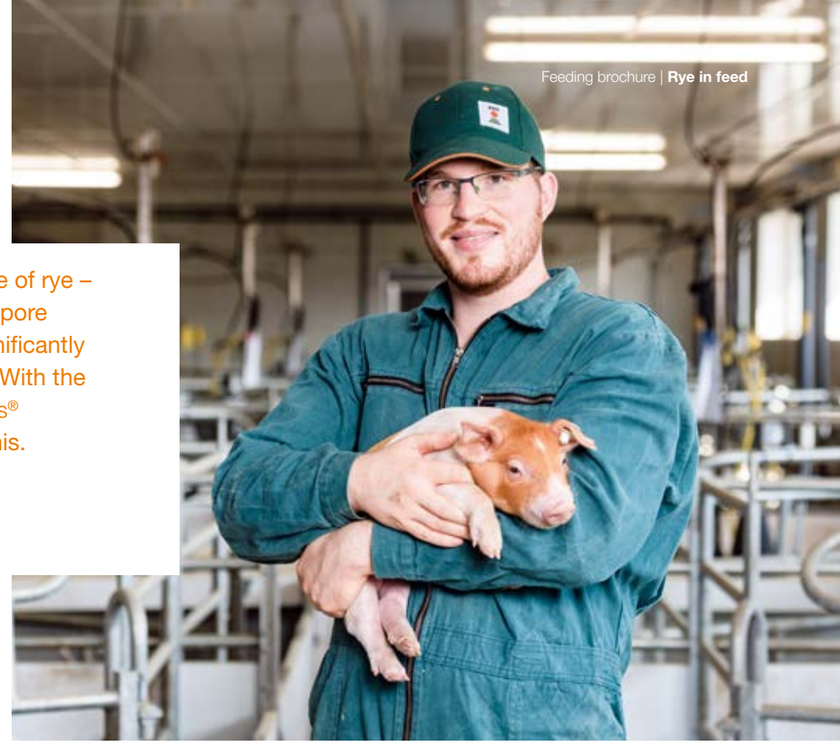
Feeding concept:

- 40% rye in the finisher diet (5% in the starter phase, 20% in the grower phase)
- 25% barley
- The rye is ground as coarsely as possible
- The lysine/energy ratio should be at least 0.75 g/MJ ME

Criteria compliance was verified by LUFA in Oldenburg.

> The farm managers were able to achieve significantly lower Salmonella levels together with reduced boar taint, while animal performance remained the same and carcass traits were good. This is a great advantage for all parties involved and these rewards are likely to pay off even further. Conditions that require no docking or castration are very likely to become an issue in the future, and without a feeding concept of this nature these conditions will be difficult to meet.

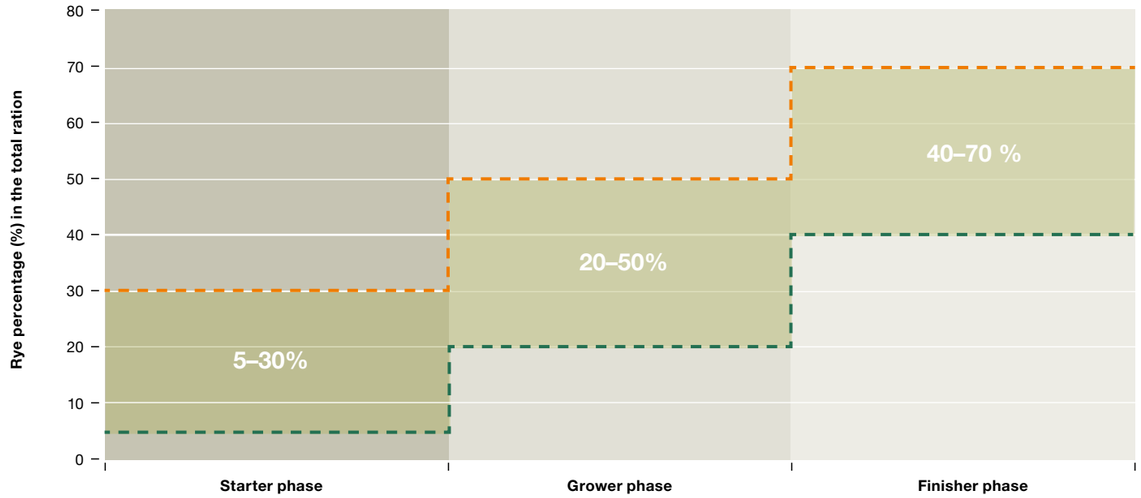
Wilhelm Behrens
Managing Director, Viehvermarktungsgemeinschaft Aller-Weser-Hunte eG



> The previous disadvantage of rye – its susceptibility to ergot spore infestation – has been significantly reduced by modern plant breeding: With the right variety and by using PollenPlus® technology, I can largely eliminate this.

