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Oats – breaking new ground

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Unique and irreplaceable!

No other cereal offers so many advantages for healthy nutrition and healthy crop rotations than oats. At the same time, oat production is particularly environmentally friendly: Due to the higher performing network of root and its resistance, only minimum amounts of fertiliser and crop protectants are required for high yields.

And: quality oats are increasingly in demand, and in many places are a highly profitable market crop. Wheat-level yields, very low production costs and finally the enormous preceding crop value all contribute to this.

Short crop rotations with high proportions of winter cereals have been coming under increasing pressure in recent years: The yields are fluctuating more and more, the costs are rising and increasingly there are problems with plant protectants. This all requires integrated cultivation methods with “healthy” crop rotations, in which oats can be an optimal constituent.

SAATEN-UNION GmbH promotes diverse and healthy crop rotations – and acts! Breeding programmes which also care for more specialised and extensive crops contribute decisively to making it worthwhile farming diversified crop rotations in the future. A good example for this is oats: SAATEN-UNION, together with its partner

Nordsaat Saatzzucht Gesellschaft mbH are intensively and internationally engaged in caring about the future of this irreplaceable cultivated plant. Be it fodder or industrial oats, yellow, white or black oats, extremely lodging-resistant half-dwarf or varieties suitable for organic farming – there are corresponding varieties for every cultivation situation and purpose!

In this brochure, plant cultivation consultants from the different cultivation areas describe adapted production processes, and special contributions are dedicated to the position of oats in the crop rotation and economy. At the same time, the many possibilities for crop utilisation are presented in a clear manner. Nutritionists report about the health promoting effects oats, feed experts about a balanced diet for horses using oats, arable farmers about the opportunities of whole-crop use for basic feed rations for ruminants and also for biogas plants. This brochure contributes to bringing breeding progress to practical farming.

With best regards,



Marcus Iken, SAATEN-UNION GmbH

Quality oats – the demand continues to grow.

Changing eating habits and growing health awareness have been leading to a strong increase in the use of oats in the food industry for some time. This trend can be observed in Europe and worldwide. Oats are finding increasing interest in Europe in response to their high preceding crop value, their good N-efficiency and the low treatment intensity.

For several years the use of oats for nutritional purposes has been on the rise, both nationally and internationally. Russia, the European Union, Canada, the USA and Australia produce around three-quarters of the global oat volume and are therefore the most important oat producers. However, while in Russia by far the largest proportion of the oats is used for on-farm feed, Canada exports about one-third of its oat production. By doing so Canada regularly provides around 60 % of the global oat exports and is therefore the most important country for the international oat trade. Moreover, un-

til now Canada was the only one of the large oat-growing countries, in which oat cultivation was at least stable if not slightly rising. This is due to an improved competitiveness of oat farming in Canada, which is also subsidised by a special form of contract farming. Furthermore, Canada benefits from its proximity to the large oat processors in the USA.

Recently it became apparent that the Canadian oat farmers are increasingly trading the harvest directly (without a middle-man). According to the opinion of the internet portal oatinformation.com this will increase because...

1. the trade monopoly of the Canadian Wheat Board no longer exists.
2. the large west Canadian grain dealers concentrate on wheat, oilseed rape and barley.
3. the farmers are trying to reduce costs through selfloading or direct marketing.
4. The concept of "farm to fork" requires priority handling of particular oat varieties for better trade reliability.



The key words here are sustainability, accountability and traceability. This also applies to the Asian region, where PepsiCo opened its first oat hulling mill in China. last year.

But contract cultivation of oats will also continue to increase in Europe. To date, around 80 % of the oats in the European Union are used for animal fodder and about 20 % for food. However, the difference between the individual countries can be considerable.

According to information from the British Department for Environment, Food and Rural Affairs, a record amount of over 500,000 t of oats was sent to hulling mills in Great Britain during the 2015/2016 season. In Germany, the use of oats for food has more than doubled since the turn of the century. The most important reasons behind this increase in both countries are the strong consumer demand for oat-based food, as

well as new and innovative oat products. The creation of new capacities for processing oats for foodstuffs and the expansion of existing ones raises the expectation in many European countries that this process will continue.

Value for money of oats has risen

The increased demand for quality oats suggests that this must also have an effect of the producer prices of oats. And indeed, the value for money of oats in Germany has risen in comparison with other cereal types, especially in the last business year (Tab. 1). With the overall strongly falling cereal prices, fodder oats have almost reached the same price level as fodder wheat, and are considerably above that of fodder barley. The price of quality oats is even almost comparable with that of quality wheat. In comparison, last year the lowest prices in the cereal sector were paid for both parties. It is also remarkable that quality oats in Germany fetch

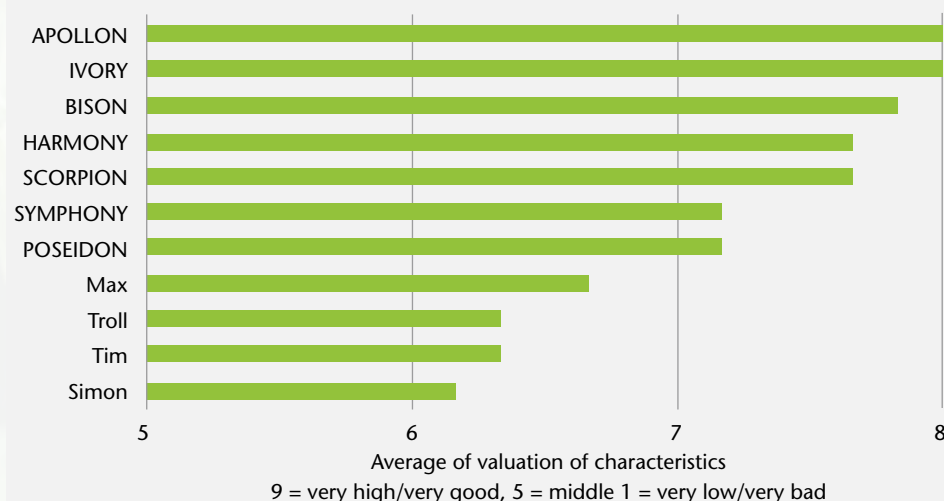
Tab. 1: Cereal producer prices in Germany

(€/t, without VAT, direct, dry, commercially available goods)

	2016	2016	2015
	Week 14	Week 13	Week 15
Quality wheat	131.36	131.22	175.00
Bread wheat	127.62	127.73	161.22
Fodder wheat	124.73	124.54	152.00
Brewer's barley	149.67	148.89	172.82
Fodder barley	119.38	119.59	141.97
Quality oats	129.71	130.00	138.91
Fodder oats	124.00	123.00	130.94

Source: Marktinformation Hessen

Fig. 1: Average quality classification of selected oat varieties



Source: Federal Office for Plant Varieties 2015

a stable subsidy of 5–10 % compared with fodder oats, irrespective of the level of the producer price. Considering the excellent preceding crop value of oat, this naturally improves its cultivation suitability, whereby the production of quality oats should take priority. Furthermore, in North America, usually a subsidy of 0.05–0.15 \$/bu is awarded for quality oats compared with fodder oats, however here there can also be considerable yearly variations depending on availability.

Quality varieties care the basis of successful marketing

In the meantime, the Descriptive Variety List in Germany takes into account the elevated demand for information on suitability for processing of oat varieties in hulling mills.

Already since 2008 there has been a considerably more extensive description of the quality of the oat varieties approved in Germany, and presents the important parameters for the hulling suitability of the oat varieties, including thousand grain weight, sorting, husk proportion and proportion of dehusked grain (i.e. the “ease” of the dehusking process). The criterion hectolitre weight, which is also important for the trade, has also been newly included; however it is less meaningful with regard to the processing suitability.

Based on this, the average quality classification of varieties currently in general use in farming, and that of oat varieties newly approved in recent years is shown in Figure 1. From this, it is clear why the white oat va-

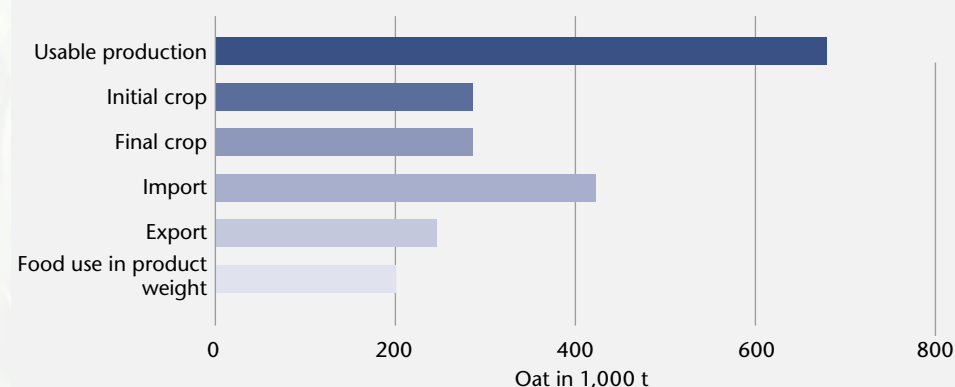
riety IVORY has become the leading quality oat variety in recent years. The two newer yellow oat varieties APOLLON and BISON are characterised by high yields in combination with excellent lodging resistance and very good hulling quality. These characteristics suggest that both varieties have a chance of playing an important role in the hulling mills of Southern Germany in the coming years. High expectations are linked to the introduction of the newly approved white oat variety HARMONY to European oat farming. With a similar quality profile to that of IVORY, HARMONY has a considerably higher yield potential in combination with improved agronomic characteristic when compared with the timetested hulled oat varieties in Europe.

Only 80 % rate of self-sufficiency in Germany

In the business year 2014/2015, Germany imported almost 420,000 t of oats, primarily for hulling mills (Fig. 2). This equates to an import value of over € 60 million according to the current producer prices. This makes Germany in the meantime one of the largest oat importers in the world, and gives it a self-sufficiency rate of less than 80 % for this crop type. There are a limited number of large suppliers of oats to the global market, which raises the dependency of the German importers. The production of quality oats therefore offers good opportunities for local farmers, while at the same time not forgetting the good preceding crop value of oats. Therefore, the use of modern hulled oat varieties like APOLLON, BISON and HARMONY increases their possibility of competing with the quality oats imported from abroad.

Dr. Steffen Beuch

Fig. 2: Oat balance Germany 2014/2015 in 1,000 t



Source: Federal Office for Agriculture and Food

Oats – the all-rounder in modern nutrition

These days, rolled oats are on the breakfast table of many consumers in the form of muesli or porridge. But the high diversity of oats means they can also be used for other meals. How do the raw oats become a tasty food? And how can oats contribute to health and well-being?

So that the natural character of the oats is guaranteed in the end product, the hulling mills place great emphasis on the good quality of the raw oats. The customers of the hulling mills, the shops and wholesalers, the processing industry and at the end of the chain the consumers, place high demands on quality and food safety. The manufacturers use a multi-step quality management system of involving risk-oriented controls beginning with the delivery of the raw materials through to the end product. Among other things, this includes analysis for contaminants such as plant protection products and mycotoxins.

The hulling mills first clean and sieve the raw oats after delivery, in order to free it from other grain varieties and other seeds. Next, the hulls of the oats are removed. The oat grains go through a hulling machine, in which the grains are thrown against a dehuller by centrifugal force, in order to remove the hull from the grain. Afterwards, the oat grains are dried, steamed and dried again. During drying, the grains are heated, which changes their physical properties in such a way that they can be rolled to flakes.

Furthermore, it prevents the oat products becoming rancid too quickly due to their relatively high natural fat content (seven per cent), as it deactivates the oat enzymes for breaking down fat. This therefore prolongs the shelf life. The heat treatment also makes the oats even more agreeable and digestible, as the oat starch is partly broken down. The typical nutty aroma of oats is also formed during the time in the kiln.

Oat quality for foodstuffs

The production of foods is subject to more and more stringent food regulations (e.g. for product safety, packaging declarations). For the producers, it is not only a matter of course to keep to the regulations but it is also time and money intensive. Furthermore, costs are rising for research, sales, marketing and logistics, and for the power supply. Therefore, the hulling mills must optimally design the cost-effectiveness of their production.

When selecting the raw oats, the essential factors are easy hulling and the lowest possible degree of contamination with other grain varieties and other seeds. Further

sorting processes and excessive amounts of rejected grains due to them not being dehulled cost time and money. The size of the grain is important for the two products that sell best, rolled oats and porridge oats. Rolled oats (jumbo oats) are rolled from the whole hulled grain. A regular oval shape is primarily obtained from a nice large grain. For porridge oats (flaked oats), the



oat grains are first cut into small pieces, also known as groat. These small pieces are then rolled to form flakes. Cutting to groat is also easier with a large grain.

Easily determined quality criteria are the freshness, as well as the oat smell, typical of the grain and variety, and the nice, light and variety-typical colour of the grain without dark discolouration.

Further assessment parameters are the grain proportion (grain to hull ratio 2:1), moisture and hectolitre weight. The hectolitre weight is on the one hand an easy to measure dimension, but on the other hand it is not always the deciding factor. When assessing the raw oats, all the criteria are involved in the evaluation for food production.

Oats as provider of nutrients and daily companion

Oats are the all-rounder for every phase in life – from infant to senior citizen. Thanks to its high-quality natural nutrient profile, it is a valuable building block for a balanced, diverse diet. Here, the wholegrain aspect and the associated nutrient values play an important role, as do the multitude of products and possible uses.

Oats – the wholegrain all-rounder

All oat products listed in the table, with the exception of oat bran are wholegrain products. Oat bran can officially not be called “wholegrain”, as it mainly consists of outer layers and germ. Due to the concentration of the nutrients in these components, however, their nutritive food value is higher!

The 10 % dietary fibre content of oats is of particular interest. The key component is beta-glucan, a soluble dietary fibre, which is only present in cereals in this specific form

Diversity of oat products and uses

Product	Production	use
Groat	Complete oat kernels chopped into little pieces.	<ul style="list-style-type: none"> For green cabbage dishes and groats sausage Prepared like rice pudding and risotto As a side dish
Rolled oats	Whole oat kernels rolled.	<ul style="list-style-type: none"> Muesli, cereal and muesli bars Pastries, muffins, cakes, bread Lightly roasted for desserts
Porridge oats	Groat (crushed oat kernels) rolled.	<ul style="list-style-type: none"> Muesli, cereal and muesli bars Porridge, warm desserts, pancakes Biscuits, muffins, cakes, bread desserts Coating for meat / cheese Mince dishes, also "vegetarian meatballs" Casseroles, pan-fried vegetable / meat dishes
Oatmeal	Groat finely ground	<ul style="list-style-type: none"> Bread, pastries, cakes; approx. 20–30 % of the flour volume given in a recipe can be substituted for oatmeal / oat flakes.
Soluble oat flakes	Oatmeal rolled during a special process to very thin flakes, which are soluble in liquids.	<ul style="list-style-type: none"> Shakes and dips Soups Coating for fried vegetables Meat or vegetable balls Desserts (quark / yogurt dishes) Baby food
Oat bran	Semolina: Outer layers and germ of the oat kernel coarsely ground Soluble oat bran flakes are produced from ground oat bran semolina in a special process.	<ul style="list-style-type: none"> Muesli Porridge, warm desserts, pancakes Pastries, muffins, cakes Desserts
Oat cereals	Extruded cereals: A paste is made from oatmeal and other ingredients and then pressed in an extruder under pressure. Water evaporates as it escapes, the product becomes hard, crunchy and long-lasting. Puffed cereals: Whole oat kernels are placed under steam and pressure. The sudden drop in pressure evaporates the water, the starch is converted. The kernels expand and become hard.	<ul style="list-style-type: none"> Muesli as topping for porridge Pancakes
Oat drink	The whole oat kernel is ground, during which water and ferment are added. After removing the insoluble components, the sweet-tasting basis for the oat drink remains. This is ultra heat treated for long-life, and decanted under sterile conditions.	<ul style="list-style-type: none"> Drink, for muesli, porridge, etc. Alternative to cow milk – suitable for people who are cow's milk intolerant, who want to eat fewer animal products, or are fully vegan.

in oats. The article by Prof. Hampshire (page 14) lists in detail the scientifically proven effects of this dietary fibre. Therefore, we will only provide a brief overview here of the approved nutritional and health-related information.

