

Let's make grain great again

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The Landrace

Newsletter no. 7
December 2021



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Please feel free to forward, quote and copy the newsletter with due reference

News from Landsorten

[Landsorten](#)'s new board elected at the general assembly in June is already preparing the new general assembly, as the ordinary annual GA is to be held in the first quarter of the year. We attempt to fix something in Copenhagen 19th 2022. We're planning some baking event along with the GA. Members will be informed when details are in place.

[Landsorten](#) attended the biannual [Danish organic congress](#) 25th- 26th November. We had a booth displaying the diversity of grain from the organisation. Both our president Morten Øster Kristensen from [Samsø Mel](#) and Anders Borgen had oral presentations at the congress.

[Landsorten](#) is working on a plan for the coming growing season 2022. [Mariagertoba](#) is still the main spring wheat but a few new crops are in pipeline. You'll hear more about this in the next issue of this newsletter.

With the reform of the EU Organic Regulation, it will be possible to certify and market populations and mixtures as Organic Heterogeneous Material. [Landsorten](#) welcomes this opportunity and plan to certify seed of [Mariagertoba](#) to be sold as certified seed for the season 2023. Because the winter crops are already sown, we cannot certify these seeds harvested in 2022, so they will not be certified before autumn 2023.

BOOST

[Landsorten](#) has along with [Agrologica](#), [Gl.Buurholt](#) and Copenhagen University applied for the project BOOST for the national research program [Organic RDD](#) and from [Foundation for organic farming](#). We expect soon to get a positive answer. It is a super exciting project aiming to boost the entire organic grain business. University of Copenhagen will develop new products from the grain from [Landsorten](#), and [Gl.Buurholt](#) will invest in [special equipment](#) able to increase baking quality and protein content in organic grain. [Agrologica](#) gets the opportunity to continue breeding of novel varieties for [Landsorten](#) and organic farming, and [Landsorten](#) will get support to develop the seed system linking it all together.



Even though the project DIVERSILIENCE (mentioned in the previous newsletter) will start only next year and we still have not received an official approval of BOOST, the seed needs to be sown when the soil is ready, so we've planted 8437 plots of winter wheat, durum and spelt for the coming year. Such a pity if it should have been delayed another year just because the financing bodies need 7 months to evaluate an application.

Cereal Cyst Nematodes

Cereal Cyst Nematodes are tiny roundworms living on roots of grasses. The dominating type in Northern Europe is *Heterodera avenae* causing severe damage in spring cereals. Roots attacked by nematodes increase branching, and leave only few if any long deep roots. With severe attacks the plants die due to lack of water and nutrients.

Cereal-cyst-nematodes can only survive on grasses and multiply in particular on spring cereals. They can survive on other grasses for some time, but causes agronomic problems only in spring crops and will eventually disappear in crop rotations without spring cereals.

England, Germany and other southern countries have traditionally grown more winter cereals, and nematodes are therefore less frequently seen. In Scandinavia, spring cereals have been the dominating cereals, and development of resistant varieties have been needed, in particular on stockless farms. In the past decades, oat and in particular barley have been the dominating spring cereals in Denmark, and most varieties are bred to be resistant to cereal cyst nematodes.

In Denmark, spring wheat has never been a major crop, and spring wheat has not been bred in Denmark. Therefore, nematode resistance has never been a priority in Danish or European plant breeding, and as far as we are aware, no European spring wheat varieties has nematode resistance. The same is the case for spring triticale.

In contrast to conventional farming, organic farmers grow more spring wheat, as protein content is higher and the risk of losing nitrogen from leaching is lower. Many organic farmers therefore have a high frequency of spring crops, and if many of the spring cereals are susceptible, there is a high risk of cereal cyst nematodes. Many organic farmers already have learned this the hard way.

Agrolgoica has worked on nematode resistance in spring wheat for many years. At first, we identified spring wheat varieties described in literature, and ordered some of these from genebanks and other places. However, one can never be sure that varieties described as resistant in literature are also resistant to the local races found here. We therefore first tested the accessions in infested soils in Denmark, and selected some of the lines that showed resistance as parents for crossing with locally adapted varieties. In particular varieties from Australia and USA look promising. The breeding is now advanced and selected for growth habit and baking quality, and in 2021 some of the lines were tested at Tystofte, who has facilities for testing spring cereals for nematode resistance. We were lucky. Indeed, out of 50 tested lines, almost half of them were not infected at all by neither of the two dominating nematode races occurring in Denmark.

Next step will be to further multiply the resistant lines and to further select for baking quality and other traits. Also, we hope to develop enough lines to identify genetic markers for the resistance. This will significantly reduce cost in breeding new nematode resistant lines in future.