Dr. Richard Grone
Product manager, Feed International
KWS Cereals

Recommendations for using rye in feed



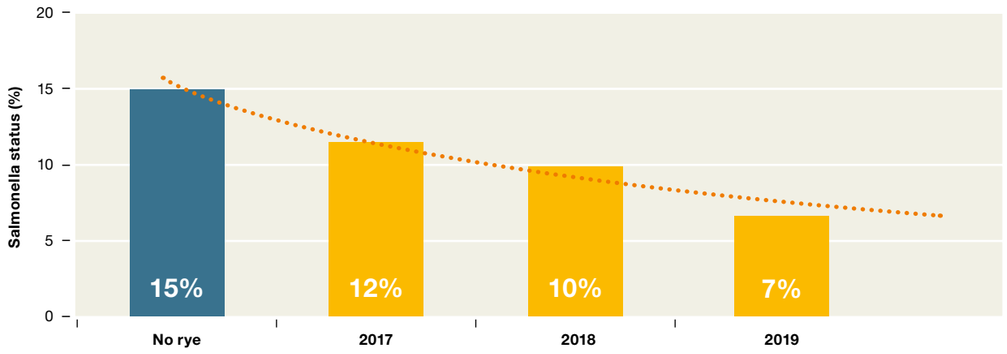
(Own representation based on information from the field study and Wilke 2020, KWS LOCHOW 2020)
* Verified in the field study with approx. 120,000 animals
** Verified by the University of Veterinary Medicine Hannover

The key factor is the composition of the ration and what should be replaced. To achieve measurable effects when using rye in feed, the minimum application quantities should be observed.

Reduced Salmonella levels at the trial farms

! Salmonella rates were reduced by up to 50% across all farms.

Decreased Salmonella levels due to rye feeding.



Salmonella status of all 9 farms in field study until 31.12.2019; n = 117,455 (KWS LOCHOW, 2020)

Results for individual farms using the specified feeding concept:

- Reduction of Salmonella levels by up to 50%
- Significant improvement in the Salmonella category status
- Reduction or avoidance of boar taint in boar fattening
- Simultaneous high performance spectrum (> 800 g daily gains)
- Calmer animals due to uniform satiation

At the Beratungsring Hannover-Land e.V., we have been successfully using rye in feed for many years. **The self-mixed** feed contains an **increasing proportion of rye**, starting at 15–20% in the starter phase, increasing to 20–30% in the grower phase and ending with 40–60% in the finisher phase, depending on individual farm availability. None of the farms have problems with **Salmonella**. It is important that the grain in the mix is not ground too finely. Depending on the dry matter content of the grain, 3, 4 or 5 mm perforated or wire screens are used. It is necessary to **check the milling process** using a shaking box.

Dr. Uta Klußmann
Beratungsring Hannover-Land e.V.

! The field study shows that, in practice, up to €10 more can be earned per pig per year. For a farm with 3.000 fattening spaces, switching to rye-based feed means additional earnings of €80.000 to €90.000 per year.

More economical fattening with rye

Click here for a video on the positive effects of hybrid rye in pig feed:
www.kws.com/gb/en/products/cereals/hybrid-rye/ryevolution/feeding/

Scientific findings

Latest research on pig feed: Improved animal welfare

The goal of this research project is to investigate the specific components of rye (particularly the non-starch polysaccharides) and canola (as a protein source). Of interest are the effects on health and performance when using high levels of rye in the mixture based on PollenPlus® hybrids with good ergot resistance.

6R-CONCEPT

ANIMAL WELFARE WITH PollenPlus®-RYE

Supported by:

Bundesministerium für Ernährung und Landwirtschaft

through a resolution by the German Federal Parliament

ptble
Projektträger Bundesanstalt für Landwirtschaft und Ernährung

6-R stands for the project title: "**R**egional **R**enaissance of **R**ye and **R**apeseed to **R**educe Problems in Crop and Livestock Production by **R**eevaluating Ingredients and Targeting Their Use to Promote Environmental, Animal and Consumer Protection".

The first results show the following:

- A high acceptance of PollenPlus® hybrid rye with a correspondingly high performance level.
- A significant reduction in Salmonella contamination due to high proportions of hybrid rye in the compound feed.
- A significant reduction in complaints relating to boar taint in the fattening of boars.
- Hybrid rye promotes gut health by "feeding" the gut wall.
- Calmer animals with reduced movement activity and thus a higher degree of well-being.
- Improved sustainability – regionally produced hybrid rye has a very low carbon footprint.

The results from the field study and extensive research approaches in the 6-R project demonstrate the considerable potential of rye for the sustainable and healthy feeding of pigs. As a regionally adapted product, rye thus offers the opportunity for healthy animal nutrition – and therefore also improved animal welfare.