1. Oat beta-glucan the reduces cholesterol level

... and maintains a normal cholesterol level. This positive effect is seen with a daily uptake of 3 g of beta-glucan an amount that can be reached by eating classical oat products (such as 7 tablespoons of oats or 4 tablespoons of oats supplemented by 2 table spoons of oat bran).

2. Oat beta-glucan contributes to a reduction in the blood sugar level rise after a meal.

This statement is authorised, if a portion of the food contains at least 4 g of oat be-

ta-glucan per 30 g of available carbohydrates: Currently, only one oat bran product fulfils this requirement. Furthermore, oat bran is naturally low in sugar and the complex carbohydrates also result in a balanced blood sugar level in terms of time span and characteristics. "Oat days" celebrate a comeback as a time-restricted dietary intervention, during which the blood sugar values and amount of insulin required can be reduced.

3. Additional health-promoting properties

- Tendencies can be extrapolated from these studies, showing that beta-glucan acts positively onto the blood pressure and supports weight management.
- Among the prominent nutrients in oats are vitamin K, thiamine, folic acid, biotin and manganese, phosphorus, copper, zinc, iron and magnesium. These nutrients



support the nervous system, brain performance, cell growth, blood formation, bone formation, muscles and immune system of adults and children.

- The fat content contains 75 % unsaturated fatty acids, which support the regulation of the blood glucose and also strengthen skin and hair.
- The oat gluten (13.5 %) is of high biological value, for example it can be used effectively for the formation of the body's own proteins.
- Sportsmen rely on oat flakes as a long-term energy supply: The broken-down

carbohydrates are stored as glycogen. Under stress conditions, energy is firstly taken from the fat reserves, and the glycogen reserves remain for the final spurt.

The diversity of oats – a tasty addition for daily meals and an effective contribution to the daily nutrient balance. Oats – simply an all-rounder!

*Hafer Die Alleskörner, VDGS e.V.
Richeza Reisinger*

more information and recipes:
www.alleskoerner.de



Oats and strawberry-quark

Ingredients for 4 portions:

400 g strawberries (fresh or frozen)
250 g low fat quark
1 tbs water
250 g creme fraiche or cream cheese
2 sachets vanilla sugar
1 sachet Bourbon vanilla sugar
Lemon juice to taste
30 g butter
3 tbs brown sugar
1 tbs honey
100 g rolled oats



Nutritional information

269 g per portion – 1.07 kg in total

Inhaltsstoff	Menge/Portion
Energy	467 kcal
Carbohydrates	32.7 g
Protein	19.3 g
Fat	28.2 g
of which saturated fatty acids	16.2 g
Dietary fibre	3.36 g
Sodium	386 mg
Vitamin B1	233 µg
Vitamin B6	16.1 µg
Folic acid	55.5 µg
Vitamin K	53.3 µg
Magnesium	62.8 mg
Iron	2.47 mg
Zinc	1.79 mg
Phosphorus	458 mg

Preparation:

Wash strawberries, remove stalks, cut into small pieces and mix in one sachet of vanilla sugar. Mix quark thoroughly with the water, add and stir-in creme fraiche or cream cheese. Mix in the remaining 2 sachets vanilla sugar and lemon juice to taste. Refrigerate for approx. 30 mins. Melt butter with sugar and honey in a pan and roast oats while stirring constantly. Allow the oats to cool down and prepare in layers with the quark mix and the strawberries.

Preparation time: approx. 25 mins.

Health aspects of oats in modern nutrition

The protein content in the oat kernel is between 8–24 %, most often between 10–15 % of the grain dry matter. The lipid content varies between 2–13 %, most often between 5–8 %. The oat lipids mostly consist of unsaturated oleic and linoleic acids. The oat kernel has among other things a high fibre, vitamin B1, phosphorus and magnesium content. As with all other cereal varieties, the main constituent of oats is starch with, a share of 49–75 % (Hampshire, 1998).

Beta-glucan: cholesterol reducing effect

Many of the positive nutritional effects of oats are caused by the soluble dietary fibre beta-glucan. This dietary fibre fraction is contained in the oat grain at levels of between 4–5 % of the grain dry matter. Beta-glucan causes a reduction in blood cholesterol. Increased cholesterol values are risk factors for arteriosclerosis and coronary heart diseases. In particular, the “bad” LDL-cholesterol values drop, while the “good” HDL-cholesterol values remain almost unaffected. Several mechanisms are discussed for the mode of action of beta-glucan: The soluble dietary fibres increase the thickness of the unstirred water layer on the small intestine epithelium, which hinders the uptake of cholesterol and bile acids by the intestinal epithelium. Beta-glucan reduces the resorption of bile acids from the ileum, which causes the liver to increasingly use blood cholesterol from the blood for the production of bile. Beta-glucan is metabolised by intestinal bacteria to short-chain fatty acids in the large

intestines. The resorbed fatty acids inhibit liver cholesterol synthesis (Hampshire, 1998; Theuvsen and Mensink, 2008).

Many studies have proven the cholesterol-reducing action of beta-glucan, so that the European Food Safety Agency (EFSA), among others, approved the following health claim for oat products: “Oat beta-glucans are proven to reduce blood cholesterol levels. A high cholesterol level is one of the risk factors of coronary heart disease.” This claim can be used for foods containing at least 1 g oat beta-glucan per stated portion. The consumers must be informed that the positive health effect is to be expected with a daily uptake of 3 g oat beta-glucan (Reg. (EU) 1160/2011).

Beta-glucan: positive effect on the blood glucose level

Beta-glucan delays stomach evacuation and reduces the postprandial rise of blood glucose and insulin after carbohydrate-rich food intake (Juvonen et al., 2009). Oat and barley products can depict this health claim:



“The uptake of beta-glucans from oats or barley as part of a meal leads to a reduced increase of the blood glucose level after the meal.”

This claim may only be used for foods containing at least 4 g beta-glucan from oats or barley per 30 g available carbohydrates in a stated portion as part of a meal. The positive effect is only triggered if the beta-glucans from oats or barley are taken up as part of the meal (Reg. (EU) No. 432/2012). Increased blood glucose levels are involved in

the formation of diabetic long-term effects, the macro- and microangiopathy.

Reference to further physiological effects of oat contents

An immune modulating effect is also assigned to beta-glucan. It could be demonstrated in an animal trial that beta-glucan from oats activates macrophages and therefore increased the immune response. In mice, beta-glucan counteracted the drop in the antiviral activity of macrophages, caused by physical stress (Murphy et al., 2008). Oat beta-glucans also possibly activate at first the intestinal leucocytes, which in turn cause extracellular activation of the enterocytes (Volman et al., 2010). The basic mechanisms of this are, however, not fully explored, which is why further research into the immune modulating effects is necessary.

A further active group in oats are the avenanthramides. This polyphenol group only exists in oats. Research demonstrates that some avenanthramides can act to help prevent arteriosclerosis. The proliferation of smooth muscle cells in the blood vessels and impaired NO-synthesis are critical pathophysiological processes in the development of arteriosclerosis. Experiments show that some avenanthramides reduce the proliferation of smooth muscle cells in the blood vessels and promote NO-synthesis in the smooth muscle cells and the endothelial cells of the aorta (Nie et al., 2006). The avenanthramides possibly contribute to a reduction of the risk for coronary heart dis-



ease through their anti-inflammatory and antiproliferative effects, and relaxation of the arteries in connection with the effects of beta-glucan. Furthermore, the anti-inflammatory and antiproliferative effects of the avenanthramides in connection with the high dietary fibre content can reduce the risk of colon cancer. The antipruritic property of oat meal can at least in part be traced back to the avenanthramides (Meydani, 2009).

Oat products often are wholegrain products. According to several studies, the consumption of wholegrain products could reduce the blood LDL-cholesterol level, the risk of diabetes mellitus type 2, hypertension and coronary heart disease (Hauner et al., 2012).

At present there is no authorised health claim for the physiological effects cited in this section.

Conclusion

The particular properties of oats are such that the wholegrain products produced from them are not only tasty with their nutty aroma, but also have an excellent nutritional composition, which contributes to a healthy diet.

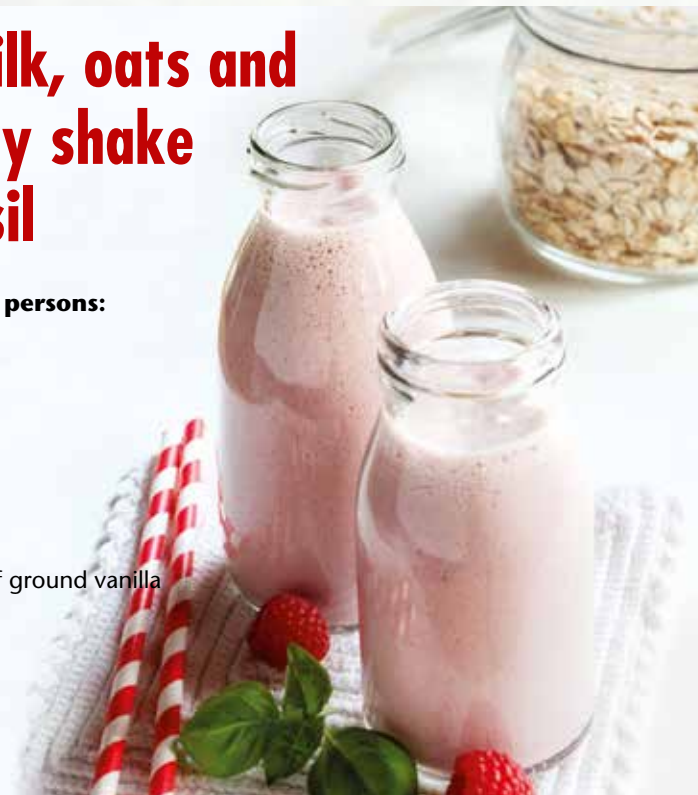
Prof. Dr. Jörg Hampshire

You can find the references on page 71.

Buttermilk, oats and raspberry shake with basil

Ingredients for 2 persons:

200 g raspberries
(fresh or frozen)
5 sprigs of basil
500 ml buttermilk
100 ml water
60 g porridge oats
20 g oat bran flakes
1 generous pinch of ground vanilla
1 tsp honey



Nutritional information per portion:

Content amounts	portion
Energy	277 kcal
Carbohydrates	41 g
Fat	4 g
Proteins	15 g
Dietary fibre	9 g, thereof 2.15 g Beta-Glucan
Salt	0.37 g
Magnesium	119 mg
Iron	3.2 mg
Phosphorus	400 mg
Thiamine	0.335 µg
Folate	78.6 µg
Vitamin K	35.8 µg

Preparation:

Thaw or wash raspberries. Wash basil, shake dry and pick the leaves. Place raspberries and basil together with buttermilk, water, porridge oats, oat bran flakes, vanilla and honey in a blender and puree everything until creamy. Vegan variety: Replace buttermilk with 400 g silken tofu and 100 ml water.

Preparation time: approx. 10 mins.

Oats for horses – optimal feed if the quality is good

Oats, which were the most important source of food for humans for centuries, remain an important food source for horses. This raw material must be treated with care in order to use its advantages optimally and compensate for its disadvantages.

Shiny coat

The oat grains are the perfect size and have the right chewing resistance for horses. Rolling the oats is therefore only advantageous if the teeth are already considerably damaged. Chewing is absolutely positive for healthy horses. At the same time, the oats with their high proportion of hulls offer the horses important additional digestive fibre. Oats are rich in unsaturated fatty acids and mucins, which can have a particularly positive effect on the animal metabolism: The coat is shiny, the mucus membranes of the digestive tract are protected and fertility is improved. Furthermore, the amount and the quality of the protein are usually sufficient for all age groups. However, temporarily adding a feed supplement with a high protein content for weanlings and lactating mares is recommended. Oats can also be added to feed mixes for performance horses.

Always supplement with mineral feeds

Despite all the advantages – there is need for improvement regarding the mineral content of oats. Because oats mainly lack calcium.

There is only one gram of calcium on average in one kilogramme of oats. And as there are approximately 3.2 g phosphorus per kg of oats, the phosphorus ratio is below 1:1. For an optimal mineral balance of the horse body, the calcium-phosphorus ratio should be at 1.8 to 2 to 1.

Furthermore, oats contain little of the fat-soluble vitamins A and D and are low in sodium. Despite the high lysine and methionine content, compared with all other cereals, these amounts are often still too low for weanlings at least.

Therefore, in practical horse feeding it is necessary to add a mineral feed or in winter vitaminised mineral feed. Otherwise, a biased feed ration of oats/hay could lead to metabolic deficiencies in the long run. As mentioned before, rolling the oats does not make sense. Additionally, rolling leads to faster vitamin E consumption and the cereal turns rancid quicker. If at all, it is advised that only very few day rations are prepared and that these are used up within a short time frame.

Don't overfeed horses

Generally, oats are highly digestible. This cereal is, however, rich in starch and excess starch leads to disturbed digestion in the small intestine. Small horses are particularly susceptible to diarrhoea and cramp colics in this context. However, there is a rule of thumb at hand, which has proven itself in practice: A maximum of one pound of oats per 100 kg live weight fed twice daily. If you have the opportunity to weigh your horse, do this at all accounts, as the live weight most often is estimated wrongly. If there is a very high energy requirement, for instance for high-performing horses in events, supplementary feed must be added to the ration. Up to 75 % oats can be used in mixed feeds. When using a feed concentrate, the horses must be regularly

exercised or worked. If this is not possible, the amount of feed concentrate must be reduced considerably on stable days, e.g. when they are not worked, in particular to avoid lumbago. If they are repeatedly affected by lumbago*, the affected animals should not be fed grains at all.

Do you "feel your oats?"

The saying "he feels his oats" probably stems from the high amount of energy and the good digestibility of oats. The sector often discusses whether horses react hyperactively to oats even when given the correct dosage and sufficient amount of work. Current research demonstrates that energy-rich feeds (concentrated feed, grains, sugar) can release endogenous messenger substances in horses, which in high doses may trigger



In general, only clean, good-smelling grains should be fed.

hyperactive behaviour in horses particularly sensitive to this and in less stress-resistant horses. The less sensitive horses, however, do not react negatively to oats.

