Let's make grain great again

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The Landrace

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A new growing season is ahead of us, and I greet the spring with news from both future and past from the organic grain sector.

I wish you joyfull reading

Anders Borgen

Content in this newsletter

Open field day and general assembly in Landsorten, Tuesday 22. June.

The organisation Landsorten was founded as a community seed bank in the winter of 2020, and is described in the recent issue of this newsletter. This upstart organisation is progressing and both farmers, millers and citizens have signed up for membership. For many years, Agrologica has been devoted to development of varieties of cereals for organic farming, and it will now be the task for Landsorten to disseminate the seed and bring it into production via farmers and millers.

The annual open field days normally attract 50-100 farmers, bakers, scientists and other grain nerds.

For the past years, Agrologica has organised popular open field days, but this will now be organised by Landsorten. This year it will be held on the 22nd June in connection with the general assembly of the organisation. A detailed program for the day will be sent to members of Landsorten. Participation is free for members, including lunch, coffee and other supplies. Please confirm your participation by email to: landsorten@kulturplanter.dk

I can only encourage you to join Landsorten and sign up for this event. It will be a long but rewarding day with many grain varieties to see, and a lot of issues to discuss about how in future to organise a system for production, dissemination and use of all these exciting cereals. Membership only costs 200 DKK (£23), about as much as the free lunch at the open field day, so there is a fast return on the investment. Please have a look at the homepage for further information https://landsorten.dk/en.

But now then, is it Landsorten or Agrologica, selling organic seed in future?

Agrologica and Landsorten are not the same, even though I, Anders Borgen, am very involved in both. Agrologica is an independent company doing organic plant breeding. Landsorten is an organisation formed of farmers, millers, bakers and others, and Agrologica is just one of its members. Landsorten is also in contact with other plant breeders in Denmark and abroad offering their seed to growers through their membership.

Landsorten does not produce seed. Not as things are today that is. For Landsorten , the principle is that farmers and members produce their own home saved seed. Landsorten only assists by providing the initial seed sample enough to start up production. Landsorten also assists with advisory and with seed cleaning. The initial start up seed lot can be provided by other members of Landsorten , including Agrologica, but also from other members such as Aurion, Gl. Buurholt, Enghaven, Jernbjerggård/ZBC and many other members depending on variety.

Shall Landsorten develop into a real seed company? Please show up at the general assembly and express your opinion!

Agrologica only grows seed in small scale and only small quantities can be purchased at Agrologica. Other members grows some of the varieties in larger scale and can provide

seed in larger quantities and at lower price. Landsorten can guide you to suppliers of the different varieties available at the homepage https://landsorten.dk. Future seed supply from Agrologica and other members will require membership of Landsorten.

This is how the situation is today. The reason being partly the seed legislation setting strict limitations for seed sale, but also that Landsorten is a new organisation with limited logistic resources for large scale seed production.

The new EU Regulation for Organic Farming and the recently published Delegated Acts implementing the Regulation, opens for legal and certified production of Organic Heterogeneous Material. Most of the seed from Landsorten is organic and heterogeneous, and this opens entirely new opportunities for certifying our material, and for Landsorten to act more like a seed company. Whether Landsorten decides to do so will depend on decisions made at the general assembly and by the leadership. This provides a good reason to turn up at the general assembly, in order to govern the future. Please find further information about the delegated acts on Organic Heterogeneous Material here: (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/11844-Organic-crops-boosting-resilience-through-a-genetically-diverse-planting-mix_en).

Mobile stone mill for local production

There is an increasing interest for bread, flour and sourdough these days, and a trend for local production. However, it is expensive to invest in professional equipment, and if the flour quality is to be optimal, the gear needs to be of a certain scale, which makes it difficult to utilise the capacity for small scale production.

On this background, Visti Møller from Gammel Buurholt Hovedgård had an idea. He and his team mounted a professional stone mill onto a truck enabling them to drive from farm to farm and from farmshop to farmshop, milling grain locally. As the mobile mill can also do, packaging and labelling, the local producer is lifted from a great deal of bureaucracy related to that. As local and decentralised as it gets.

Gl.Buurholt already have 13 trucks driving in Denmark and neighbouring countries cleaning home saved seed for farmers, and can now also mill and destone bread wheat locally.

The mill is certified for organic production, and the product quality looks very promising. Gl. Buurholt has been very active in establishing Landsorten , and together with improved baking quality from Landsorten's varieties, this creates the basis for boosting local production of organic grain products.