> The consumer expects us, i.e., animal nutrition, to adopt approaches that promote animal welfare. And in this context, rye really deserves our attention.

Prof. (retd) Dr. Josef Kamphues
Institute for Animal Nutrition, University of Veterinary Medicine Hannover

> We receive many inquiries from compound feed companies and from pig farmers who want to use rye as part of the research project. If we were to plant about 200,000 more hectares of rye in Germany in the short term, a lot would already have been achieved.

Dr. Andreas von Felde
Head of product management Feed International KWS Cereals

In the project, which will run until 2022, the following participants are responsible for the following tasks:

- KWS – together with the Viehvermarktungsgemeinschaft Aller-Weser-Hunte eG and the mixed feed producer Raiffeisen Mittelweser – will implement the trials with the specified rye qualities.
- The most appropriate feed mixture for reducing Salmonella is being developed by the Institute for Animal Nutrition at the University of Veterinary Medicine Hannover.
- Animal nutritionists at the Freie Universität Berlin will test, among other things, the effects of rye-rich mixed feed on the intestinal mucosa and its defense function.
- Animal nutritionists at the University of Bonn will analyze the special non-starch polysaccharides (fructans and arabinoxylans) in rye and determine the energy content and digestibility.

High acceptance promotes performance

As seen in the scientific trials in the field, feeding rye to young animals is both possible and makes sense.

Effects of rye on the most important performance parameters in young pigs for fattening

Rye content in the ration	0%	23%	46%	69%
Feed intake (g/day)	**1220** (± 84.6)	**1173** (± 81.2)	**1225** (± 160)	**1257** (± 149)
Daily gain (g/day)	**883** (± 68.9)	**862** (± 59.5)	**865** (± 104)	**839** (± 78.1)
Feed conversion (kg/kg)	**1.56** (± 0.475)	**1.55** (± 0.474)	**1.61** (± 0.495)	**1.66** (± 0.510)

Feed composition: Total cereals 79% (of which 69% is wheat that is replaced by increasing proportions of rye, with a constant barley proportion of 10%), soybean meal 11.5%
Energy (MJ ME/kg DM): 15.7–15.8
Crude protein (g/kg DM): 98–205
Piglets between 42 and 52 days old; mean starting weight: 16.1 kg
(Wilke 2020, modified from KWS LOCHOW 2020)

Findings when feeding young pigs with different percentages of rye:

- Very good and almost equal fattening performance in all feeding regimes (no significant differences).
- Rye acceptance is already high in young animals.
- Rates of 70% rye are preferred in the finisher phase.

We have had positive experiences using rye in our finisher pigs. Our starter feed contains 30% rye, which we increase up to 70% for finishing.