Store carefully after harvest. Oats of a good feed quality cannot be farmed every year. When the quality is bad, oat feeding can be problematic. But that is the case for all feed components. Handling feed oats wrongly can mainly lead to a high microbial and dust load. A high microbial load points to bad storage conditions. Oats must be dried carefully to a residual moisture content of 14 % after harvest; if they are transported over longer distances, 12 % is necessary. Afterwards, clean and dry storage is required.



Fundamentally, only clean and well smelling grain should be fed.

The cereal must also not be stored in the damp stable air. To reduce the microbial load after harvest, bridge the so-called grain sweating phase, and improve the digestibility, it is recommended that the oats are stored for at least six to eight weeks before feeding.

Pay attention to the microbial load

There are white, yellow or black oats on offer on the fodder market. Black oats have a minimally higher protein content. But all in all the differently coloured varieties do not differ in feed quality for the horse. In all varieties the grain cross-section is light yellow to white. A gray or dark cross section and dark films indicate moulds; these oats are easy to spot and must not be fed. As a matter of principle, no batches should be used that smell dull-musty, are dirty or show mites, or are even damp. This is valid for all grain types. Many horses react to mite faeces with asthma-like attacks. Oats contaminated with earth, dust and weed seeds should be cleaned before feeding. If the animals are susceptible to dust, the rest of the dust should be bound in the feed trough with a little water or molasses. The Institutes for Animal Feed currently offers a practical total microbial count test for fodder oats. It is also worth asking the feed supplier for such a test result. The microbial load is also related to the hectolitre weight. Very light grains (< 46 kg/hl) often contain more protein, have an increased microbial load, reduced digestibility and should not be used even in small horse feeding.

Exact feed value only with laboratory analyses

Generally, oats with a hectolitre weight of over 54 kg/hl are recommended for horses. However, newer studies show clearly that there is next to no relation between the hectolitre weight and the actual energy content of the cereal. In general, there is a slight drop in dietary fibre and the crude protein content, and a slight increase of the crude fat content with increasing hectolitre weight. However, in oats there is next to no correlation regarding hectolitre weight and energy content.

To determine the real feed value of the oats, extensive feed analyses would be necessary, which would not be worthwhile for small scale purchases.

Conclusion

Oats are optimal fodder for horses if the quality is tested and if they are supplemented with a suitable vitaminised mineral feed. The amount fed can easily be adjusted to the respective requirement of the horses. The requirements should also be adjusted to the age, the performance and the specifics of each individual animal. Recommended is in total a maximum of one kilogramme oats per 100 kg live weight, distributed over several portions per day.

Dr. agr. habil. Ines von Butler-Wemken

Oats in competitive sports

Natural energy fodder for best performance



Johanna Huesmann, show jumper from Schleswig-Holstein, vice-champion U 25 2015 and 7th at the German young riders championship 2015.

"My horses get 2–3 kg whole cleaned seed oats. They all eat the oats with great appetite. As far as possible, I distribute the energy feed between four rations. Muesli or pellets are not fed at all. In addition to hay and straw, we also feed a mineral feed by Salvana.

Two years ago, we had a gelding with severe stomach problems in the stable. According to my vet, oats are the easiest of all energy feeds for horses to digest. Thus we have nursed it back to health with hay and oats and all year round daily grazing. He is now 9 years old, currently S*** placed and always willing to perform."

Oats used as whole-crop silage

Oats can be extremely flexibly when used as an energy-rich whole-crop: in pure culture or in mixes, in fresh feed or preserved as whole-crop silage, as main crop or as second crop

The advantages are obvious

Oats offers a number of important advantages in comparison with maize and other cereals:

- As cold tolerant C3-plant, oats grow where the heat loving C4 plants maize or millet won't want to start. The differently timed development rhythm when compared with maize widens the available time window for the application of digestates. This saves on costs for buildings, personnel and machinery.
- In comparison with other cereals, oat straw ripens comparatively late; the flexibility of the harvest date is therefore greater than for other cereals.
- The option of alternative use must also not be disregarded: If there is a lucrative market for wet biomass, for instance in a bad maize year, this can also be satisfied. However, if high yields of silage maize are forecast after a spring of good growth, the more viable alternative is to go for threshing

Whole-crop use as main crop

Whole-crop use as main crop can be considered on cooler locations – e.g. higher altitudes. There, after a late harvest of the preceding crop, it is often impossible to

continue with autumn planting of cereals. Furthermore, the necessary temperature for maize or sorghum planting is also lacking.

For this purpose, oat varieties with the highest grain yields and at the same time strong vegetative development are suitable, which do not ripen too quickly in the straw for wide harvest flexibility. Here, the variety POSEIDON would be ideal, from which we would expect total dry matter yields of between 10 and 15 t/ha.

Besides timely and not too thin seeding, it is important, to ensure a sufficient N-supply of in total approx. 140–160 kg N/ha incl. Nmin at the beginning of the vegetation and at shooting. Use of a fungicide is only worthwhile as an early measure at shooting when there is high disease pressure. Herbicides can often be saved on; applications of growth regulators with CCC must be finished in time for shooting.

... or as second culture

In growthy regions with over 700 mm precipitation, after harvest of winter cereal whole-crop silage the potential of the site can be fully exploited with a second harvest. For this, the oats as second crop do not need to be drilled before the beginning



On cooler sites and where the vegetation period is short, oats are a safer crop than maize, millet or sunflowers. The variety POSEIDON for instance offers itself where there is sufficient water supply. This variety combines highest grain and rest plant yields with good growth and comparatively high harvest flexibility.

of July but rather up until mid-July at the latest, in the waning long-day. The optimal seeding density in this timeframe is at 350–400 grains/m². In addition to a fertiliser starting dose of at least 60 kg N/ha, it is essential to carry out a combined fungicide and insecticide treatment against rust and aphids as virus carriers.

How to determine the optimal harvest date for oat whole-crop silage

From flowering onwards, the assimilates are no longer used as fibrous matter but they are stored in the grain as reserves. Therefore, the energy content and the energy yield increases steeply until yellow ripeness. Later, the increasing lignification hinders ensilaging and reduces the feed value and methane

yield. Crucial for a high methane yield and also a high feed value is therefore the timely harvest before onset of lignification. The optimal cutting date therefore lies at the end of the green ripeness in dry years with quick straw ripening. In growthy years with longer living assimilation structures the optimum of yield and quality is at the beginning of the yellow ripeness. During this time, the grain changes to the colour typical of the variety. The grain content is still soft but can be squeezed out of the husk in one piece. If at that point of time the straw begins to get lighter, the dry matter content is approximately 34–38 %. The higher the dry matter content, the shorter it must be chopped.

Sven Böse

Cost cutter and winner crop

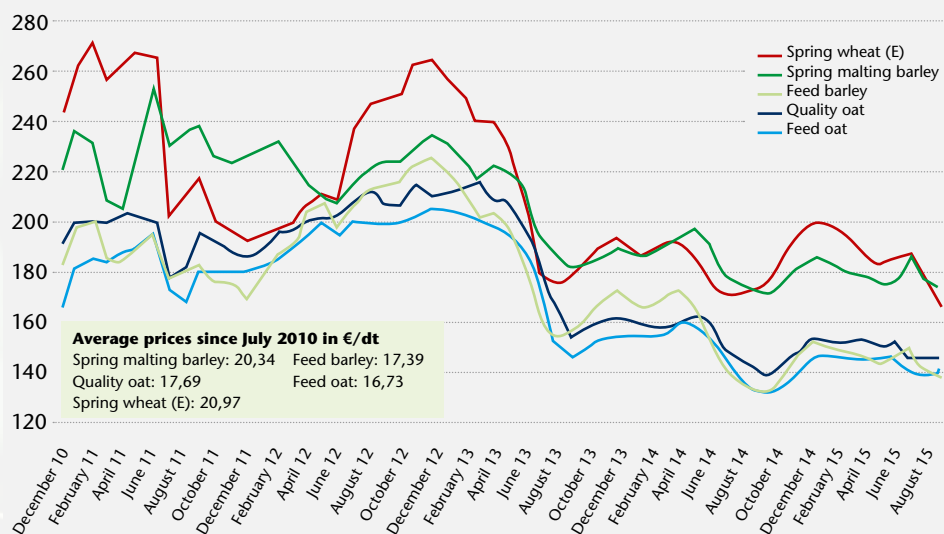
Oats are not only the most environmentally-friendly type of cereal but, together with the production target, quality oats are at the same time a highly economical market crop.

Quality is in demand, this is also the case for oats! While fodder oats in the five-year average made 16.73 €/dt, quality oats sold on average at 17.69 €/dt and thus fetched over a Euro more (Fig. 1)! The oat prices cannot compete with E spring wheat, however, the production prices are about 20 €/ha lower. The widespread oat roots offer excellent nutrient concentration. Even top yields of more than 80 dt/ha do not require more than 70–90 kg/N mineral N-fertilisation. In

the future, also the lower residual nitrate concentrations after an oat culture will gain increasing importance with the amended fertiliser ordinance. Basic nutrients are also tapped better by the mighty oat roots. The follow-on crop can benefit from this as well through the large proportion of biopores. Furthermore, oats are the healthiest cereals with the best weed suppression. Only very targeted use of fungicides and even herbicides is needed, and even in the high-yield

Fig. 1: Price development spring cereals

Direct from the storage unit in €/t, national average (Germany) without VAT



area, the costs for the agents most often remain below 50 €/ha (Fig. 2). However, a timely aphid treatment against barley yellow dwarf virus and a retardant in luscious crops should be permanently scheduled in. During the economic evaluation of oats, the high value as preceding crop has to be taken into account – which results in financial benefits:

- Oats have relatively low demands as a preceding crop and are ideal as the last fruit in the crop rotation, e.g. after wheat or maize.
- Oats leave behind optimal soil quality thanks to ideal soil shading and root penetration. Wheat after oats means a considerably higher harvest than wheat-wheat!
- Oats reduce the risk of root diseases (take-

all!). Wheat and triticale mainly profit from this.

- As a summer crop, oats prevent problems of excessive grass growth due to resistance formation or reduced soil working intensity.

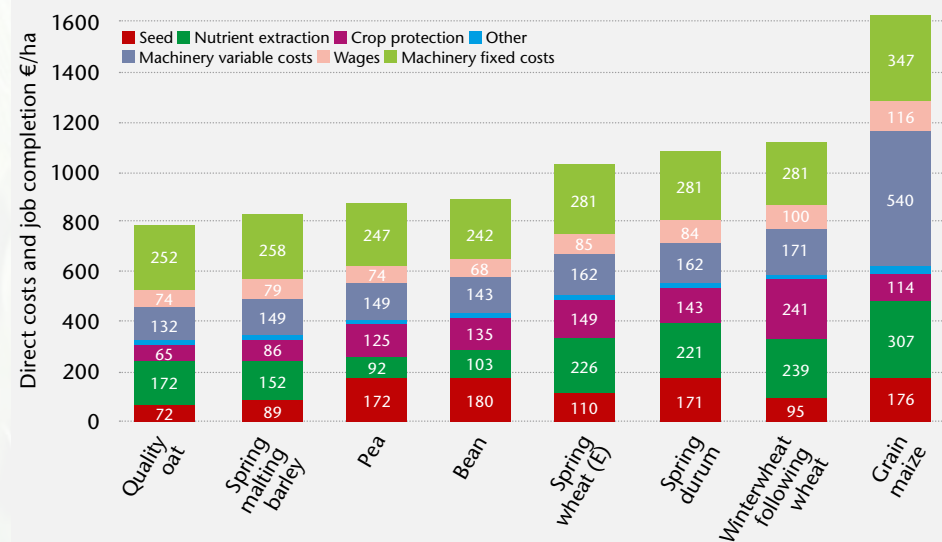
For the following calculations, the preceding crop value of the oats were calculated as a total of 80 €/ha. The closer and more “winter oriented” a crop rotation is, the higher this value must be set per individual farm.

When are quality oats worth planting?

Tab. 1 below shows that quality oats are highly economical with regards to yield and price relationships. Taking into account the preceding crop value, the “direct and work

Fig. 2: Production costs of selected field crop

according to KTBL, country services and own research



cost-independent performance" (DAL) is higher than for wheat on wheat and the fodder cereals. Therefore, on suitable sites, oats as last crop in the crop rotation, for instance after wheat, are a highly welcome enrichment for cereal or winter accentuated crop rotations.

However, this calculation only works as long as the harvest can be marketed as premium feed or hulled oats at a price level near wheat. Deciding factors for this are – besides light colouring and excellent smell – large, round grains. These achieve at the same time good sorting (90 % > 2 mm), TGM above 30 g, and the required hl weights of over 54 kg. Five prerequisites are decisive for those quality targets:

1. Site

Oats are the cereal most susceptible to drought. Only locations with good water capacity deliver reliably good harvests with excellent grain formation. The cooler locations with a slower grain filling (e.g. low mountain ranges, coasts) are also ideal.

2. Crop rotation

Quality oats do not require a luxury preceding crop and will also grow well after winter cereals, maize or late root crops. Due to its susceptibility to stem nematodes, it should, however, not be planted as oats-oats or after spring rye.

3. Variety selection

Varieties with an exceptionally large grain (e.g. IVORY, HARMONY) are best suited for hulling mills. Good hullability should also be a criterion when selecting varieties for the hulling mill (HARMONY). Another marketing path is horse feed. Here are good utilisation possibilities for regionally preferred black oat varieties (e.g. ZORRO).

4. Sowing time

"May oats are chaff oats". The lower the location is valued, the more important is the early seeding, if possible by the end of March/beginning of April. As a cereal with long-day emphasis, oats need sufficient vegetation during the short-day period for strong shoot and root development.

5. Fertilisation

For oats, the effect of N fertilisation and fungicide measures on the grain formation is relatively low. On the other hand, the trace element supply must be carefully observed on low clay sites, especially with higher pH values (no liming with oats).

Outlook:

On suitable sites, quality oats can relieve wheat-dominated crop rotations and realise lucrative marginal returns. Increasing demands on climate and groundwater-friendly production and modern nutrition trends increase the interest in oat farming. More and more federal states also reward extended crop rotations with spring cereals and legumes within the framework of the modulation, and as a very cost-effective alternative crop oats will profit from this!

Sven Böse

Tab. 1: Balanced price and balanced yield

	Direct costs and job completion	Price expectation	Yield expectation	Market performance	Crop rotation value	DAL (incl. crop rotation value)	Equilibrium yield to wheat on wheat	Equilibrium price to wheat on wheat
	€/ha	€/dt*	dt/ha*	€/ha	€/ha	€/ha	dt/ha	€/dt
Soya	950	38,39	30	1.152	120	324	25,7	36,91
Grain maize	1.630	17,20	111	1.901	40	309	101,8	16,21
Spring durum	1.090	25,38	59	1.354	40	307	47,6	20,98
Quality oat	780	15,98	60	959	80	255	54,1	15,73
Spring wheat (E)	1.000	18,95	65	1.224	40	228	61,0	18,51
Spring malting barley	830	18,38	55	1.011	40	220	51,7	18,00
Fodder oat	780	15,10	60	906	80	202	57,2	15,73
Spring barley	850	15,72	60	943	40	131	61,8	16,85
Bean	890	20,13	43	856	150	116	44,7	24,68
Pea	880	21,24	39	834	150	109	41,7	26,35



Oats – the most important spring cereal in organic farming

About 17 % of the oat growing area in Germany (approx. 24,500 ha) on average of the last few years was farmed according to the regulations of organic farming. These organically farmed oats are preferentially used for human consumption. But it is also an important component of fodder mixes. Organically farmed spring barley and wheat use only 2 to about 6 % of the total area (Tab. 1).