Wanted:

Please contact Agrolgoica if you have or know someone having soils infected by nematodes. We are looking for places to test our resistant varieties in field scale.

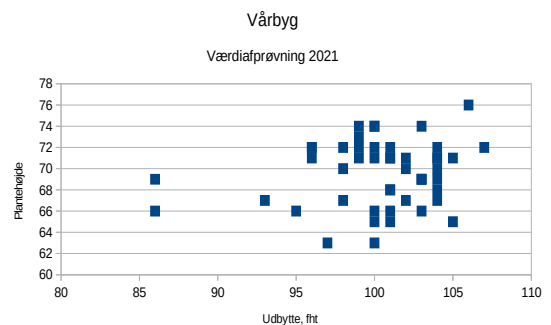
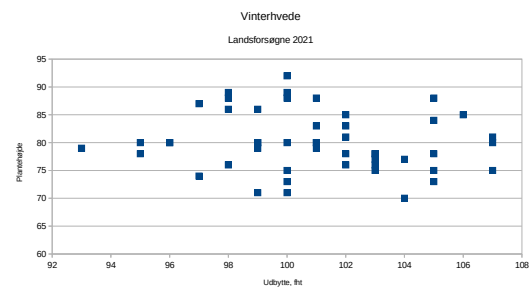
Work with nematode resistance has been part of the ØKOSORT-II project supported by GUDP.

Plant height – a lost quality

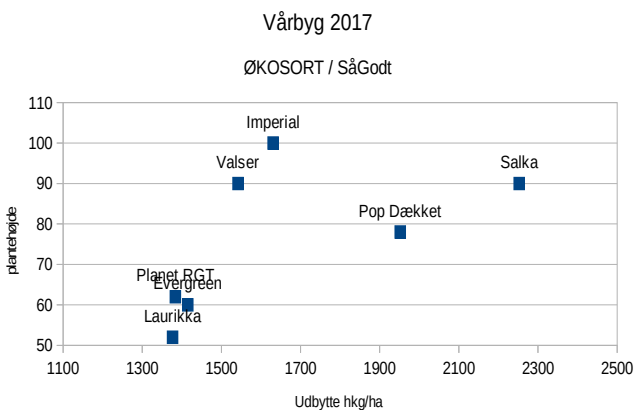
During the past 150 year or so, cereals have become gradually shorter, and in the same period, the yield have gradually increased. A simple conclusion could be that the two traits are directly connected. But is it really so? Is there a direct negative correlation between straw length and yield? The short answer is NO. Nothing points in that direction.

When a plant is tall and there is a head full of heavy kernels in the top, it is a simple effect of the lever principle that there is an increased risk of the straw to break. This leads to lodging of the crop, and makes it difficult to harvest and leads to loss of both grain and quality. Lodging is in particular seen at high input of fertilizers, as nitrogen is a water soluble nutrient, and if access is ample the plants will take up too much, filling the cells with water and reduce the ratio between cell wall carbohydrates and nucleus proteins. The result is a weak straw that easily break.

During the past century, plant breeders has therefore selected short plants, because in that way it is possible to apply more nitrogen without risking lodging. Apart from shorter straw, breeding has also increased straw diameter and improved straw strength, and there is a huge difference in the risk of lodging between varieties, also between varieties with the same plant height.



Each year, cereals are tested in VCU trial and national test under conventional conditions with chemical control of lodging and weed. Neither in barley nor in wheat any correlation between plant height and yield can be observed.



In trials with a heigh pressure of weed, the plant height certainly has an impact on yield. Even ancient varieties such as Imperial from or Salka from 1970 had under these conditions significant higher yield that to short straw varieties Evergreen, Laurika and Planet that in trails without yield would give higher yield caused by lower protein content. “Pop Dækket” is a mixture of breeding lines from Agrológica.

Short plants have an advantage in being able to resist lodging at high input conditions, but there are also disadvantages related to short straw. The main disadvantage is that the competition with weed is low in particular if the plants are also short in the early season, which is often correlated with the plant height at harvest time. For this reason, there is a correlation between the increasing use of fertilizers, the decreasing plant height and the increase of herbicides in conventional agriculture during the past century. The one leads to the others.

Organic farmers use less fertilizers, and have no access to herbicides. Therefore, it is likely that the balance between cost and benefit of plant height is different in organic and conventional farming.