Nordic grain festival 28th-30th October 2021 in Norway

The annual Nordic grain meeting is now planned for the 28th-30th October 2021 near Oslo. It was previously postponed due to corona, however as the pandemic develops, we hope that we can all meet by then. The meeting will be in dual language, Scandinavian and English, and the organisers have made a nice homepage on the event: https://www.nordicgrainconference.com/

News from Agrologica science lab

Genetic markers for bunt resistance - news from LIVESEED-, Økosort-II and bunt projects

Progress has been made in identifying genetic markers for bunt resistance. Dennis Christensen has analysed field data from over 300 varieties and also analysed the DNA of the varieties. We still cannot identify the single genes, as we only have 25,000 genetic markers from each variety to represent the entire DNA, but we have managed to link the disease registration to the markers, and we know where these markers are in the wheat genome. We therefore now know approximately where 10 of the genes are on the DNA strand. This is a giant step for gene hacking, since we now know where we should look for the specific causal genes of resistance. We presented our research at the recent international online bunt workshop, and we also published a couple of abstracts on the topic which are listed at the bottom of this newsletter.

The work on gene hacking started back in 2010-14 in the BIOBREED-project, and continued in COBRA 2014-17 and LIVESEED-projektet 2018-21, so a long streamof previous work has led to the development of a system able to provide the needed information. Also the project Økosort-II has a minor bunt component, and we receive a lot of help from our skilled geneticists and project partners at Nordic Seed. Promilleafgiftfonden has also supported our bunt work via the project Stinkbrand.

Agrologica has applied to Organic-RDD and CoreOrganic for new projects to continue our key work on genetic markers, and in particular to focus on areas on the wheat genome where we now know that we have to look for the causal resistance genes. We work closely with researchers from Witzenhausen/Germany, BOKU/Austria, CRI/Czech Republic and USA on the topic as they are looking for some of the same genes. If we get the opportunity to continue our work, there is a good chance that within a few years we can use these genetic markers in practise in breeding.

Acid rain and gluten-index

Coal contains sulphur, and in the “good old days” power plants polluted the environment with vast amounts of sulphur containing smoke all over Europe causing forests to perish from acid rain. However, the acid rain also had a minor positive side effect on crop production, as fields were well applied with sulphur fertilisation.

Sulphur is a fertiliser that resembles nitrogen in the way that excess of the nutrient not taken up by the crop or humus building microorganisms will leach from the soil into the surrounding environment. Very much like nitrogen, new nutrients are needed every year to avoid deficiency, but unlike nitrogen, there are no sulphur fixing plants or bacteria. Rape seed and other cabbages are well know in need of huge sulphur supply to retain yield, but less focus is put on cereals, as yield loss due to sulphur deficiency are not very much expressed in cereals. For bakers and sourdough nerds however, sulphur supply in wheat production is important as sulphur affects baking quality.

Cereals and in particular wheat contains different proteins, and they affect baking quality in different ways. Proteins consists of aminoacids, and some om them contains more sulphur than others. If the wheat is in deficiency of sulphur, the protein will contain less surphur containing aminoacids, and this affects baking quality. A high content of sulphur containg amnoacids in the gluten structure smooths the dough, whereas a sulphur deficient dough is more firm, affecting the gluten index. The lack of sulphur containg amino acids is also a problem in organic non ruminant animal production where in particular the sulphur containing amino acids cysteine og methionine are limiting factors in organic feed. Most modern varieties used also in feed have a very high gluten index. I don’t know if organic feed quality for non ruminants could be improved by selecting wheat varieties with low gluten index, but it may be worth testing.

Gluten Index is measured on a Perten Glutomat, and express how many percent of the gluten that can be pressed through a sieve of a certain mesh size. We measure gluten index on hundreds of varieties each year.

Gluten index has a huge impact on baking quality. Many spelt varieties have a low gluten index, and baking freeformbread from pure spelt flour is often difficult as it tends to turn into a pancake-like shape. We would guess high gluten index is not something that has developed naturally but rather a result of human selection, as bread wheat has for a century or more been selected for better dough structure and therefore for increased gluten index.Spelt breeding has been less intensive, thus a lower gluten index. Most ancient grains have low gluten index, including most bread wheat landraces. In Denmark, the most widely used grain conservation variety is Øland, which also has a low gluten index, even though higher than the spelt variety Oberkulmer Rotkorn, which is the coming from Switzerland and is the most grown in Denmark in organic farming. For most baking enthusiasts, the gluten index in Øland and spelt is too low for common baking without mixing with four with stronger gluten. On the other hand, the gluten index can also be too high. If the dough is too strong, the air bubbles developing within the dough during risingcannot pump up the dough resulting in decreased bread volume as the bread will not hold it’s shape. Yeast develops more gas than pure sourdough (a mix of yeast and bacteria), and with yeast it is therefore possible to work with higher gluten index than with sour-dough. The food industry often prefers a a higher gluten index than home bakers do as they predominantly use yeast, and also synthetic baking enzymes

rarely used by home bakers. Most home bakers probably prefer a gluten index around 80, whereas Øland wheat often is about 60 and Oberkulmer Rotkorn spelt often 30-50. I have developed a new spelt variety with a gluten index of 85, and I'm looking forward to see if spelt enthusiasts embrace this effort, or prefer the lower gluten index of the landraces.