I. Suitability of the plots and sorting into crop rotation

High adaptability to different conditions

Oats are an attractive cereal variety for medium loam soils as well as sandy soils due to its broad ecological range resulting from its high adaptability to differing conditions and low site demand. High efficiency in terms of nutrient digestion and water use results from the large root system with a high share of fine hair roots. This ability is very important in organic farming, as no easily soluble fertilisers are used.

While oats compete with the other more demanding cereal varieties such as wheat

and barley on the better plots, they are a welcome change on sandy sites, which are mainly used for rye cultivation. Here, they are actually an economical alternative! However, soils with plot indexes of er 30 and poor water supply during the vegetation period are only conditionally suitable for oat cultivation.

Sorting of the crop rotation according to economical value

The production of oats for food requires favourable conditions for optimal grain formation, which must be warranted by selecting a suitable plot and place in the crop rotation. The positive economic value, which is determined by the yield and the price to

Tab. 1: Development of the organically farmed oat area (thousand hectares) in Germany (Schack et al. 2014)

	2012	2013	2014	Percentage of oecol. 2014
Oat	23,5	25,5	24,5	16,9 %
Spring barley	14,5	14,5	12,5	2,1 %
Spring wheat	10,0	8,5	8,5	5,6 %

Tab. 2: Examples for the crop rotation order for oats under different site conditions

Sandy soils	Loamy sandy soils	Sandy loamy soils
Clover grass	Clover grass	Clover grass
Oats	Cereals	Cereals
Cereals	Oats	Cereals
Pulses	Pulses	Pulses
Cereals	Cereals	Cereals
Cereals	Cereals	Oats



be reached in comparison to other farmed crops may not be overlooked.

On sandy soils the oats generally belong among the economically preferential cereals and should therefore be placed after legumes and their mixes. On the more nutrient-rich soils, oats are often in competition with wheat, which pushes them into the lesser preferred places in the crop rotation. There, they are generally the last crop in the rotation and do not come directly after the legumes (Tab. 2). If there are too many nutrients on offer, this can also be used to prevent lodging and delayed straw ripening. The oats in mixed cultivation with pulses, which is common in organic farming, are positioned in crop rotation the same way as pure pea or lupin cultures.

seed (loose smut *Ustilago avenae*; *Septoria avenae* leaf blotch; *Helminthosporium* leaf spot *Drechslera avenae*). Therefore, if possible, certified seeds should be used. In case of on-farm production, the plant culture must be checked closely and the seeds must be examined in the laboratory if applicable.

Optimal seeding time is decisive

Unfavourable weather conditions up to germination and lengthening of the emergence time increases the risk of infection. Signs of nutrient deficiency in the juvenile development appear at these time points when low temperatures or dryness hinder a timely provision of soil nutrients. Therefore, selecting the optimal seeding time is crucial.

Direct weed control with the harrow

Plough usage in organic farming is standard practice and an important indirect measure for weed control. Insufficient soil loosening and aeration, and stronger pressure from weeds are the main arguments for using the plough. Especially the shorter cereals such

II: Particulars of cultivation under organic conditions

Only use healthy seeds

As untreated and normally organically-propagated seeds are sown, particular attention should be paid to diseases carried by the

as oats and spring barley can suffer from stronger weed pressure when farmed without the plough. In organic farming, drilling should also take place as early as possible, but not at the cost of weed control by adaptation of all work processes to seeding. Every soil working measure facilitates weed germination, and the weeds can then be effectively reduced by the next work step. Therefore, seedbed preparation and seeding should take place 7–10 days after the seed furrow. Winter furrows are scrubbed approximately 10 days before seeding using appropriate machinery. Early seeding of the oats



must not be at the cost of optimal seed bed preparation but on the other hand the fear of weeds must not delay seeding to May. After seeding, mechanical maintenance is the most important measure during the vegetation period in organic farming. Blind scrubbing 5–7 days after drilling is particularly effective. The weed seeds have already germinated by then and can be effectively controlled before the oats even appear on the surface. A second scrub is performed as

soon as the plants are sufficiently anchored in the soil and there is no danger of burying the oat plants (three leaf stage). The effective burying of the still small weeds requires a crumbly soil and adapted speed. The oats are relatively hardy regarding this measure.

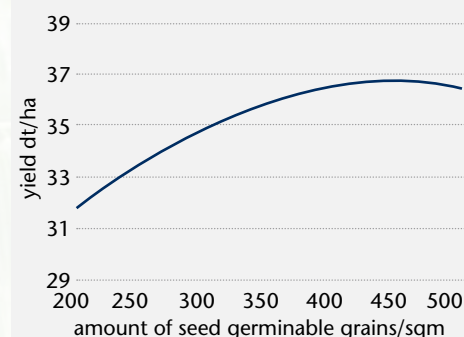
Low seeding density can lead to lower yields

The seeding density should not be too low and is slightly above the conventionally stated number of grains, so that a seeding density of 350–400 germinable grains/sqm is recommended (Fig. 1). A feasible economic gain through increased yield can be reached with a seeding density of up to 400 grains/sqm. The usually insufficient nutrient provision sets clear thresholds for a stronger tillering of the individual plants at lower seeding density. The compensatory effect of the higher thousand seed weight achieved at lower seeding densities is not sufficient for balancing the yield. The better the soil, the further the seeding density can be reduced. Higher seeding densities can also make up for the lower emergence rate and the loss of plants during scrubbing.

Fertilisation

Oats are able to utilise well any additional nutrients, e.g. from digestates, and turn them into higher yields and quality. As little as 20 m³ digestate (approx. 100 kg N) can, depending on the weather, result in up to 10 dt/ha extra yield and a higher crude protein content of up to 2.5 % (Fig. 2). Just under one-third of the nitrogen is taken up by

Fig. 1: Influence of the seeding density onto the yield of oats in organic farming, location Gülzow



Source: Gruber et al. 2003

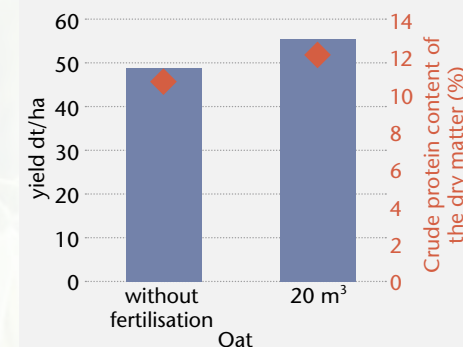
the oats and a further share is saved for the follow-on crop and stored in the soil pool. Quick working-in of the digestate reduces gaseous losses.

Variety selection

In organic farming, hulled oat varieties with good tillering, quick juvenile development and longer growth are preferred. Good crop density and taller plants suppress the weeds effectively from emergence to ripening and tall growing plants also yield more straw. As there are no further opportunities for direct disease control, the resistances of a variety are of particular interest.

Besides the growth properties, the choice of variety is determined by what the grain will be used for. The quality requirements are identical to those for conventional grains. Varieties with low amounts of hull and easy hulling are suitable for use as hulled oats. Not all varieties deliver a hectolitre weight

Fig. 2: Influence of the digestate fertilisation on grain yield and crude protein content of oats, location Gülzow 2013–2015



Source: Gruber et al. 2016

of 54 kg straight from the field, so that most often precleaning is necessary to not lose the better price.

While yield is the most important selection criterion during the production of fodder oats, for hulled oats certain compromises are made. Normally, higher prices even out the difference in yield when reaching the respective qualities.

Naked oats are only available in a few varieties. As naked oats are a demanding crop during cultivation, harvest, storage and processing, the cultivation area remains small at present. Nevertheless, marketers point to it as an interesting alternative (Becherer, 2016). Before cultivation it is however necessary to discuss all the questions regarding marketing and processing.

Mixed culture with oats

Oats are an excellent partner for mixed cultures with non-cereals. In comparison with

pure culture, e.g. legumes, the mixed culture with oats suppresses the weeds and the harvestability of the crops is improved. It can also serve as a support crop for fully leafed pea varieties. Trials have demonstrated that yield and the proportions of the mix partners are subject to year-dependant fluctuations. In such mixtures, oats can act strongly compensatory and for instance counterbalance the lower yields of legumes caused by the weather conditions. The seeding density can be reduced for oats to 100–150 germinable grains per square metre, depending on the site conditions. Lupins or peas, however, require a pure seed share of two-thirds, in

order to reach a legume share at harvest of at least 30 %. Compromises must be found regarding sowing depth, seeding time and culture care measures. Not the least, the cultures have to be selected regarding ripeness times and growth heights.

III. Oats as valuable feed component Silage with oats and legumes

Using oat-legume mixes as whole-crops can be an alternative to using the grains of the mix. Harvesting the entire aerial biomass is already possible during yellow ripeness of the legumes. Particularly the oat mix with lupins demonstrated in addition to good



Oat has a very high fodder value in mixtures.

Tab. 3: Crude nutrient content, digestibility and energy of whole-crop silages

Mean of the results of 3 ears mix

Mixture	DM %	Crude protein/ g/kg DM	Crude fibre g/kg DM	Starch g/kg DM	Enzyme sol. org. matter g/ kg DM	Energy DM yield		DM yield dt/ha
						NEL	ME	
Peas/oats	34,9	100	266	92	521	4,94	8,50	60
Lucerne/oats	30,0	102	258	103	579	5,40	9,23	72
Peas/cereals	33,6	100	236	140	623	5,76	9,75	60
Lucerne/grains	27,0	116	255	103	600	5,56	9,45	78
Target values	30–35	> 100	230–260	> 140	> 630	> 5,80		

Source: Titze, Gruber 2006



Silage made of oats and beans

Oats in feed concentrates

Oats are an important partner in feed concentrates for several animal species. The fraction can be, for instance in lamb fattening, a share of around 30 % (Martin, Blum, 2015). When designing the ration, it has to be taken into account that the feed value differs when compared with components of conventional farming. In comparison with conventionally farmed oats, only 75 % of the crude protein content and approx. 90 % of the crude fat content are reached (Tab. 4). Therefore, to create the rations, own quality tests should be performed or the tables for organic farming should be used.

Oats actually offer advantages in organic yields, comparatively advantageous crude protein and energy values. Three-year analyses of whole-crop silage demonstrated that the quality of these silages conformed to the requirements as a single base feed for cows and sheep when not used during the lactation period (Tab. 3).

Oats actually offer advantages in organic farming with regard to the required design of crude fibre-rich rations. They possess a particularly high crude fibre content in comparison with other cereals, which, in combination with the high crude fat content, leads to a favourable protein-energy ratio (Tab. 4).

Tab. 4: Feed value of organically farmed cereals¹ and comparison with conventionally farmed components

Fodder	Content per kg fresh matter						
	Crude protein	Crude fat	Crude fibre	Metabolisable energy	PEQ ²⁾	Minerals	
	g			MJ ME	g/MJ ME	g	
Barley	89	24	47	11,0	8,2	0,4	2,8
Oats	82	45	119	10,0	8,2	0,7	2,9
Rye	75	15	24	11,4	6,6	0,3	2,7
Triticale	90	16	24	11,4	7,9	0,3	3,0
Fodder	Feed fraction in the fresh matter in comparison with conventional = 100 %						
Barley	73*	93*	108*	98*	74*	82*	92*
Oats	74*	89*	107*	98*	75*	84*	94*
Rye	73*	91*	110*	98*	75*	63*	78*
Triticale	71*	85*	107*	99*	72*	75*	84*

* Significance of the differences of the mean values ($p < 0.05$)

1) Results of analyses of the LFA MV and the LUFA MV, 2) Crude protein-energy-ratio in g per MJ ME

Source: Martin, Blum 2015

Conclusion

- Oats are the most important summer cereal for organic cultivation.
- Their cultivation suitability for diverse site conditions makes them an attractive recovery crop for many farms.
- Oats can be grown in pure cultivation and in mixes, particularly with legumes but also with other crops.
- Therefore, it is interesting not only as grain crop but also as whole-crop.
- Oats can be an important component in the ration design for various animal species.

Dr. Harriet Gruber

You can find the references on page 71



Green smoothie bowl with oat muesli mix

Ingredients for 2 persons:

- 1 banana
- 1 kiwi
- 100 g cucumber or 1 small apple
- 1 handful of corn salad
- 150 ml water
- 80 g rolled oats
- 20 g oat bran flakes
- 1 tsp linseed, crushed
- 1 tbs pumpkin seeds
- 1 pinch turmeric and cardamon seeds, ground



Nutritional information per portion ...

	with apple	with cucumber
Energy:	313 kcal	290 kcal
Carbohydrates:	50 g	45 g
Fat:	7 g	7 g
Protein:	11 g	10 g
Dietary fibre: of which beta-glucan	9.5 g, 2.6 g	9 g, 2.6 g
Salt:	0,016 g	0,016 g
Magnesium:	111 mg	113 mg
Iron:	3.44 mg	3.45 mg
Phosphorus:	235 mg	238 mg
Thiamin:	0.356 mg	0.361 mg
Folate:	78.9 µg	84.7 µg
Vitamin K:	44.1 µg	48.2 µg

Preparation:

Peel banana, kiwi and cucumber and cut into slices (if an apple is used, do not peel). Wash and clean corn salad. Finely puree fruit and salad with water in a blender and fill into two bowls. Mix oats together with the oat bran flakes, linseed, pumpkin seeds and spices. Briefly dry-roast this mix in a pan until you notice a faint scent. Distribute the muesli mix over the smoothie and serve with a spoon.

Preparation time: 15 minutes

The importance of oats in the crop rotation

Short crop rotations with high proportions of winter cereals have been coming under more and more pressure in recent years: The increases in yield fail to appear, particularly in winter wheat, the costs for fertilisation, crop protection and farm work are rising.

Also the increasing problems with resistance especially in weed grasses indicate that crop rotation must once again receive greater attention.

Besides the typical foliage crops, predominantly pulses and summer cereals offer a further extension of the crop rotation. Oats are of particular relevance here as they can take on the function of a foliage crop in the rotation.

Oats are often wrongly evaluated

Around 26 % of the domestically-grown oats enter the food industry, and this shows a rising tendency. Quality oats can reach the price level of quality wheat, so that combined with high yields, the cost-effectiveness of oat cultivation is improved. However, oats only occupy a 2.5 % proportion of the German cereal area (Stat. Jahrbuch 2008), as the significant value of the oats is not evaluated during the design of the crop rotations. The market performance and the profit margin are often estimated too low. The Statistische Jahrbuch shows that oats on average over seven years only have a grain yield of 45 dt/ha. In practice, however, an average of 65–70 dt/ha is often achieved:



This decisively alters the competition situation.