I have to admit that I have so far been influenced by the general story told by conventional plant breeders that there is also a cost for the plant to produce a lot of leaves and

straw. The theory is that there is a limited amount of sunlight available, and if the plant gives priority to creating a straw, then there is less energy left for filling the grain, and the yield is therefore reduced. The harvest index is the term for the ratio between grain and straw, and increasing the harvest index has been a priority all during the Green Revolution. However, I fail to find any documentation confirming this theory. All literature on the relation between plant height and yield I have found can be explained by the effect on weed competition and risk of lodging. So if there is any cost of growing a tall plant, it must be compensated later by increased leaf areal for photosynthesis.

Heritage varieties has in general higher protein content than modern varieties leading to a lower yield, and they are also in general taller. However, it is not the plant height in itself that causes the effect on protein content and yield. Within the group of modern varieties, or within the group of heritage varieties, there is no correlation between plant height and yield, unless lodging or weed competition influences the trials.

The conclusion must hence be that both in organic and in conventional farming, plants shall be as tall as possible to help controlling the weed, as long as there is no risk of lodging.

Wholegrain and sourdough to combat climate change

COP 26 is over and the Danish Parliament agreed on a roadmap to reduce the impact of agriculture on climate change. even though sour dough and whole grain flour hardly can solve the climate and biodiversity crises by itself, I'll argue that it does have a significant impact.

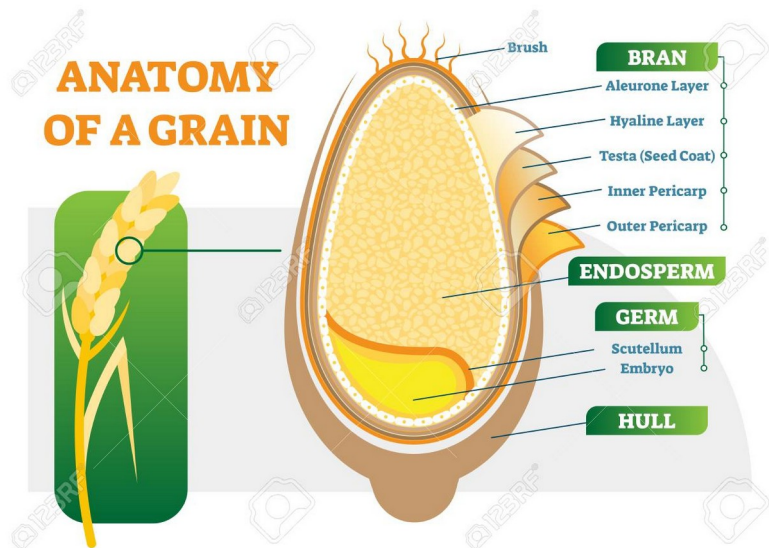
Many recipes of pizza recommend 50% durum and 50% Tipo-00, and today lots of balled bakers in the high end bakeries worship Tipo-00 as the savior of artesian baking. But what is Tipo-00 really, and why put it into a pizza?

Outside Italy, there is a lot of confusion about Tipo-00, so let's start with the official definition: Tipo-00 is the Italian category of the finest sifted flour. According to the standards, Tipo-00 must have less than 0.55% ash. In Germany this is called Type 405 and in Austria Type W448. In the primitive Danish classification it is just called fine sifted flour. By using an exotic classification, the price can be increased, and I won't blame anyone for doing that. So Tipo-00 just means that it is sifted wheat flour with a colour of bleached paper and with a nutritional value similar to that.

No matter if the flour is Tipo-00 or not, there are huge differences between different flour. Protein content can be high or low, and the gluten can be elastic or not. The sifting and colour does not inform the consumers about that. Hence, Tipo-00 does not necessarily have good baking quality. It just says that it is sifted very fine.

The outer layer of a wheat kernel is called the bran, and beneath is the alouron layer, and in the centre is the endosperm. The three layers have completely different ingredients and properties. In one end of the kernel is the germ, which again has unique properties. Each layer of the seed is subdivided into further layers, but here we will simplify it and focus on the three major layers of the seed morphology.

Even though being a part of the kernel, the properties of the outer layer of bran is more comparable with the straw, made from cellulose and lignified cells. Valuable dietary fibres, but with a poor baking quality as the bran hardly contain any gluten. When the bran is included in the flour, it decrease bread volume as the small fragments of bran can puncture the air-bubbles developed by gluten during leavening of the dough. The bran contains poly-phenols with a bitter taste and brown appearance, and whole grain flour therefore is darker and with characteristic bitterness to the taste.



The aleuronlayer is full of vitamins minerals and proteins, but the proteins are not gluten but other proteins used by the seed during germination, and with a high content of healthy essential amino-acids. The structure of the flour from the aleuronlayer is very different than the flour from the endosperm. The aleuron-flour is not as fine but granules. (I think it is called middlings in English but I'm not sure).