Baking quality in grain also very much dependent on protein content, as the more protein there is in the flour the more protein there will be contributing to gluten quality. However, a high protein content is expensive for the farmers as it can only be achieved on the expense of yield. As a rule of thumb a 10% increase in protein content will cost a 10% decrease in yield, and for good reasons farmers don't like that. Millers often experience that organic wheat has a better baking quality than conventional wheat of the same variety and with a comparable protein content. The reason most likely being that animal manure and compost contains sulphur, whereas artificial fertilisers only contain sulphur if it is added. As many farmers apply fertilisers to optimise yield with less focus on quality, conventional wheat is often fertilised with shortage of sulphur in respect to baking quality.

The most grown populations from Agrologica and Landsorten are the spring wheat Mariagertoba and the winter wheat Popkorn , both have high gluten index of 90-95. To prevent these populations from being too high in gluten index, sufficient sulphur must be supplied. If you haven't access to sulphur containing manure, the four can be mixed with Øland, spelt or other types with lower gluten index. For the coming season Agrologica has composed a range of different mixtures with different agronomic traits and baking properties, including differences in gluten index so that members of Landsorten can select exactly the type fitting for their specific field conditions and baking style.

Zanduri, Macha, and the hailstorm in Georgia

In the project Sunde Glemte Guldkorn financed by the MFA progam for genetic resources, Agrologica has in the period 2018-2021 opportunity to grow and test the quality of a collection of ancient grains, and if possible to commercialise some of them.

Cereals are like other plants and creatures divided into families, genus, species and varieties. Cereals all belong to the grass family, which is divided in different genus, including barley belonging to the *Hordeum* genus, and wheat belonging to the *Triticum* genus. Wheat is further divided into different species, either because they cannot naturally cross with each other, or because they for some other reasons haven't done so, at least not very much.

The Southern part of the Caucasus is the center of origin for modern bread wheat, but also for a diverse range of other wheat species. In Georgia, the saver organisation lkana tries to restore their ancient grains lost during industrialisation of agriculture. They have a small farm, The Seed Arch Farm, where they with limited resources propagate grain and other crops for local farmers. After many years of intense effort from the organisation and farmers in the area, the farm was hit last year by a hail storm, and the entire propagation was lost. Eli Rogosa from GrowSeed visited me last year on her way back from there, and when I heard the sad news we organised the shipping of a whole pallet of backup seed of the grains we grow here of the species from Georgia, as the alternative for them would be starting up from scratch with a few seed from genebanks. We hope for better luck in 2021.

Colchic emmer (*Triticum paleochochicum*).

Most of the more common wheat species are descended from emmer (*Triticum dicoccum*).Colchic emmer does not, but has its own family tree, and is one of the rarest cereals in the world. It developed in Caucasus and has to my knowledge never been grown anywhere else. Kernels are hulled like emmer and einkorn, and dehulling is therefore needed before milling. Like other cereals there is a negative correlation between yield and protein content, and last year we measured a protein content in colchic emmer of 24% and responding low yield. Flour is yellow like durum and einkorn, and gluten structure is soft like spelt. Hence, it is an absolute specialty fit for innovative grain enthusiasts ready for new challenges. Colchic emmer survived the Danish winter last year, but we recommend it to be grown as a spring crop.

Emmer

Emmer (*Triticum dicoccum*) is the ancestor of most European wheat species and the first and dominating crop in Western European Stone Age. The dough is not elastic as it is short of high molecular glutenin, and is therefore better fit for pizza and pasta, and less so for bread unless baked in tinform. In Denmark, most emmer is grown from heritage varieties from Gotland/Sweden, but Agrologica are also testing varieties from Central Europe.

Durum

Durum (*Triticum durum*) is the second most grown wheat after bread wheat, and is in particular grown in the Mediterranean area. Genetically, durum is a naked version of emmer. Being less extreme than emmer, durum also lacks the elasticity in the dough fit for baking of free standing bread, but for pasta and pizza dough this is a good trait. The colour of the flour of most durum varieties, in particular modern bred varieties is yellow due to the content of the antioxidants lutein and carotenoids, pre-stages of vitamin A.

There are no local durum varieties in Scandinavia, but we have tested many foreign durum varieties and most of them, both modern varieties and landraces, perform poorly under organic conditions in Denmark. Most of them are susceptible to fusarium head blight, mildew and rust. Most of the modern varieties are too short, as they are day length sensitive and get confused in the short bright nights here, and many landraces have very soft straw. However, we've managed to select types with proper agronomic traits and have also done crosses starting up a breeding program for Scandinavian conditions. In the past years, we've been able to harvest durum quality comparable to Mediterranean durum.