A single representation of the competition situation based on profit margin calculations is not sufficient. Without doubt this can contribute to shortening of the farms' crop rotations and to alignment to the strongest performing crops. Above all winter wheat benefits here. At the same time, during the evaluation of wheat cultivation, hardly any difference is made between foliage crop –

wheat rotations and wheat – wheat rotations, although considerable site-dependent differences in performance can be determined.

Consider the entire farming system

Not only is the crop yield crucial for the cost-effectiveness of a cultivation process, but also the cost-adjusted performance of the entire cultivation system. Besides the direct costs, the costs for farm work in particular are included here (see also pages 32–35 of the article). Both cost items are determined by the crop rotation. Regularly alternating foliage and cereal crops, or changing from winter-planting to summer planting makes conservation tillage easier, leads to cost savings for fertiliser and crop protectants, and increases the monetary performance of the crop rotation.

In addition to foliage crops, oats also have particular significance as a rotation crop. On the one hand, this covers the phytosanitary aspects. On the other hand, however, its

position within the crop rotation has a direct effect on the utilisation of the yield potential of the oats.

Oats in the crop rotation

A glance at the old text books confirms the expression still used today that wheat deserves the best position in the crop rotation – in other words after a foliage crop. In contrast, oats are usually the “clearing crop” after the winter cereal species. Without a doubt, oats cope with this unfavourable position in the rotation system best, due to their good ability to predigest and acquire nutrients. However, optimal exploitation of their yield potential is not possible here – the yield performances are therefore lower than those predicted.

How do the cereal types react after different preceding crops? Continuous crops lead to considerably lower yields, which can only be moderated by soil working, fertilisation, crop protectants, etc. (Tab. 1). The immediately preceding crop and the combination of the preceding crops are exceedingly

Tab. 1: Grain yields (dt/ha and %) of the cereal type at the centre of five sites and six trials years under different crop rotation conditions

Cereal type	Fruchtfolgeform				
	Crop change		over 50 % proportion of the respective cereal type		Monoculture
			Repeat crop	Crop following oats or wheat	
	dt/ha	%	%	%	%
Winter wheat	46,3	100	66	81	65
Spring barley	39,5	100	88	94	86
Oats	40,4	100	76	95	71

Source: from BACHTHALER, modified

important for the yield formation (Tab. 2). Of the tested cereal species, oats have the best preceding crop effect for wheat (Tab. 2, foliage crop – oats – wheat). Depending on the preceding crops and preceding crop combinations, the yield response shows crop-characteristic differences.

Positive yield effects in the crop rotation

The resistance of oats to the important pests parasitic eyespot (*Pseudocercospora herpotrichoides*) and take-all (*Gaeumannomyces graminis* var. *tritici*) makes it a “recovery crop” in short cereal crop rotations – comparable to a foliage crop (Tab. 3). Winter cereal species therefore achieve similar yields after oats to those after the foliage crops oilseed rape, sugar-beets or legumes. The actual yield response is really influenced by non-pathogenic preceding crop effects such as nitrogen availability, water supply and soil structure effects. Tab. 4 presents information about the preceding crop suitability of agricultural crop plants for oat cultivation and other selected cereal species. As oats show a relatively minor reaction to

different preceding crops (Tab. 1), they are easily integrated into the rotation system. Exceptions occur when there is a risk of infection with cereal cyst eelworm (*Heterodera avenae*) or with stem and bud nematode (*Ditylenchus dipsaci*). Monocultures or being positioned too close together in the crop rotation must be avoided! The proportion of oats should therefore be at most 20–25 %.

Reconsider short crop rotations

During the economic evaluation of crop rotations, two particular cost items must be taken into consideration: the direct costs like seed, fertiliser and crop protectant, and the costs for farm work. While the saving possibilities in the direct costs in short crop rotations are exhausted to a large extent, there are considerable saving opportunities through the integration of more foliage crops or summer cereals. In this way, the costs of the farm work can be reduced, especially using conservation tillage through to direct seeding. The greatest benefits are expected using ploughless culture techniques with rigorous cereal/foliage alternation or even by switching from winter to summer-

Tab. 2: Relative preceding crop value of foliage and cereal crops for winter wheat

Direct pre crop									
Early pre crops	Pulses	Sugar-beets	Potatoes	Winter oilseed rape	Silage maize	Oats	Spring barley	Winter barley	Winter wheat
Foliage crop	100	94	93	91	88	85	83	79	79
Cereal	97	91	90	89	86	83	80	75	75

Relative grain yield from wheat 100 = 68.7 dt/ha
Source: from BAEUMER 1992

Tab. 3: Infestation of winter wheat with take-all and eyespot in different crop rotation groups, on average from five sites and over two years

Crop rotation groups	Infestation winter wheat (% the stalks)	
	take-all	eyespot
> 50 % winter wheat	33 %	50 %
after spring barley	30 %	44 %
after oats	10 %	38 %
crop rotation	9 %	30 %

Source: from Gliemeroth and Kübler 1973

planting. In multi-year trial crop rotations combined with conservation tillage methods, the preceding crop values of winter oilseed rape and oats for the yield of the following wheat were tested in the rotations oilseed rape – wheat – wheat – wheat in a

plough system and cereal rotation oat – winter wheat – winter wheat – winter rye. The average yield performance of the two wheat on wheat crops in the culture system oilseed rape and 3 x wheat were used as the valuation standard (Tab. 5). The preceding crop value of oilseed rape or oats is calculated for winter wheat using the change in yield and the actually realised cost savings for fertiliser, crop protectant and farm work compared with the average value for the first and second wheat crops from wheat on wheat. About the same preceding crop values exist for oilseed rape and oats at the Soest site. However, the differences are much more pronounced at the Gülzow site. This can be traced back primarily to the very low yield performance of the wheat on wheat in the reference system. Both foliage crops (oil-

Tab. 4: Suitability as a preceding crop of agricultural crop plants for selected cereal types

Pre crop	Successor crop			
	Winter barley	Winter rye	Winter wheat	Oats
Winter barley	-	±	-	o
Winter rye	±	o	o	±
Winter wheat	+	±	o	±
Spring barley	o	±	o	-
Oats	+	±	+	-
Winter oilseed rape	++	++	++	-
Potatoes – late	-	++	++	++
Sugar-beets	-	-	++	++
Silage maize	-	+	+	+
Peas	++	++	++	-
Lucerne	-	-	+	++
Red clover	+	+	+	++
Clover-grass	+	+	±	++
Perennial grass	-	+	±	++

++ very good, + good, +/- sufficient, o no preceding crop effect, - not possible / not usable cultivation combination.
Source: from Seifert, 1988, modified

seed rape and oats) produced considerable surplus yields in the following wheat crops, which was particularly noticeable in Gülzow. This result continued as a recurring theme in all five tested culture systems.

The change from foliage to cereal crops in one culture system altered the production expenses for the following crop: very low intensity soil intervention, low fertilisation and crop protection costs, savings in the cost of the farm work. Generally, the yields also increase. The advantage of oats is in particular the phytosanitary effects. For this reason oats have a “foliage crop” character in cultivation systems. Early sowing ensures high yields. The advantages of oats growing in extended crop rotations promote site-specific high grain yields. The most im-

portant requirement for this is exploitation of the available vegetation period with very early sowing times. A date in January / February with light frosts has proved suitable for farms in autumn with conservation tillage on preprepared arable land with 230–250 germinable grains/sqm.

Conclusion

Oats can only be correctly evaluated through a full cost calculation of the entire rotation and utilisation of the preceding crop value. Oats can lead to an economic improvement in the whole crop rotation in short, wheat-dominated rotations.

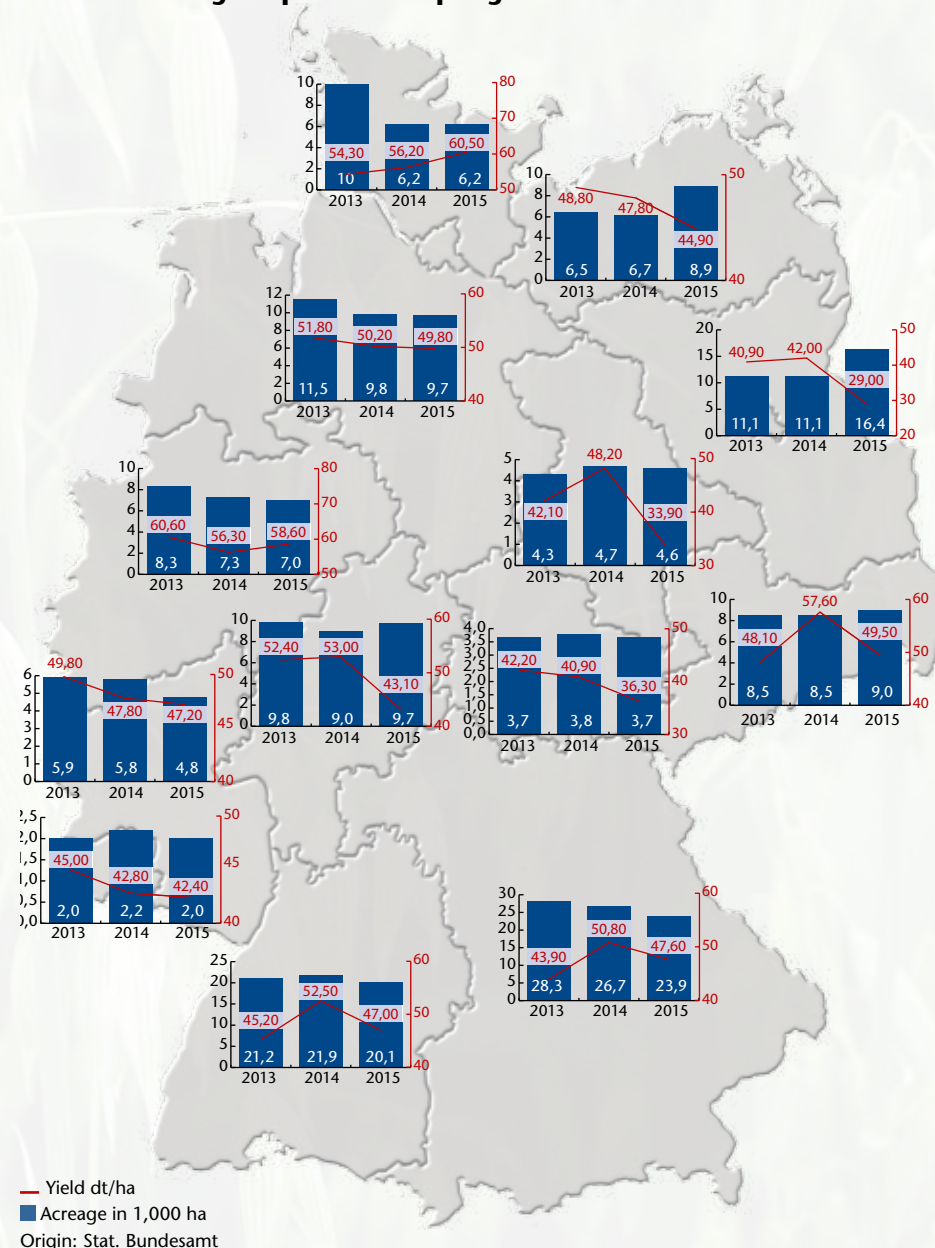
Prof. em. Dr. Norbert Lütke Entrup

Tab. 5: Preceding crop value of oilseed rape and oats for wheat depending on the management system and site measured by the average yield of the 1st and 2nd wheat on wheat in the plough reference system, 2003–2005

	Extra yield		cost savings			
Management system/cultivation sequence	dt/ha	€/ha	Fertilisation €/ha	Plant protection €/ha	Costs for working €/ha	Pre crop value €/ha
Location Soest (North Rhine-Westphalia)						
Oilseed rape-WW-WW-WW (plough system)	0.9	9	16	35	-	60
Oats-WW-WW-WR (conserving)	2.1	20	-12	-4	52	56
Location Gülzow (Mecklenburg West Pomerania)						
Oilseed rape-WW-WW-WW (plough system)	17.5	174	3	28	2	207
Oats-WW-WW-WR (conserving)	21.5	214	3	23	50	290

Source: Schneider and Lütke Entrup 2006

Yield and Acreage of production spring oat 2013–2015



10 tips for successful oat cultivation at high altitudes

In the high altitudes of south-west Germany oat cultivation is still very significant due to the lack of alternative foliage crops, especially as a preceding crop for wheat. However, since 2005 oat cultivation has declined, above all in the climatically-favourable regions of Baden-Württemberg where it has sunk by 14 %.

Today, marketing to hulling mills for processing to oat flakes as for example baby food plays a much greater role than cultivation for fodder. Top farms harvest here on average for many years up to 50 % more than the country average; the average for the years 2005–2009 was 51.6 dt/ha. Jens Heisrath (ABIP Dietingen) describes impor-



tant cultivation rules for growing oats successfully on high-altitude sites.

1. Crop rotation: Maintain at least a five-year cropping interval!

Oats are commonly considered to be the recovery crop, however they can be damaged by cereal cyst eelworms. Other cereal species can be damaged once the nematode population has become established. A five-year cropping interval has proved able to keep the incidence of infection low.

2. Site selection: Do not grow if there is a risk of regular water shortage!

Oats need a lot of water. In particular oats react extremely badly to water shortages and heat stress after shooting. The oat yield regularly drops if heat waves with over 30°C last several days. Therefore they are not grown on sites which can easily become dry (shallow soils or those with regular pre-summer droughts).

3. Weed infestation: Do not grow at sites where foxtail grass is problematic!

Weeds in oats can be fought easily and viably compared with weed grasses. Particular sites with a known high level of foxtail grass should be ruled out for oat cultivation. For these sites, however, Lexus® is available as a possible control measure, which is a product from the sulfonylurea group. To prevent resistance, the use of Lexus® in oats should be avoided, especially in clay soils. On the one hand, the success of the control in this case is often less than satisfactory (promoting resistance!), and on the other hand the tolerance of Lexus® is often critical with the weak root formation at these sites. Therefore, foxtail grass should be controlled as well as possible in the preceding crop.

4. Sowing time: May oats are chaff oats! The earlier the oats are placed in the soil, the more stable are the yield and quality. The later sowing takes place, the worse is above all the hectolitre weight.

The first good weather in spring must be used for sowing because this is generally when there are the best conditions – even if this is only February. It is important to use soil conserving techniques. Reduce the tyre pressures as far as possible (0.5–0.8 bar). Sowing is even possible when the surface is frozen and therefore the soil is able to support the tractor.

5. Sowing density: Ensure yield and quality by using an appropriate sowing density! The main shoot always dominates the yield in oats. If the oats are too dense, the crop is dominated by unpro-



ductive side shoots. This costs unnecessary amounts of strength, and the yield performance of the main shoot is disproportionally reduced and the hectolitre weight suffers. Single panicle types such as Neklan or Typhon provide good yields after early sowing or quicker young plant development. But their yield often drops after late sowing or in cold springs, particularly at high altitudes. For later sowing times, dense crop types like Aragon should be used.

In our experience, oats react positively to a sufficiently deep sowing depth at high altitude, better too deep than too shallow!