Sonja Schumacher
Farmer from the district of Nienburg/Weser

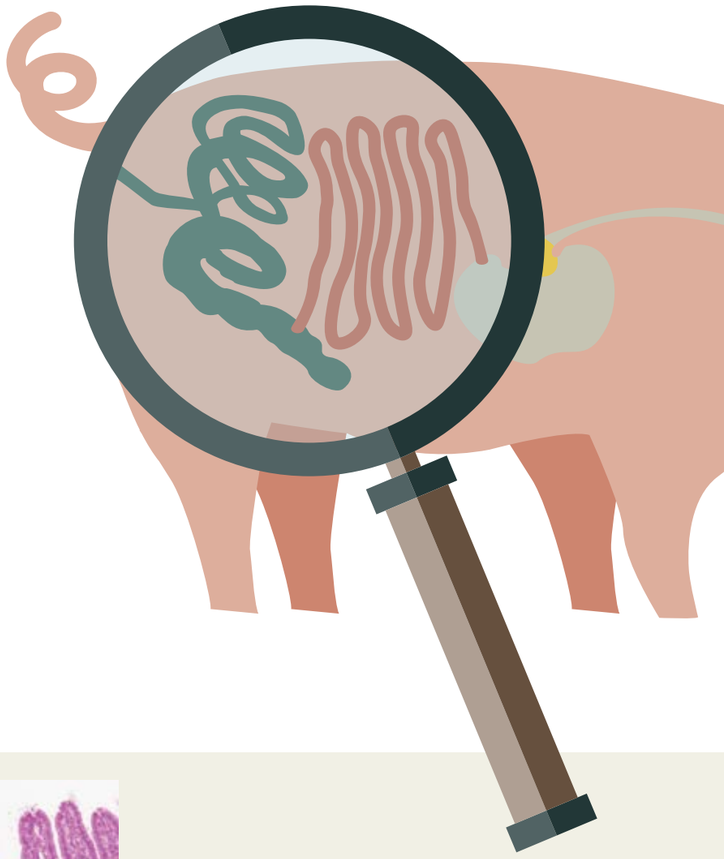
Gut health

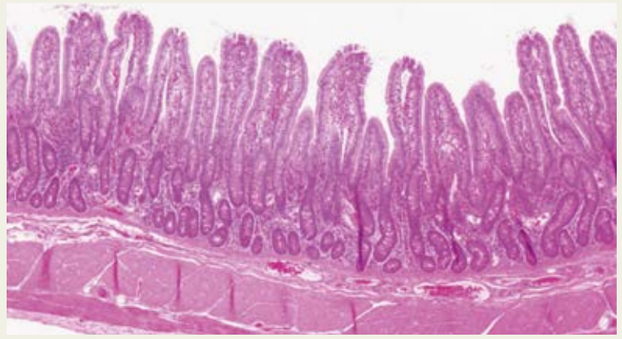
Healthy animals are happier and gain weight more easily. The basis for this is a healthy intestinal flora and the pigs' feed has a major influence on this.

Rye, as a cereal feed component, is rich in dietary fiber that is only broken down or metabolized by bacteria in the large intestine. This process produces beneficial substances that are important for maintaining the health of the intestinal mucosa and promoting the flora of the large intestine.

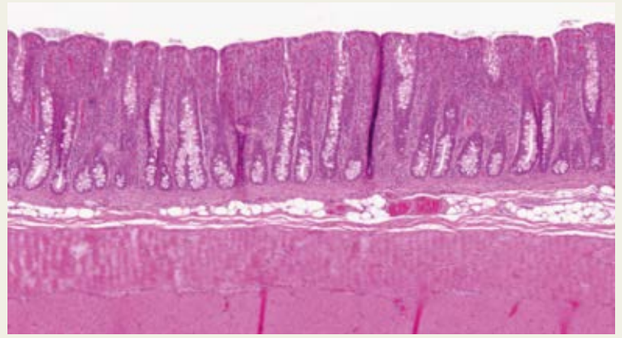
The produced butyrate is a source of energy for the thin layer of cells on the surface of the small intestine wall that are responsible for the absorption of nutrients. Butyrate also supports the growth of the intestinal cells.

! Rye nourishes the wall of the intestines, thus promoting intestinal health.





Cross-section of a healthy small intestine wall with the mucosa and villi clearly visible.



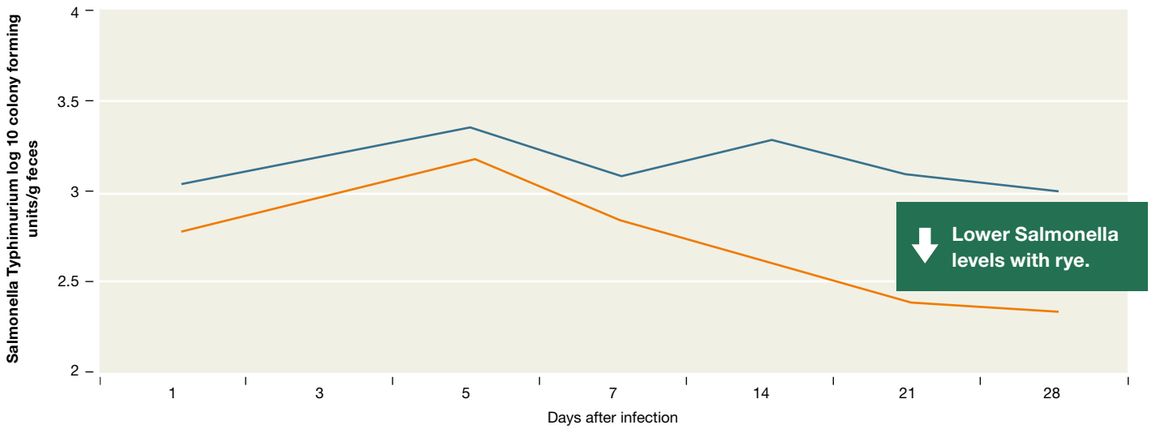
Cross-section of a large intestine wall, which is nourished with substances formed by the intestinal flora from the feed, e.g. butyrate.

Source: Carola Ellner, Institut für Tierernährung, FU Berlin

Reducing Salmonella

In this trial on Salmonella reduction within the 6-R Concept, very young pigs were fed a 69% wheat ration in the control group shortly after weaning and a 69% rye ration in the comparison group. The Salmonella infection curve of the "rye group" shows a clear downward trend over time.