The germ is the yolk of the seed. The germ has a high content of healthy omega-3 fatty acids, including vitamin E. The germ and the aleuronlayer only represent a minute part of the kernel, but contains the majority of the valuable nutrients and also most of the tasty ingredients.

It is in the endosperm you'll find the unique baking properties of wheat. Gluten form during knitting of the dough from the content of gliadins and glutenins of the endosperm. Gluten has a high water capacity, elasticity and stretchability, exactly what is needed for bread baking. However, the modern diet is rich in energy and amino-acids, but short in minerals, vitamins and essential aminoacids. Therefore, high content of starch and the poor protein composition of amino-acids makes the endosperm less nutritious in a modern diet, as additional starch and low quality proteins serves little purpose for us.

When organic matter is burned, it transforms into water and CO₂. However, there will always be a left over of ash, which are the non flammable minerals. The more efficient the flour is sifted, the less ash and thereby minerals will be left after burning. And the less nutritious the flour will be. The requirement for Tipo-00 is that it contains less than 0.55% ash after burning. Hence it is a guarantee that it is free from nutritious quality, but it is not a guarantee that it has a high baking quality, but only that baking quality is not decreased by the content of bran, germ and aleuron. Whether it has a good baking quality depend mainly on the gluten content and gluten quality, but the standard does not tell the consumer that. On the contrary, if the protein-content is very high, it is difficult to keep the ash content low enough for the standards, and most (but not all) Tipo-00 flour has therefore relatively low protein content.

In a traditional stone mill, the grain is crushed between two rotating stones, and all parts of the grain are mixed. Sifting after stone milling can separate most of the bran from the endosperm, but it is impossible to completely separate the flour into each of parts. Stone mill flour will therefore normally contain most of the germ and aleuron in the sifted part of the flour, and it will also contain some parts of the bran. On the other side, some flour from the endosperm will be discarded along with the bran. To minimise waste, some mills, including Kornby Mølle and Gl.Buurholt in Denmark

has a combi-mill, where a roller mill first takes off most of the bran, and the remaining part of the grain are afterwards milled in a stone mill. In this way it appears white, but the germ and alouron are maintained in the flour contributing nt taste and nutritional value, and at the same time less flour is wasted from the end product. As the flour contains minerals, it will rarely live up to the Tipo-00 requirements, and the baking quality in terms of bread volume will be lower than white flour form a 100% roller mill removing all germ and alouron. To compensate for the decrease in bread volume, combi-mills and stone mills often used wheat varieties with higher protein content, including heritage varieties or populations from organic plant breeding. with this combination, it is possible to get nutritious and fluffy bread at the same time.

The world population keeps increasing, and in particular as people also get richer, we consume more nutritious food including meat, which seize more area for agriculture. However, we also need more nature to reduce decline in biodiversity, and we can only get more nature by reducing farmed land. It is about the survival of the biosphere as we now it, and this dilemma is by far the biggest and most urgent problem in the world today. Some become climate vegans, and there is good reason to reduce consumption of animal products. But we can also do something within the grain world.

When flour is sifted, 30-40% of the grain is discarded and used for feeding or burned. What a waste. The worst part of it is that we discard the most nutritious parts of the grain. To compensate for the loss of essential amino-acids, we need to consume more high value food with more concentrated nutrients, which normally means animal products, soya or low yielding crops like chia seed. The dominating minerals we discard when sifting grain are iron and zink. The deficiency of minerals is called the hidden hunger, and today more people in the world suffers from iron and zink deficiency than from traditional hunger (energy and protein deficiency) and obesity together. About 30% of young females in the world suffers from iron deficiency, and it is partly caused by sifting flour and polishing rice. The discarded bran of our grain contain enough iron to supply them all. The main recommendation today in case of iron deficiency is eating red meat, because there is one more aspect to the story.

In the aleuronlayer there is a substance called phytate. Phytate helps preventing the minerals in the brand to leach during rain, and to ensure they are still available for the seed fro germination. This is a disadvantage for humans, because phytate also prevent us from digesting the kernels and to absorb the minerals. Humans cannot utilise the minerals in grain unless the phytate is neutralised. Actually, the phytate is so efficient in binding minerals that it not only binds the minerals in the grain itself, but also minerals from other food stuffs consumed along with grain products, including supplements such as mineral pills.