6. Fertilisation: Basic nutrients and trace elements must not be neglected!

Oats have a considerably better rooting system than spring barley and therefore can penetrate even heavy soils well and in doing so acquire the nutrients. Due to its short vegetative periods when compared with winter wheat, and the associated fast-



A fertilisation window is the simplest method for determining the optimum N-amount.

er growth, there is at least temporarily an increased nutrient requirement. In our trials oats always reacted positively to fertilisation with phosphate, potash and magnesium, depending on their availability in the soil. At the same time it has proved worthwhile incorporating these nutrients into the soil before sowing so that they are as close as possible to the roots.

In addition to the basic nutrients, oats react especially positively to fertilisation with trace elements. Here, manganese must be mentioned first and foremost, but also small amounts of boron in deficient sites (max. 50 g pure boron as leaf application). In some trials in our region, dressing with trace elements was superior to the leaf application, however the combination of dressing and leaf application was ideal. With this, we were able to realise extra yields of 7.2 dt at costs of around 10 € on average over the last 3 years. Nutriseed® for example recom-

mends itself as a seed dressing at 0.25 l/dt. Leaf applications with trace elements should only be performed after determining the nutrient demand through leaf analysis.

7. Nitrogen: Too little costs yield, too much costs quality!

Oats react badly to too much as well as too little nitrogen. Too little nitrogen can result in considerably reduced yields, especially if the supply from the soil or from organic fertilisers is not used as calculated. Deficiency in the shooting phase of only 20–30 kg N/ha can quickly become 10–15 (!) dt/ha loss of yield. But if this N-amount is simply applied in addition to the amount usual for the site, this can backfire if the supply from the soil is good: Straw ripening is delayed and relocation of the assimilates slows down ("more straw, less grain"). Oats are very sensitive to this. Added to this is that straw from over-fertilised crops has to be "forced" through the thresher. The hectolitre weight

also drops with excessive N-fertilisation. The simplest method for determining the optimum N-amount is a fertilisation window with around 30 % less fertiliser than usually to be applied until mid-tillering. If the fertilisation window pales at the start of shooting, subsequent supply does not work as expected. This can still be responded to with complementary fertilisation of 30–40 kg N/ha at development stage ES 31/32 at the latest. Caution: Too late complementary fertilisation in weak crops increases the risk of secondary growth. If the fertilisation window only pales later, then complementary fertilisation is not required.

8. Growth regulator: Storage prohibited!

The use of growth regulators is a touchy subject in oat growing. On the one hand, CCC is generally prohibited in contract farming, while the use of Moddus is dependent on the buyer. Too much Moddus in the shooting phase can also quickly have negative effects on grain formation (silver-top) and the hectolitre weight. On the other hand, lodging must definitely be avoided for quality reasons. Also for this reason, oats should not be planted too close together or too heavily fertilised. If growth regulators are required, split applications of the Moddus amounts at ES 31/32 (e.g. 0.2–0.3) and ES 39 (e.g. 0.15–0.2) have proven successful.

9. Fungicides: Watch out for mildew and rust!

Oats are generally fine without fungicides. But in years with high disease pressure, oats

can also be highly attacked by rust and mildew. Recently in 2007 we had such disease conditions whereby fungicide application from the flag leaf stage was able to deliver an extra yield of about 12 dt/ha. Usually there is no sense in using the full approved amounts of strobilurins (Amistar®) or combinations with azoles (Juwel Top®) because these can considerably delay the ripening of the straw. The tried and tested level is 50–70 % of the approved amounts, which are designed for the high disease pressure in winter cereals.

10. Pests: Check for leaf beetles and aphids during ripening!

Due to its attractive flag leaf, oats are readily attacked by leaf beetles. Especially in dry years, close monitoring after panicle earing should be performed because this is where the worst damage occurs. Control with approved pyrethroids makes sense at a damage threshold of 0.5–1.0 larvae/plant. In years with high pressure from aphids, generally a later infestation can also be significant for the yield in oats, even if this is uncommon at high altitudes.

Therefore, top yields can also be achieved with oats. For this, high intensities are not essential, more so intuition and the intelligent use of the resources. If the site is right, the marketing is good and the crop is given the necessary attention, oat growing can be highly economical.

Jens Heisrath

Oats as recovery crop

Oats are often only a stopgap in crop rotations. But that is unfair – because the yields of the new varieties can easily reach 90 dt/ha. Furthermore, its cultivation offers many advantages:

- As summering, oats help tackle the problems of resistance formation in weed grasses. This is particularly the case when maize cannot be planted.
- It is the only cereal species that can be used to break up short cereal and oilseed rape crop rotations.
- Oats reduce the pressure of root and stem base diseases. Its root excretions prevent take-all developing. However, they slow down N-uptake in early sown winter barley.
- Early ripening oat varieties such as Aragon or Ivory can also be used before oilseed rape. This has a “double recovery” benefit. Because both crops reduce the level of infestation by soil-borne pathogens.

The earliest possibly sowing is important for this. If a crop only emerges during the

second half of April, the yield and the hl-weight drop dramatically. In the majority of regions, oats should be in the soil by 25 th March. The target is a crop density of 350 to 500 panicles/m². At sites with a guaranteed water availability in April/May, the varieties Dominik and Max are suitable. On the semi-heavy to heavy soils in the North, varieties such as Poseidon, Scorpion and Symphony have proved themselves. Ivory and Moritz can be used on somewhat weaker soils. However, after flowering there should always be enough water available. Anyone interested in growing oats, should however initially check the marketing with the local agricultural trade or cooperative. While Germany currently imports around 250,000 t of hulled oats, in spite of this there are only limited buyers. Good quality is at any rate important for the trade, such as

high hl weight and good hullability. This indicates how easily the hulls can be removed from the grain.

Dr. Hansgeorg Schönberger

By means of oats it is possible to loosen cereal rotation and rape rotations.



“N.U. Agrar GmbH is an independent consultancy for arable and crop production, partner to the farmer for 25 years. As a link between research and practice we transfer scientific findings into practical agriculture. Findings from research and current experience flow straight into the business consultation. At present the consultancy team is overseeing 1,000,000 ha of agricultural land from Denmark to Hungary, from France to the Ukraine.”

The voice of experience

Franz Füser on the topic Production/Crop rotation: “One can clearly see that slender meadow foxtail causes fewer problems in oat crop rotations. As we really always have sufficient precipitation, we achieve good yields, which in top years can already reach 85 dt/ha. On average we see 70 dt/ha. (cited from praxisnah 4/2012)

Steffen Schur, Gut Lewitz GmbH, on the topic Feeding: “The hectolitre weight is not as important as many people believe. (...) If the sensory quality is right, we can easily manage the energy supply using the volume. Therefore we ensure very hygienic storage conditions.” (cited from praxisnah 1/2013)

Marcus Ehrler, agricultural cooperative Bergland Clausitz e.G., on the topic Production: “What I particularly appreciate about oats besides its preceding crop value is the low production cost (...)” (cited from praxisnah 1/2016)

Karl Senne from Wunstorf has been planting oats mixed with legumes since 1985: “Using a mix of cereals and legumes we have the advantage of risk spreading. Last year this worked really well for broad beans and in some cases they were dominant. This year has been the complete opposite; the oats are the dominant crop.” (cited from praxisnah 4/2011)

How intensively should one farm for 8 tons/hectare

Oats are being used for food production more and more in many European countries, where to the crops can realise highly attractive prices. High yields and best qualities are necessary to remain competitive in this segment when compared with arable crops.

Furthermore, German oat processors are increasingly taking into account consumer demands for regionally produced foods. There, the oats are naturally in competition with other crops. In order to be able to economically serve the growing market in this competition, German oat growing must provide high yields and the best possible qualities. Both requirements can be fulfilled with knowledge of the optimum growing intensities of the oat varieties.

Increased yield is possible in practice

Results from oat field trials in previous years demonstrate very clearly that the difference between the yields gained there and the yields in practice are continuously increasing. This difference is greater than for other crops. Seemingly, the farmers often do not see oats as a lucrative market crop but more as a stop gap. As a result, farmers do not inform themselves about this crop to a great extent. However, time and again there are farmers who in practice clearly exceed the yields of 8 t/ha using modern oat varieties and our conditions. If this yield potential is coupled with attractive marketing quality,



and a reliable marketing partner is present, oats do not need to shy away from the big crops on the market.

From experience during consultations, oats are seen as a low input crop. Often in conventional practice, fungicide application is required, and sufficient mineral fertilisation dominates with a single or at most two applications of growth regulator. The intensity

increases show a different picture in the oat field trials: As calculations of the economic values by LWK North Rhine-Westphalia demonstrate, it is very important to take the properties of the variety and the growing conditions into consideration during crop management.

During variety approval, the Federal Plant Variety Office (Bundessortenamt, BSA) tests oats at two different intensities. Step 1 does not use fungicides or growth regulators and thus records the “net” variety yield with regard to the grain yield. Step 2 adjusts the treatments for the optimisation of yield and quality to the locally used practice. The BSA describes the recorded variety specific reaction in its Descriptive Variety List. Most of the oat varieties react pretty much identically to an increase in farming intensity with regard to lodging tendency and disease susceptibility.

Variety specific crop management is the basis for high yields

To ensure high yields, every specific growing situation requires variety-specific crop management. Information about this can be taken from the trial network of the Bundessortenamt (Federal Plant Variety Office).

Yield: Tab. 1 depicts the grain yields of known and newer oat varieties from the VCU tests of the years 2012 to 2014. In those years, on average most varieties in part clearly surpassed the aimed for 8 t/ha in the intensive step. The new variety Yukon was the only variety that also nearly reached this target in Step 1 too. Never before, in Germany has a variety reached higher yields than that in the extensive step!

The yield reaction to the increase in intensity was variety and year specific. In the grain yield, Yukon and Bison demonstrated the least reaction to the intensity rise. The variety Max, with the greatest susceptibility

Tab. 1: Yield results of oat varieties compared by year

Intensity	2012		2013		2014		Diff. level 2 – 1	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	dt/ha	%
Number of sites	n = 12	n = 12	n = 12	n = 12	n = 11	n = 11	Average for all years	
Max	77,9	84,4	74,8	78,4	74,5	80,5	5,3	7,1
IVORY	75,6	81,1	70,0	74,8	69,4	76,9	5,9	8,2
SYMPHONY	83,1	88,9	74,4	80,6	73,7	80,3	6,2	8,0
POSEIDON	83,2	87,5	76,0	81,8	76,0	82,3	5,4	6,9
APOLLON	81,5	87,9	74,2	80,0	74,2	80,0	6,0	7,8
BISON	82,1	83,5	73,2	76,8	74,1	76,1	2,3	3,1
Yukon	85,0	87,9	78,8	82,5	75,2	80,5	3,9	4,9

Source: VCU tests of the Federal Plant Variety Office (Bundessortenamt)

to lodging and stem kinking, reacted less than expected.

Lodging and diseases: While in 2013 the seeding time was delayed, 2012 and 2014 were years of stronger lodging pressure with lower disease infestation after early or late seeding. In 2013, the lodging pressure remained low up to harvest and there was a stronger infestation with powdery mildew. Tab. 2 depicts the grades of the varieties in the characteristics lodging tendency, stem kinking and mildew infestation (1 = very low to 9 = very high). Other diseases were of no mentionable consequence for the oats in the recorded time span.

It was demonstrated that in the year 2012, the lodging tendency had a dominating influence on the variety reaction. The most strongly lodging variety Max demonstrated

the greatest increase in grain yield as a result of treatment, while the variety Bison, as a strongly lodging resistant variety, showed the least reaction. In 2014, the lodging tendency was dominating, but Max reacted less intensively than the other considerably more lodging resistant varieties. In 2014, the lodging pressure was at an earlier point of time than in 2012, and Max was possibly able to profit from its earlier straw ripening. As a result, Max was the only variety of this comparison that registered a lower lodging rate for 2014 than in 2012. Varieties with a slower straw ripening such as POSEIDON, SYMPHONY and Yukon were softer in the stem at the earlier lodging pressure time than Max and thus lodged slightly more strongly than in 2012.

Growth regulator splitting also an idea for oats

Due to the strong mildew infestation in the year 2013, treatment had little effect on the resistant varieties Bison and Yukon. There was a somewhat stronger effect with the mildew susceptible but lodging resistant varieties such as POSEIDON and APOLLON. Overall, the disease treatment in the year 2013 did not lead to the increase as a result of using growth regulators that it did in the lodging years 2012 and 2014. As 2014 demonstrated, the year effects can also shift the otherwise known lodging susceptibility of oat varieties. The crop management must be adjusted accordingly in these cases. In intensive oat crops therefore the growth regulator application should be split depending on the variety: The first treatment with a moderate GR-amount in a stage as early as possible as of EC 32.

Resistant varieties offer a more reliable yield

Fungicides only make economic sense during a severe infestation of leaf diseases. In the high yield area, experience shows that stronger disease pressure (mildew) is to be expected due to the denser and better fed crops. Disease resistance is gaining importance, because only very few fungicides are approved for use in oats in Germany. New, strong yielding, very healthy and lodging resistant varieties such as Yukon, Apollon and Bison considerably improve the cultivation reliability considerably.

*Dr. Steffen Beuch
published first in 1/2015*

Tab. 2: Grade results of oat varieties compared by year

Capture of damage*	2012			2013				2014			Average		
	Mildew	Lodging	Stem kinking	Mildew	Lodging	Stem kinking		Mildew	Lodging	Stem kinking	Mildew	Lodging	Stem kinking
Number of locations	n = 6	n = 7	n = 6	n = 5	n = 5	n = 5		n = 5	n = 7	n = 4	n = 16	n = 19	n = 15
Max	2,5	6,3	6,2	4,8	4,0	6,8		4,2	5,9	3,9	3,8	5,5	5,8
IVORY	2,9	5,2	4,7	4,2	3,9	4,3		3,6	5,7	3,5	3,5	5,0	4,2
SYMPHONY	2,8	4,8	5,0	3,4	3,3	5,3		4,5	5,6	2,9	3,5	4,7	4,5
POSEIDON	3,0	4,9	4,3	4,0	3,2	4,8		4,6	5,4	3,0	3,8	4,6	4,1
APOLLON	3,1	3,9	4,7	4,4	2,8	3,4		4,8	4,6	2,6	4,0	3,9	3,7
BISON	1,1	2,8	3,3	1,2	2,5	4,1		1,2	3,7	2,0	1,2	3,1	3,2
Yukon	1,1	4,4	4,4	1,1	3,0	3,5		1,5	5,2	3,1	1,2	4,3	3,8

*1 = very low, 9 = very high ■ = very good ■ = very bad result

Source: VCU tests of the Federal Plant Variety Office (Bundessortenamt)

Oat production in Sweden

Oats traditionally occupy an important place in cereal production in Sweden. In the late 19th century, oats were even considered to be the most important agricultural crop in the country. While oat production has recently declined, cultivation is however increasing in some regions, making oats one of the most important components of the crop systems in central and southern Sweden.

In normal years, Sweden produces 800,000 tonnes, whereby this is predominantly destined for animal fodder. However, the interest is gradually growing in processing oats for human consumption. The kernel is particularly valuable from a nutritional point of view. Consumer-oriented companies are increasingly using oats in innovative food products. The developments in this product area are progressing rapidly and in the future there will be completely new oat products, such as oat milk, oat oil or even β -glucan as a food additive.