Artificial infection with Salmonella

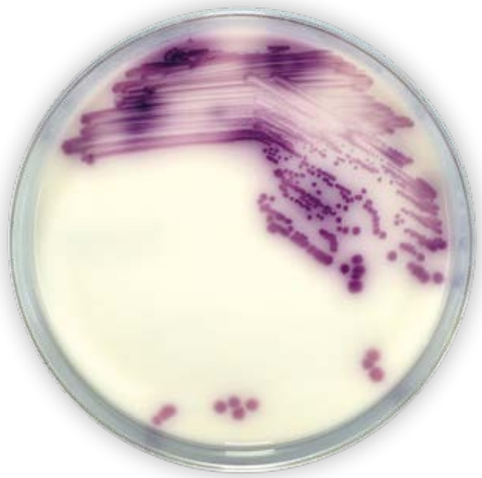


number of animals per group = 21 (Chuppava, 2020)

High levels of rye could help reduce Salmonella excretion via feces in young pigs.

Dr. Bussarakam Chuppava
Institute for Animal Nutrition
University of Veterinary Medicine Hannover

Salmonella on an agar plate



Source: Chuppava, University of Veterinary Medicine Hannover

Calmer pigs

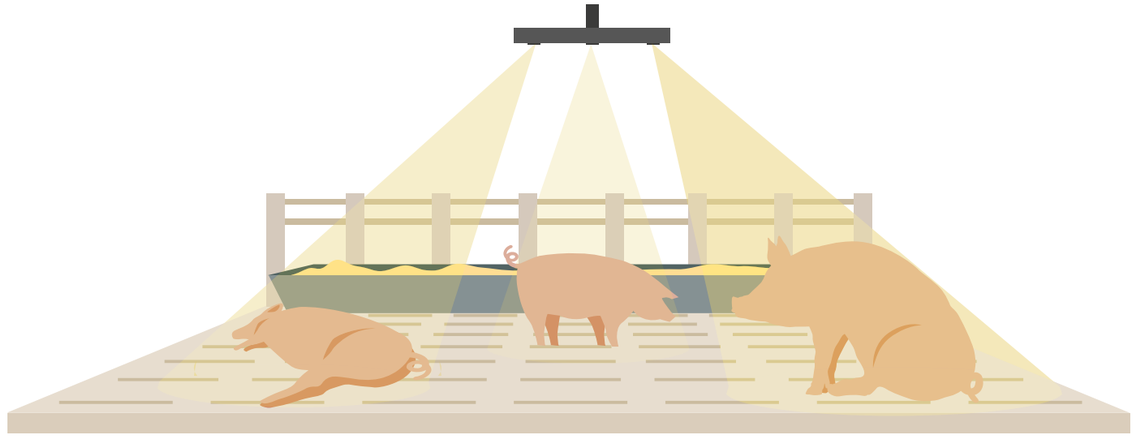
Within the 6-R Concept, the Institute for Animal Nutrition at the University of Veterinary Medicine Hannover is researching the influence of a rye-based diet on the behavior of fattening pigs. For this, a camera system installed in the barn is used to observe the pigs.

The cameras record the moving activity of the animals in a compartment for the full 24 hours of the day over the entire fattening period. Using software based on machine learning algorithms, the movement activity and position (lying, standing, sitting) of the pigs at all times is recorded. The resulting data is then evaluated using statistical methods. Groups of animals fed either a wheat-based or a rye-based mixed feed are compared with each other. In the trials, up to 70% rye is used in the mixed feed during the final fattening phase.

The expectations

Overall, calmer animals are expected, since a high rye content in the ration (compared to a wheat-based ration) results, in particular, in a higher fiber content in the compound feed, which means the following effects can thus be assumed:

- Slower and thus more sustained accumulation of glucose in the blood and thus more moderate fluctuations in glucose and insulin levels.
- Longer-lasting satiation levels due to an increased filling of the gastrointestinal tract (physical satiety) and the fermentation in the large intestine (chemical satiety).
- Positive effects on the basic mood of the animals due to the production of, among other things, butyrate as a product of the fermentation.



Source: Own representation (KWS LOCHOW, 2020).

The preliminary results from the first fattening run we observed means we are optimistic about being able to measure an effect of the rye-rich diet on behavior.

Dr. Volker Wilke
Institute for Animal Nutrition, University of Veterinary Medicine Hannover

Carbon footprint

If all pig fattening farms in Germany switched to this new feeding concept – that's more than 18,000 farms with over 17 million animals – we could save about 6.5 million tons of CO_2 annually in agriculture.