To break down phytate, grain or flour needs to imbibed in water for some hours. This is traditionally done by leaving the bread with sourdough which takes enough time to break down all phytate. In industrial bakeries, bread is raised with yeast and synthetic baking enzymes and are baked 1-2 hours after adding the fist water to the flour, and this is not enough to break down phytate. This is the reason that the remaining nutrients left in the flour after sifting is also not utilised in our food system, and the cause of iron and zink deficiency in the population.

The main benefit of a home baked sourdough bread is the time it takes to raise a bread. It is impossible to cheat with the time needed. Bread bought from a bakery is more scary, as even if it says sourdough bread, it may very well be raised with a lot of yeast and enzymes in short time, and sourdough only added to improve taste. Dark bread may be made from sifted flour and added malt flour to give the dark colour giving the consumer the fake impression that it is made from wholegrain flour.

The dough of pizza should not be elastic. When you stretch the dough to make it thin, you don't want it to return to the original shape. Therefore, pizza is often made from durum, as durum lacks the D-genome that gives the unique properties of bread wheat. However, durum has a very hard

seed, which is difficult to mill into fine grade. Often, it is sold as simulina, which absorbs water slowly and tends to get sticky if milled too fine. As Tipo-00 is milled very fine, it is often recommended to mix the durum with some Tipo-00 to compensate for the rough character of the durum. However, there are differences also in the character of durum, and it is possible to make pizza from pure durum milled finer than simulina and with enough elasticity not to collapse under the tomato sauce. In that case, the Tipo-00 makes no sense really.

Guldkorn – an exhibition on plant breeding at the Green Museum (Gl. Estrup, DK)

As part of the permanent agricultural exhibition at the Green Museum at Gl.Estrup Castle, a new exhibition has opened focusing on the history of plant breeding. Video monologues presented by the leading experts in the field tell the story also about present and future plant breeding. Please watch some of them here (in Danish):

<https://vimeo.com/592223921/32436fa0f4>

<https://vimeo.com/593265134/83bd4d13d0>

Kornboka – a new book about the history of bread and beer

The author of the book [Our daily bread](#), Åsmund Bjørnstad has written a new book about the history of bread and beer. The name is [KORNBOKA](#), written in Norwegian. As the previous book, it is filled from the first to the last page of intense information covering the entire cultural history and the link to cereal genetics.

Seed for spring sowing 2022

Seed is sold only to members of [Landsorten](#), and only in limited quantities.

Mariagertoba	Best bread wheat in Northern Europe. A mixture of spring wheats with high protein content and high gluten index. Resistant to rust and other leaf diseases, and Bt7-resistance to common bunt.
Purple wheat	Good baking quality and beautiful colour. Bread baked from purple wheat will be naturally dark.
Durum	Tall variety with good quality for pizza and pasta.
Danish spelt	The only spelt variety with Danish origin. Can be grown both as spring spelt and as winter spelt. Sowing in spring gives higher protein content.
Blue wheat	Beautiful blue kernels. Compare with purple wheat, blue wheat has the advantage that the colour is in the aleuronlayer which means that the colour will remain also in sifted flour.
Minarett	Spring wheat variety with a low content of alfa-9-gliadin, a protein causing gluten allergy by some consumers.
E3 spelt	Spelt variety with a low content of expansin, causing wheat allergy. The variety also has a low content of fructan causing Irritable Bowel Syndrome (IBS). E3-spelt therefore is tolerated by many consumers intolerant to common bread wheat.
Xinchang "rice"	Exotic wheat species with giant seed and traits similar to spelt, but it is free threshing and need therefore no de-hulling. Super cool!
Yellow wheat	Spring wheat with a yellowish flour similar to durum.
Foxtail millet	The early-most millet variety on the market with a maturity only about two weeks later than spring wheat. Good for breakfast cereals and gluten-free flour or feed. Expected yield: 2-4t/ha. Seed for sowing: 5-8kg/ha.
Proso millet	Proso millet is later than foxtail millet, but this variety is still the early-most proso-millet on the market with a maturity about mid-September in Denmark. Good for breakfast cereals and gluten-free flour or feed. Expected yield: 2-3t/ha. Seed for sowing: 15-20kg/ha. Swathing may help harvest in humid conditions.
Spring barley	A mixture of spring barley selected for weed competition and resistance to cereal cyst nematodes.
Naked Austrian bitter oat	Naked oat for feed or fro home made oat-meal. De-hulling is not needed.

Links to previous issues of the newsletter:

[September 2021](#) [May 2021](#)

Links to Danish versions:

[September 2021](#) [Maj 2021](#) [Januar 2021](#) [Februar 2020](#) [Julen 2019](#)

Merry Christmas to all and please enjoy the winter and off season