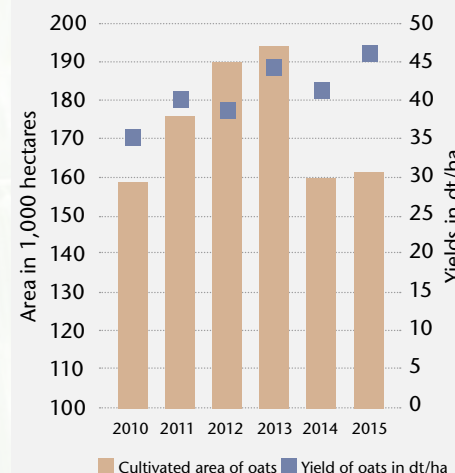
Transformation of the Swedish oat market

Sweden is an oat export country with a long tradition. In the mid-19th century, large amounts of the oats predominantly produced in western Sweden were used as fodder for ponies and horses in England. As well as being increasingly used as a means of transport, the animals had to work hard in the mines, and this required large amounts of good-quality oats. Oat production in western Sweden was perfect both from the quality aspect as well as from the point



Popular Swedish export

Crop areas and yields of oats in Sweden 2010–2015



Source: based on datas of Eurostat

of view of low freight costs. The oat trade brought a boom to this region.

In the 1970s and 1980s, large amounts of oats with a high specific kernel weight left Sweden and Finland destined for the USA as fodder and also for human consumption. Today the goods are sent primarily to northern Europe, particularly Germany. The total export volume has dropped to between 100,000 and 200,000 tonnes.

The standards are rising

Oat production has aligned itself more and more with the specific wishes of the end user. Contracts and planting recommendations for farmers separate the goods into different groups right from the start: Fodder oats without variety purity or export oats, which can fetch different prices for particular parameters such as specific weight or

colour. The contracts with mills and with the food industry stipulate particularly strict regulations for cultivation parameters, varieties, crop rotations, etc.

Spring oats are cultivated in Sweden almost without exception. However, there are also trials running to determine the varieties which will cope best in the relatively harsh climatic conditions. As oats require a good water supply, western Sweden is predestined for the production of good quality and at the same time high yields. Due to the geographic advantages, however, oat cultivation has also expanded into southern Sweden.

Quality assurance through arable measures

The basis for a good start to the growing period must be provided by an early sowing time and uniform field emergence in order to harvest the best quality. Furthermore, optimal weather conditions at harvest are very important: The later the harvest, the greater is the risk of bad weather, and this is not compatible with good quality. Additionally, the crops are more uniform at harvest and the frequency of frit fly infestation (*Oscinella frit*) is much lower after early seeding. If later sowing is unavoidable, the crop must be regularly checked for pests in order for crop protection measures to be performed in good time.

The climate is changing

The ever earlier warming in spring combined with higher temperatures, earlier



insect infestation and a wet autumn must be taken into consideration when making recommendations for crop management. A sowing density of 450–500 germinable grains/qm is recommended for Sweden, depending on the variety, sowing time and soil condition. The recommended sowing density increases with increasing heaviness of the soil and a higher risk of a dry seed bed.

Under normal weather conditions, oats should only be fertilised once at the start of the vegetative stage with an NPK-application of 80–100 kg N/ha. Often fertilisation needs to be adjusted to 110–130 kg N/ha when the expected yield is more than 60 dt/ha, obviously this is dependent on the fertiliser costs and the expected crop revenue. As a rule, NPK fertilisers such as 24-4-5 are used combined with sulphur. Some years a second application of NS fertilisation, for example 27-4, is also used for yield optimisation. The fertilisation recommendations are very strongly depending on the specific requirements. It is usual practice to apply manganese in the form of $MnNO_3$ leaf fertiliser together with insecticides. Fungicides are rarely necessary.

New varieties bring market stability

The statistics show that the average oat yield in the past was very low because the proportion of extensive cultures in some regions is very high.

This means the country-wide average yield only produces around 4 t/ha while in intensively managed regions or under better conditions this can be 6 to 7 t/ha.

Despite the declining overall volume of recent years, it can be assumed, however, that the demand of the food industry and the breeding of varieties will bring about stability.

New varieties with special component ingredients will increase the demand for oats for human consumption. Therefore, oats will also remain an important crop in Swedish cereal production in the future.

Here, the high value of the oat crop for wheat and barley dominated crop rotations must not be forgotten. Unfortunately, this value is not always included in the crop comparison calculations.

Jan Rundqvist

Oat production in Poland

In recent years, the average area used for oat cultivation in Poland was around 550 K ha, corresponding to 6.9 % of the total cereal growing area. Thus, Poland has the largest oat cultivation area in the EU 27.

In addition to monoculture, oats in Poland are also grown as a component of mixed cultures with other cereal types (spring barley, spring wheat) for fodder cereal production. With almost 19 % of the oat growing area, this mixed cultivation also takes up a comparatively large area. While in eastern, southern and northern Poland oat cultivation constitutes around 8–12 % of the cereal growing area, its significance in western Poland is substantially lower with only 2–4 %.



Still relatively low demand from the food industry

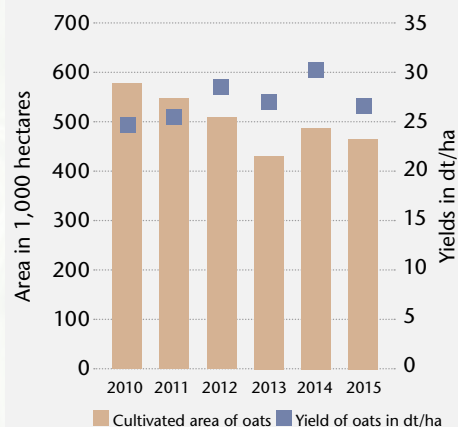
Around 80 % of the oats produced in Poland are used for fodder purposes, 15 % for seed, and the rest for human consumption. Although the dietary significance of oats in human nutrition is also gaining increasing attention in Poland, the use of oats for food is lower than in other West European countries or even in North America. Oat flakes, semolina and bran are produced and processed. At the same time, appreciation of the health-promoting properties of eating oats for the prevention of lifestyle diseases such as arteriosclerosis, obesity, diabetes and bowel cancer is growing. Additionally, oats in Poland have good prospects in the cosmetic, pharmaceutical and chemical industries. Here the high fat content (4–7 % in hulled oats, up to 9 % in naked oats) plays a role because of its specific composition (40 % linoleic acid, 35 % oleic acid, 20 % palmitic acid) as well as the fibre and roughage of the oats (e.g. the β -glucan). As the proportion of horses used in agriculture declined, the amount of oat straw used as litter also fell. Horses can process oat straw considerably better than ruminants. But the use of oat chaff and straw as fodder in pig farming has a certain degree of importance.

Seed

As plants of damp and temperate climates, oats do not tolerate heavy frosts in spring in Poland either. Despite this, sowing should take place as early as possible as germination already begins at 2–3 °C. Temperatures above 12 °C have a somewhat negative effect on the seedling phase. It is important that the soil has sufficient moisture before sowing, as the hulled grains require a large amount of water for germination. Depending on the region and the sowing time, between 500 and 650 grains/sqm are sown, corresponding to a sowing rate of 170–215 kg/ha. The optimal sowing depth is around 4 cm. Oats are very susceptible to drought due to the high transpiration coefficient (500 l/kg). During grain filling in July in Poland, 50 % of the total water volume is required, i.e. around 100–120 mm precipitation, must be available for satisfactory yields and qualities. Oats in Poland can also be integrated very well into short cereal crop rotations with rye, wheat or barley, as it interrupts the chain of infection of many diseases when these cultures form a high proportion of crops. The optimum pH-value for Polish oat growing is 4.5–7.2 %. Oats can tolerate a calcium deficiency in the acidic region, and an excess of Mn is also relatively well tolerated. However, this crop is very susceptible to an Mn deficiency, which can occur at very high pH-values.

Good preceding crops for oats in Poland are potatoes, lucerne, beans, clover and beets. Furthermore, it is a good preceding

Crop areas and yields of oats in Polen 2010–2015



Source: based on datas of Eurostat

crop itself for other cereal species, as it suppresses weeds very efficiently. Oats can even produce specific organic substances which interfere with the development of soil-dwelling pathogens. The soil should be ploughed to a depth of approximately 20–25 cm. If there is no straw preventing working of the soil, a grubber can also be used. The seed bed should not be prepared to a depth below 5–7 cm so that the water available in the soil is preserved for seed emergence.

Fertilisation

If a mixed fertiliser is applied to oats, this should have an N/P/K ratio of 1/0.8/1. Depending on the soil moisture and the expected yield, the nitrogen level in Poland is between 60 and 120 kg/ha, whereby the lower value goes for dry regions with a single application. Where there is a risk of leaching the nitrogen amount can be split,

with 40 kg applied during sowing and the rest as a second application at shooting. More than 120 kg N/ha is not effective in Poland and compromises the grain quality at harvest. Depending on the requirement, 50–120 kg/ha P_2O_5 and 60–150 kg K_2O can be applied before ploughing in autumn. The application can be reduced by 10–40 kg/ha when organic fertilisers are used. Oats are sensitive to trace element deficiencies, in particular copper, manganese, zinc and molybdenum. Therefore it is primarily recommended that leaf fertilisers are applied in chelate form, however as a targeted application after a soil analysis.

Fungicides

Fungicides are unprofitable in oat production in Poland, although profit cuts can occur due to leaf rust and sometimes even mildew. The seed should always be disinfected against loose smut and barley stripe, as these diseases can cause severe damage during the vegetation.

Outlook

In recent years the appreciation of oats in Poland has risen, because arable farming here is characterised by a high proportion of light soils and increasingly cereal-dominated crop rotations. At present an increasing proportion of cereal in ever shorter crop rotations in Poland is leading to phytosanitary problems. Oats have a very positive influence of the productivity and natural yields of the other cereal types in such crop rotations. This known effect is seen for ex-

ample as the resistance of oats to fungal diseases and its good suppression of weeds. Oats clean the soil of pest microorganisms and are valuable components in a cereal crop rotation, particularly if the proportion of cereal in the crop rotation exceeds 55 %. Polish agriculture has clearly come to recognise this, because the appreciation of this crop is steadily growing.

Mariusz Ratajczak



Winter oat production in Ireland

“True” winter oats, in other words winter-hardy varieties that require vernalisation, do not exist. In countries with milder winters, however, summer oats are sown in autumn, as these are relatively winter-hardy and survive lighter frosts without damage. None of these varieties require vernalisation.

No other European country can realise similarly high average oat yields per hectare as Ireland can. The country average was in the last four years constant at more than 70 dt/ha. The specific soils and climatic prerequisites require a special production technique.



Seeding time

The ideal seeding time for winter oats is between the 1st and the 31st October. As a rule, only spring varieties are sown in Ireland in autumn and in spring, more specifically winter varieties are hardly used.

Sowing density

Sowing densities of 130 to 160 kg/ha are selected under normal sowing conditions and with average thousand seed weights. The generally recommended sowing density is 300 to 400 grains/sqm.

Fertilisation

Oats have a lower fertilisation requirement compared to wheat. A soil index of 1 usually has a nitrogen requirement of 145 kg/ha. In a continuous cereal crop rotation, this amount is normally given as a first application in early March (50 kg/ha) and the main application at the first node stage (EC 31), approximately 4–6 weeks after the first fertilisation.

These applications, however, can vary widely depending on the soil and vegetation condition.

Growth regulator

General for autumn sowing, the application of growth regulators should only be split if the lodging risk is high. Example: 0.75–1.0 l/ha CCC 750 at the end of February to mid-March plus 2.0 l/ha in the 2 and 3 node stages (EC 32–33). In colder weather, in practice the growth regulator Ceraide (1.0–1.4 l/ha) is often used. This product is based on CCC as the active ingredient, but also includes a special biochemical system which makes the active ingredient chlormequat more effective, particularly at low temperatures of up to 1°C and its phytotoxicity is reduced. A different possibility is using a mixture from Modus and CCC 750 with 0.2 l/ha Moddus EC 30/31 followed by 0.2 l/ha + 1.0 l/ha CCC 750.

Crop protection

Insecticides/aphid control:

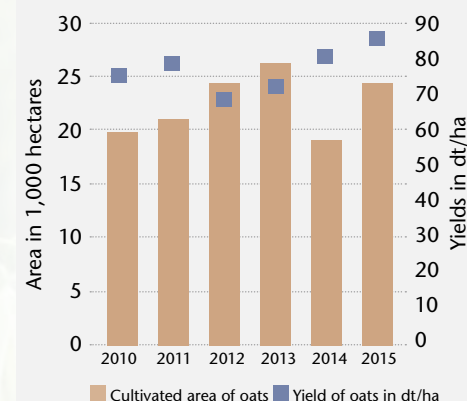
At least one autumn application is recommended depending on the extent of the aphid infestation.

The diseases mildew and crown rust are predominantly worth treating in Ireland. Even if the culture is clean, prophylactic treatment against mildew with long-term effect is recommended.

Example for a fungicide application:

1. Application: EC 30 to 31 mildew agent +/- broad acting fungicide
2. Application: EC 32 broad acting fungicides / strobilurin + mildew agent
3. Application: EC 39 to 51 broad acting fungicides / strobilurin + mildew agent

Crop areas and yields of oats in Ireland 2010–2015



Source: based on data of Eurostat

Weed control

Oats are highly competitive and usually do not require weed control. If there are problems, broad leaved weeds can be controlled during their first emergence in spring using sulfonylurea plus growth promoters (e.g. in Ireland the preparation Ally®, before EC 31).

Oliver Carter



An oat breeder introduces himself

Only a few cereal breeding companies are still strongly involved in oats in spite of the difficult economic situation. Nordsaat Saatzzucht GmbH is the leader here in Germany.

The original building of the company founded in 1910 is located in Granskevitz on the Baltic island of Rügen, however the head office is the breeding station Langenstein in Saxony-Anhalt.

Today, the innovative and internationally successful breeding company employs around 100 staff members. Work on the development of high-performance varieties of winter wheat, triticale, winter and spring barley and last but not least oat is carried out at three breeding stations covering about 150 ha of nursery area. Increasingly, biotechnological procedures are also being used besides classical plant breeding, for example the DH technique or marker-assisted selection.

The necessary conditions are met through an extensive national and international testing network and corresponding, state-of-the-art laboratory facilities.

It takes on average 10–11 years from the start of breeding to the approval of an oat variety. A variety is only approved by the Federal Plant Variety Office if it brings with it considerable added value compared with the varieties already in use - in other words, it demonstrates breeding progress in one or more relevant characteristics.

At present, Nordsaat oat varieties are already being grown or tested for cultivation in 27 countries throughout the world.



An approved variety only has a chance on the market when it has proved itself in the eyes for the farmer.



Oat breeding – where is the journey heading?

I. Introduction

Oats probably arrived in Central and Northern Europe as weeds in wheat and barley, where it then became domesticated. Wild forms of our present-day common oat (*Avena sativa*) are diploid and tetraploid oat species. The hexaploid oat varieties *Avena sterilis*, *Avena fatua* and *Avena sativa* are easy to cross with each other, which frequently leads to problems in seed production, particularly with the weed *Avena fatua*, the common wild oat. The genus *Avena* is made up of 30 species, of these 16 are diploid, 7 tetraploid and 7 hexaploid. All the species are self-pollinating annuals, with the exception *A. macrostachya*, a cross-fertilising perennial species of unknown origin.