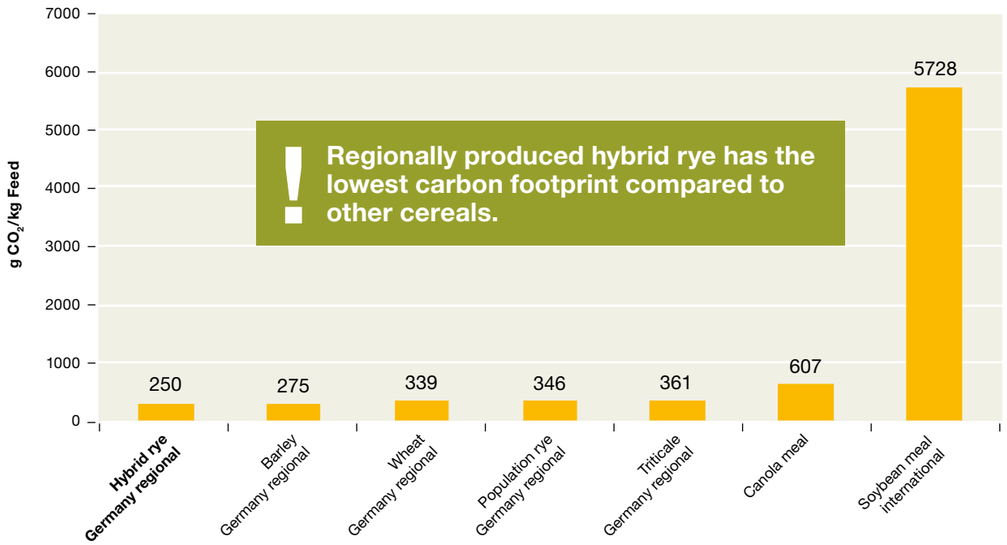
Dr. Andreas von Felde
Head of product management, Fütterung International
KWS Getreide

! Rye-rich feed mixes can reduce CO_2 emissions in pig fattening by more than 20%.

In cereal production, hybrid rye can reduce CO_2 emissions by up to 80 kg/ton of yield compared to wheat. This is because rye requires significantly less fertilizer than wheat, has much lower water requirements and generally has very good plant health.

In addition to the advantages of hybrid rye described above, the CO_2 savings from the new feeding concept arise from the fact that animal feed can be produced regionally and long transport routes are eliminated. Currently, the source of the protein content in feed is often derived from imported wheat or soybean products. This, of course, negatively impacts the CO_2 balance. Hybrid rye, on the other hand, can be grown regionally in sufficient quantities, and the domestic protein crop canola can be used to replace soybean.

Carbon footprint of different feed components



CO_2 equivalent, g/kg

Own representation using the program "feedprintNL" of Wageningen University (KWS LOCHOW, 2020)

We are convinced of the benefits of rye-based feeding in fattening. The lower CO_2 footprint of the rye ration compared to the standard wheat ration does not play a role for our 'everyday production' at the moment. But discussions about sustainability and climate protection are on the rise and have long since reached agriculture, not least due to Germany's climate protection targets.

Heinrich True
Farmer from the district of Verden, trial farm, closed herd system pig farm

RYE-SaFe

RYE FOR SOWS AND PIGLETS

Feeding with rye – for healthy sows and piglets

RYE-SaFe is a research project that focuses on feeding rye to sows and piglets. The project began in August 2020 and will run for 3 years. It addresses the question of how to reduce both the incidence of Salmonella in sow farms and the transfer of Salmonella from piglet production to fattening using a rye-based feeding concept. The research builds on the 6-R Concept and other preliminary work that has addressed, among other things, the effect of rye in feed as well as Salmonella levels in finisher pigs.

Aim of the project

The aim of the project is to investigate the effect of rye on animal health, starting with gilts, continuing with piglet production and ending with fattening.

The 3 stages of anticipated positive effects

1 Gilts
- Salmonella reduction
- Increased calmness in the barn
- Improved intestinal health

2 Sow nutrition for the periods shortly before birth and during lactation

Birth:
- Simplified farrowing conditions
- No obstipation (constipation)
- Improved manure quality
- Better start for lactation

Lactation:
- Increased colostrum quality
- Higher feed intake
- Reduced MMA (mastitis, metritis, agalactia)
- Salmonella reduction
- Increased rest

3 Piglet development
- Better colostrum intake
- Improved intestinal health
- Better weaning phase
- Salmonella reduction
- Improved manure quality

Own representation (KWS LOCHOW, 2020)

Project partners and sponsors

Gefördert durch: Bundesministerium für Ernährung und Landwirtschaft aufgrund eines Beschlusses des Deutschen Bundestages

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VIEHVERMARKTUNGS-GEMEINSCHAFT ALLER-WESER-HUNTE eG

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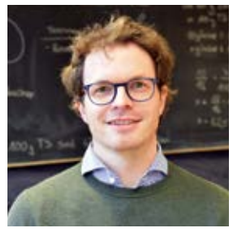


> The goal is less Salmonella contamination throughout production. RYE-SaFe focuses on using the prebiotic-active ingredients of rye to maximize butyric acid production in the large intestine. We aim to develop a new RYE-SaFe compound feed concept that offers a simple, cost-effective and animal health-promoting solution for reducing the occurrence of Salmonella in piglet production farms, thereby mitigating the Salmonella situation along the production chain.