As recently as 100 years ago, oats were the most widespread cereal in the German Reich after rye and before wheat. The main reasons for this were its undemanding nature in terms of soil and climate and its ability to take up soil nutrients well. Furthermore, oats were needed as a performance feed for horses, which were the most important means of land transport. So it is not surprising that oats are one of the first agricultural plant species, which was already adapted, predominately through systematic selective breeding, by innovative farmers in the last decade of the 19th century. At the start of the 20th century, 53 farmers in



Germany bred oats; in comparison with 43 for winter rye, 61 for winter wheat, 23 for spring wheat, 5 for winter barley, and 60 for spring barley. Combination breeding in oats was first used after the First World War. This process with some modifications is still the main breeding method used throughout the world today.

II. Breeding targets

Yield: Potential yield performance is rarely realised in real life.

Throughout the decades, plant breeders in Germany have followed numerous breeding targets for oats, with varying emphases. However, the main point has always been the grain yield and to begin with also the straw yield. As a comparatively water intensive summer crop, oats are subject to

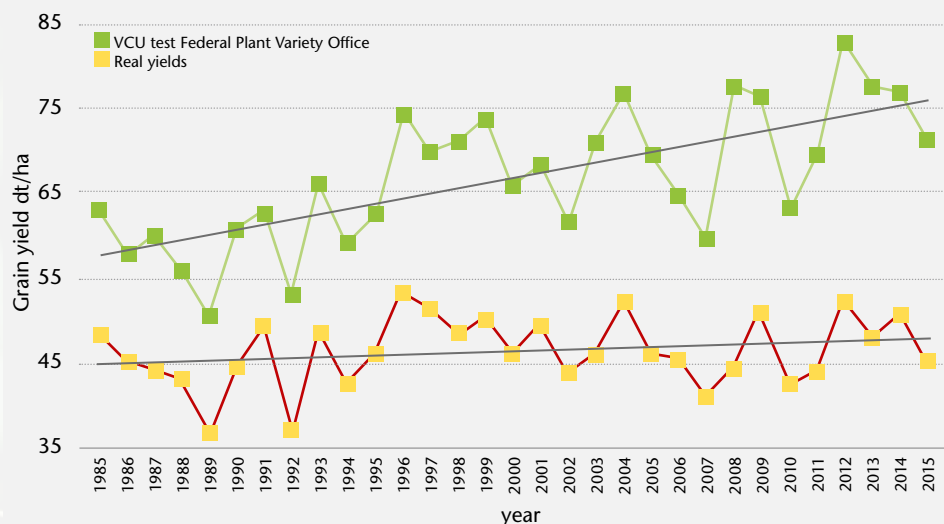
greater year and location-related yield fluctuations than winter cereals. That makes reliable selection of a higher grain yield more difficult. Despite this, plant breeding has substantially increased the grain yield even in oats over the last couple of decades. Furthermore, the breeding progress in modern oat varieties in terms of the agronomic and qualitative parameters is quite considerable.

While in Germany in 1907 only 20.9 dt/ha oats were harvested, in 1990 the harvest was 44.5 dt/ha and 52.1 dt/ha in 2004. Meanwhile, in variety trials and some agricultural businesses, top yields can exceed 90–100 dt/ha. The annual increase in grain yield thanks to breeding was about 33 kg/ha for the last 30 years. This equates to around

0.6 % per year and is therefore within the range of other cereal crops. Unfortunately, increasingly in Germany this progress is not reaching the farmers due to the varieties changing slowly and oats being pushed onto the less productive sites. During the same period the grain yield only increased by 0.37 % annually, while a stagnation or even a drop is observed since the middle of the 1990s. (Fig. 1). Additionally, from a global viewpoint, oats are also suppliers of green fodder, hay and silage.

This utilisation route hardly plays a role in Europe and is therefore considered less significant during breeding.

Fig. 1: Oat yields in the official variety approval tests and in practice in Germany 1985–2015



Source: Federal Plant Variety Office (Bundessortenamt)



Agronomic characteristics

The agronomic characteristics at the centre of the breeding efforts include good straw stability, rapid seedling development, early maturation, low tendency to secondary growth, and uniform ripening of the grain and straw.

Health

Resistance breeding in Germany is mostly restricted to the foliage diseases mildew and crown rust, whereby the latter is by far the most important oat disease worldwide. Additionally, the growing infection of oats by various *Fusarium* species is becoming of greater significance in northern and western Europe in particular. Alongside this, *Septoria*, leaf spot and viruses such as BYVD can occur. Among the seed-borne pathogens, loose smut and barley stripe are important in Europe, however these can be very effec-

tively controlled by seed disinfection. Animal pathogens of oats are predominantly cereal nematodes, frit flies and aphids as virus vectors. Their significance in Europe is subject to the local characteristics.

Quality

The external grain quality of oats is evaluated using the characteristics grain size, sorting, hull content, hullability and hectolitre weight. Fodder oats and hulled oats demonstrate nearly identical quality standards. Rather than the hull content, sometimes the raw fibre content is used for feed value calculations in Europe. Thus, in the future oat varieties with a reduced lignin content in the hull could also become important. The hectolitre weight is a controversial quality criterion, however it still plays a dominant role in the oat trade. The hull colour (e.g. white, yellow, black) must also be mentioned here



due to it being a dominating factor in the planting decision in many regions, although from a scientific point of view it in no way influences the individual quality parameters of the oat grain.

The fat, protein and starch content are usually used in Europe to determine the inner grain quality. In many cases, a high oat fat and protein content in feed for ruminants and horses is still considered beneficial. Newer assessments in Scandinavia, however, demonstrate that the starch content also has a greater importance. For human consumption, a low fat content should be aimed at for dietary and processing reasons. Besides this, the health-promoting contents of oats, such as β -glucan, certain vitamins, polyphenols and antioxidants are moving ever closer to the fore (Reference to Hapshire article). The gluten-free aspect of oat varieties is also a topic here. As the proportion of oats used

in human nutrition is increasing throughout the world, these parameters could further gain in importance. However, they can only be influenced through breeding with a huge input of effort.

III. Breeding methods

Until now, only a small number of modern biotechnological procedures have found their way into oat breeding throughout the world. The costs involved in using them in these comparatively small cereal cultures with generally high reseeded levels are often still too high. Furthermore, oat has repeatedly shown itself to be very “unmanageable” when biotechnological methods such as tissue culture or marker-assisted selection are employed. But biotechnology is expected to also become more important in oat breeding in the future. At the same time, transgenic approaches will probably

not play a role to begin with, although this breeding method is also available to oats.

IV. Outlook

Over the last 20 years, both the number of new approvals of registered breeding lines and the number of active breeders of spring oats in Germany have massively declined. At the same time, it has been possible to keep the number of new approvals constant and thereby to involve the farmers in the breeding progress (Fig. 2).

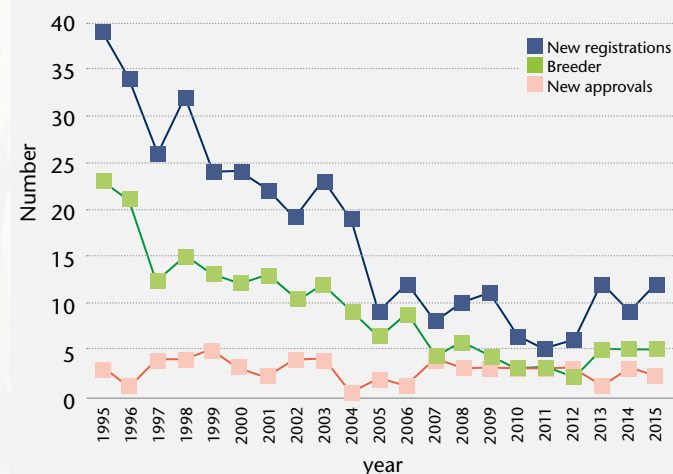
Just recently this downturn in development has not continued. Despite this, however, in the future new ideas and partnership approaches must develop for oats in Europe if the breeding intensity of this crop is not to fall further behind other cereal types.

Here, niches such as winter planting or naked oat will probably only be of regional importance. The use of biotechnological procedures are certainly much more promising for accelerating the breeding progress or the use of hybrid breeding, which are both being very intensively tested at the moment.

However, the agricultural sector must realise that successful variety breeding in self-pollinating oats can only be achieved with sufficient financial support. The falling FSS charges while the use of FSS is on the rise is jeopardising this objective, encouraging further breeders to abandon their breeding programmes and threaten to marginalise oat cultivation.

Dr. Steffen Beuch

Fig. 2: Variety approvals, new registrations and number of breeders of spring oats in Germany



Source: Federal Plant Variety Office (Bundessortenamt)



Successful collective campaign for the “All-rounder”

The first collective campaign of the oat hulling mills in the Verband der deutschen Getreideverarbeiter und Stärkehersteller (Association of the German grain processors and starch producers) – VDGS e.V. (previously the Getreidenährmittelverband e.V.) is running now for almost eight years. Its aim is to make the huge health potential of oats better known among dietary specialists, opinion makers in the areas of nutrition and health as well as the consumers, and to pitch its product diversity.

“Using the high-quality nutrients, we would like to motivate this target group to consciously use oats during breakfast and other meals”, explained Ulrich Schumacher, speaker for the oat mills division in the Association, during 2008. Almost eight years later, Ulrich Schumacher and his colleagues in the oat mills division of the Association can look back at numerous positive results and market developments, from which both the specialists and consumers, as well as the hulling mills have profited:

- The extensive information available in printed and digital form is in high demand,
- A strongly growing website in terms of both visitor numbers and content (www.alleskoerner.de),
- The oat processing volumes of the VDGS mills have risen since 2008 by a total of 45 per cent and
- The market for oats in the food trade has risen by over 30 per cent!

The elements of the campaign

Over the years numerous topics about oats have been developed to satisfy the fierce demand for information of the advising core target group, e.g. dieticians and nutritionists. To do this, the initiative analyses scientific studies and works in collaboration with renowned dieticians, physicians and consultants. The results are published in a wide range of topic-specific brochures and biannually in a news issue which is released in selected specialist nutrition magazines. All the brochures can be ordered free of charge by nutritionists and distributed among their customers and patients – a service which is intensively used and highly valued by independent consultants, hospitals, rehabilitation clinics and health insurance companies. The initiative is regularly represented with an information stand and presentations by experts at the congresses of professional associations and nutrition societies.



Specialist topics are also produced for the media used by non-specialist consumers. Nutritionists and magazine editors in particular make use of the over 60 oat recipes developed specifically for the campaign. Expanding media channels such as facebook and blogs are integrated into the communication (www.facebook.com/haferdiealleskoerner).

The campaign has also expanded its activities to cover nutritional education and school meals. Media for school lessons in primary and secondary schools have been prepared with the partner information.medien.agrar e.V. Furthermore, there is extensive material for the preschool area in the form of the collective project from “Hafer Die Alleskörner”, information.medien.agrar e.V. and the Verband Deutscher Mühlen e.V.

Growth of the key markets in oat cultivation not used

Today, the amount of oats processed in the VDGS hulling mills is around 350,000 tonnes per year. While this amount alone has grown by 45 per cent in the last seven years, and has doubled since the turn of the century, oat cultivation and harvest amounts are dramatically decreasing in Germany. Since around 2008, the oat harvest in Germany has halved, and in 2015 was around only 570,000 tonnes. At the same time, the domestic use of oats as fodder has remained relatively constant at 500,000 tonnes or more. As a result, the hulling mills cannot cover their growing demand with purely German oats.

They have to import oats, primarily from Scandinavia. And that is not only because of the high quality of the northern oats (with good hullability and high hectolitre weight),



but simply because of the required amount! Further market growth through new diet trends and new products

The trend of oats in the diet will continue to increase – the experts are certain of this. Nutrition will increasingly gain in significance in the health system. Both politics and the health insurance companies will shift the focus to a “healthy diet” with nutrient-rich plant-based foods and whole-grain products.

The awareness of and the interest in a balanced diet have increased enormously, especially in young people. This is seen as trends like “vegetarian”, “vegan”, “clean eating”, “lactose-free”, “low in gluten / gluten-free” – for whatever reason these forms of nutrition are chosen.

The availability of oat products in the supermarket is already greater than in 2008: many more ready-mixed mueslis with oat flakes, more oat brans and oat cereal products, the product innovation oat drink and the convenience product porridge prepara-

tion. These single ingredient products are supplemented through regular use of oat flakes in chocolate-cereal bars and muesli bars, as well as in biscuits and pastries. The potential for product innovations with oats is not yet exhausted. The German hulling mills and their purchasers continue their investments in product development; new recipe ideas motivate further consumption. Added to this are recent trends such as Overnight Oats, Proats and Smoothie Bowls. And that increasing numbers of creative porridge varieties are on the menu in the gastronomy branch, as well as cafes opening which offer only porridge, demonstrate the – not quite so – secret potential of this cereal species. The hulling mills are continuing to campaign

Voluntarily and without public funding, the German hulling mills are investing for the ninth year in a communication campaign for oats. To support oat cultivation and oat research they are holding talks at federal and state government levels.

The hulling mills are open to discussions with partners from the seed, agricultural, trade and research areas. They value the long-term cooperation with SAATEN-UNION, through which communication has already been established with partners in many areas: most recently in spring 2015 during the symposium “Stand der Forschung an der Wertschöpfungskette Hafer” organised by the Gesellschaft für Pflanzenzüchtung in collaboration with the Julius-Kühn-Institut.

*Hafer Die Alleskörner, VDGS e.V.
Richeza Reisinger*

The VDGS e.V.

The Verband der deutschen Getreideverarbeiter und Stärkehersteller – VDGS e.V. was created through the merger of the Getreidenährmittelverband e.V., the Fachverband der Stärke-Industrie e. V. and the Verband der Teigwarenhersteller und Hartweizenmühlen Deutschlands e. V.

Present in the VDGS e.V. are the notable hulling mills, durum wheat and rice mills, cereal and pasta producers, and starch producers in Germany.

Among the current 34 member companies are medium-sized and family-owned companies as well as large international concerns. The companies present in the VDGS process over three million tons of grain and two million tons of starch potatoes per year.

Hulling mills division

Many of the eight oat hulling mills are also successful internationally. Almost all the mill businesses are family-owned and are managed by the family members.

The hulling mills division includes:

- **H. & J. Brügggen KG**
Lübeck
www.bruegggen.com
- **Fortin Mühlenwerke GmbH & Co. KG**
Düsseldorf
www.fortin.de
- **Harries Mühle – Bernhard Harries sr. Nahrungsmittel-, Schäl- und Spezialmühlenwerk GmbH & Co. KG**
Stuhr
www.harries-muehle.de
- **Megro GmbH & Co. KG (Juchem-Gruppe)**
Eppelborn
www.juchem.de
- **Peter Kölln GmbH & Co. KGaA**
Elmshorn
www.koelln.com
- **Kolks Mühle – Wilhelm Kolks Handels GmbH**
Borken
www.kolks-muehle.com
- **Rubin Mühle GmbH**
Lahr
www.rubinmuehle.de
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