Prof. Dr. Christian Visscher
Institute for Animal Nutrition, University of Veterinary Medicine Hannover

Sow feeding in practice

> Hybrid rye has replaced wheat in our feed ration.

Mikael Rabjerg
Østerbjergegård
Breeding farm
Sonder Felding, Denmark

The farm began using hybrid rye five years ago. Mikael Rabjerg reports on the use of rye in feed for sows and for fattening pigs.

"We produce Landrace x Yorkshire (LY) pigs for Danish pig farmers and for export. The LY crosses mean our animals are more active with a tendency to bite their tails – but since the introduction of hybrid rye in the feed ration, they have stopped doing that.

"Our young pigs (17–40 kg) get 12% hybrid rye and 18% wheat in the mix, fattening pigs get 33% hybrid rye, (the rest is barley, no wheat), gestating sows get 17% hybrid rye (with 42% barley and 12% wheat) and the gilts for sale and export get 33% hybrid rye (as for the fattening pigs).

"Our use of hybrid rye is increasing every year, making it more and more difficult to grow enough hybrid rye in our own fields to meet our demand.

"When we grind the hybrid rye, we must pay close attention because with different grain sizes, there's a risk of small grains falling through the sieve. On the other hand, we don't grind the hybrid rye too finely because of the increased risk of stomach ulcers, which we want to avoid at all costs."

Farm facts:

- Approx. 300 ha of arable land
- 75 ha of hybrid rye (8 t/ha on light, sandy soil)
- Approx. 500 breeding sows
- Approx. 6,000 gilts sold
- 8,000 fattening pigs
- Additional 240 outdoor sows

Source: Article in LandbrugsAvisen by Morten Thomsen, September 2020

Cultivating rye

The potential of hybrid rye!

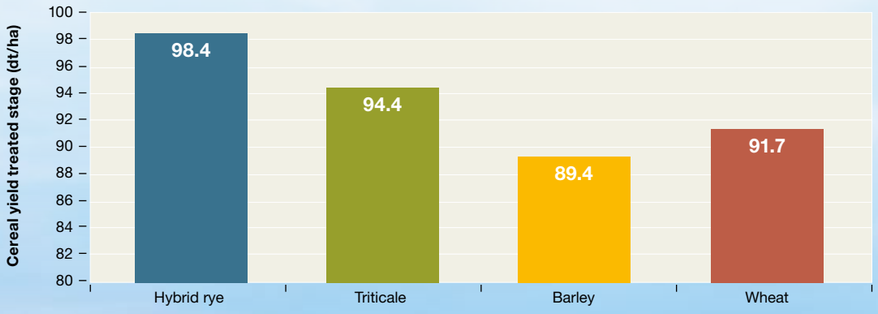
Crop comparison trials of wheat, barley, triticale and rye in the different German federal states (Landessortenversuchen, LSV)

Due to its robustness, rye is often grown on lower-yielding sites. However, an analysis of cereal yields on the same sites shows **that hybrid rye is the highest-yielding crop on both lighter and better soils.**

The analysis

- A comparison of the yields of winter cereals tested on the same LSV site (previous crop, soil quality, information provided by LSV applicants)
- Crop management optimized for the crop type at the site
- Comparison over 10 years (2011–2020)

A fair yield comparison of cereals:
Trials in the different German federal states



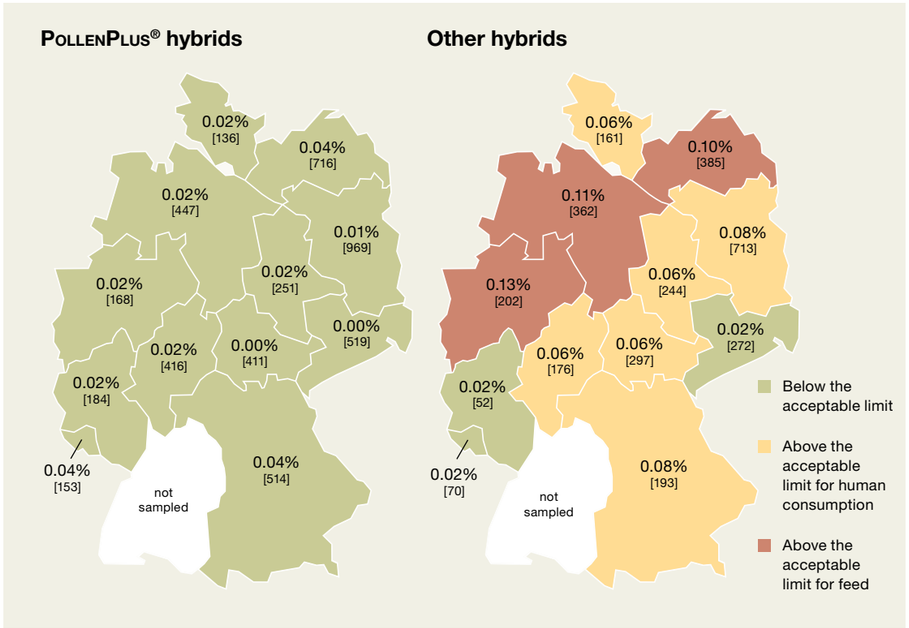
Results of trials in the different German federal states, 2011–2020, 150 locations with LSV rye, LSV triticale, LSV barley and LSV wheat, a comparison of the means of all tested varieties, results for Lower Saxony, Northrhine-Westphalia and Schleswig-Holstein calculated from relative values, cereal yield treated stage (dt/ha).
(KWS LOCHOW 2021)

Successful ergot prevention with KWS hybrid rye

Pollen PLUS

Hybrid rye varieties differ in their susceptibility to ergot. The PollenPlus® hybrids are characterized by, at most, a low to medium susceptibility to ergot and therefore show high ergot resistance even without the admixture of population rye. In addition to PollenPlus® hybrid rye, there are other varieties that show higher susceptibility. An analysis of ergot percentages in the German federal states from the "Besonderen Ernte- und Qualitätsermittlung" ("Special Crop Quality Assessment") clearly shows that the cultivation of varieties with PollenPlus® technology can safely and effectively reduced ergot infestation. It is thus possible to achieve nationwide ergot levels below the acceptable limit for feed and, for the most part, also below the acceptable limit for human consumption.

Ergot prevalence in practice in Germany, 2006–2020



75th percentile of ergot content (wt%) in crop samples of hybrid rye. Own representation of the results from the special crop quality assessment of the MRI, Detmold, 2006–2020

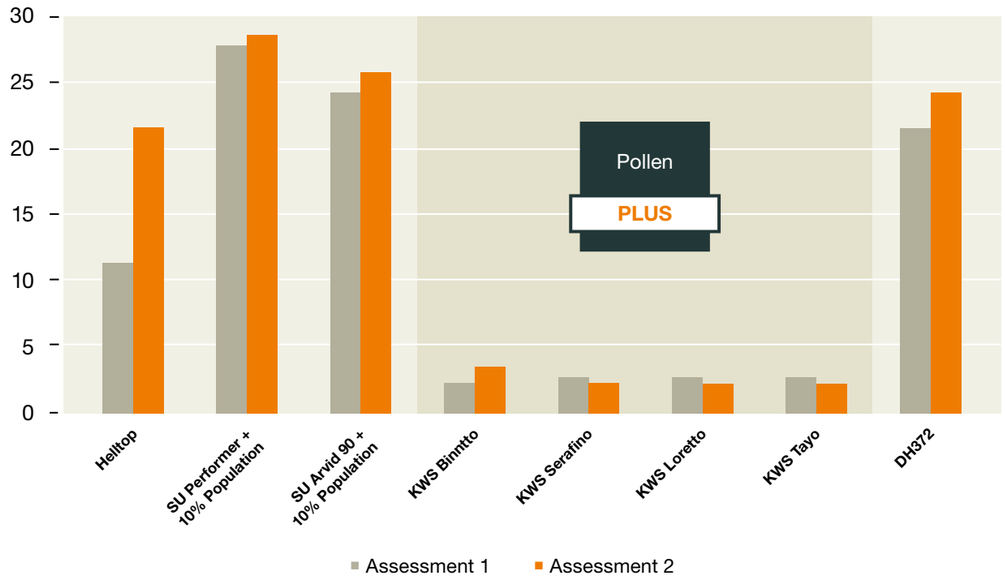
Every year, the Max Rubner Institute (MRI) in Detmold evaluates the quality of German bread cereal crops on the basis of grain samples from the "Besonderen Ernte- und Qualitätsermittlung" ("Special Crop Quality Assessment") in the individual German federal states. For this, 600–700 samples per year are examined for their ergot content.

! Improved pollen production = rapid fertilization and rapid glume closure = reduction of ergot contamination

Growing PollenPlus® hybrid rye varieties gives peace of mind when it comes to marketing your rye or using it for feed.

- Significant improvement in ergot resistance of hybrid varieties.

Ergot contamination (AKS) in Hybrid Rye (%)



Source: Trial from Flakkebjerg (DK) with artificial infection of powdery mildew. In the experiment, the number of ergot particles has been assessed out of 100 in two repetitions. 7/7 (1st assessment) and 10/7 (2nd assessment), respectively.
Source: www.landbrugsinfo.dk (2019)

For more comprehensive
information on rye in feed:
www.kws.com/corp/en/products/cereals/rye/ryevolution-2-0/

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