Most durum varieties have white kernels or rather light-yellow, as they lack the polyphenols in the bran. The polyphenols are protecting Hagbergs Falling number, and white type durum like white type wheat is therefore sensitive to decline in falling number. On the other hand, the polyphenols have a bitter taste, and some consumers prefer pasta without too much grain character in the taste.

There is also purple colour durum. In fact, the purple colour in common purple wheat from Agrologica and other breeders decend from purple durum wheat landraces from Ethiopia. Agrologica has also developed purple durum wheat based on Ethiopian landraces. However, I'm not

sure if is is truly durum as it may actually be the close related species *Triticum abessinicum*,. Never the less, it is some exotic stuff not too adapted to our climate, so I crossed it also with emmer to retrieve some climate adaptation from there. I hope it'll work. Quite cool isn't it?

Dikha

Dikha or Persian wheat (*Triticum carthlicum*) is one of the primitive wheat species that resembles bread wheat the most. There is still a scientific debate whether this is because dikha is a direct forefather of bread wheat, or if dikha is rather an offspring of bread wheat returning to a more primitive form by loosing the D-genome. I'm not an expert on that, and can only quote what others are talking about. The point is however Dikha, just like emmer, durum and others, is lacking the D-genome that causes problems with wheat and gluten intolerance in common wheat. Not all gluten sensitive patients can tolerate durum, emmer or dikha, but some can, and with dikha they can find a wheat with a baking quality more similar to bread wheat. Unfortunately, dikha is not performing too well in our climate. Often sensitive to leaf diseases, but some accessions can be grown with a decent result and we're working on improvements.

Khorasan

Khorasan is today best known under the trade name Kamut®. Hence, Kamut® is not the name of the species, but the name of the company that sells it. The name Kamut® is protected, but since the consumers often don't know other terms of it, Kamut® has more or less become a synonym of khorasan. In Italy, seed savers are introducing the term Etruscan wheat for the species, and in older Danish literature, the term Oriental Wheat is often used.

Khorasan has emerged from a cross between durum and Polish wheat, and it's traits are somewhere between the two. The seed is large and normally without polyphenols in the bran. Harvested in due time under optimal conditions, the kernels are beautiful with a nice yellow appearance. It is hard to grow in Denmark with a decent yield and quality, but sometimes we can. The winter hardiness is poor, and recommended only for spring sowing conditions.

Polish wheat

Polish wheat (*Triticum polonicum*) is another durum like species, with very large kernels and a very strange appearance with extraordinarily long glumes. It is free threshing and requires no dehulling. The kernels are pretty hard, often harder than durum and very fit for semolina, bulgur or similar.

I wonder where the name Polish wheat comes from, as the crop has nothing to do with Poland. It comes from somewhere between the Middle East and western China. Please inform me, if you know the origin of the name.

Most accessions are hopeless to grow in Denmark, but a few can be grown with a decent result.

Polish wheat has very characteristic heads with awns and very long glumes.

Turgidum

Turgidum like durum, polish wheat and dikha emerged from emmer, where a mutation hasmade the grain free-threshingg. This mutation happened in different places and times independently from each other several thousand years ago.aSome of these mutated germplasm havebeen grown apart from each other for a sufficient time and they have developed distinct characteristics, meaning it can be argued they belong to different species, even though they easily cross pollinate if given the chance.

There are two types of turgidum, the Rivet and the Poulard. Rivet or Cone Wheat is the English version, being brought to Britain by the Normans in the Middle Age, and later being imported to Denmark in 19th century. In older Danish literature it is called English Wheat. Poulard is of the French version, slightly more affected by durum, with harder kernels.

Turgidum is not used very much in foodstuffs nowadays. Baking quality is poor compared with bread wheat, and it does not have the hard kernel that makes durum better fit for pasta. Whereas most durum wheat is of the white type lacking polyphenols in the bran, most turgidum varieties have brown kernels like most bread wheat varieties in humid zones like Northern and Western Europe. On the other hand, turgigum and in particular Rivet has better climatic adaptation in Northern Europe, where a thousand years on the British Islands have made an impact.

Einkorn

Éinkorn together with barley was the first crops Adam, Eve and their older son Cain grew after leaving the Garden of Eden. From genetic analysis it has been documented that both emmer and einkorn most resemble wild grasses from the area near Karakadac in Kurdistan suggesting that this was the place for first domestication of the crops some 11,000 years ago. However, we cannot be really sure, because at the time before the global flood some 7500 years ago, most of the Black Sea was dry-land and inhabited by early Neolithic people, and there may be a lot of evidence on crop domestication on the bottom of the Black Sea, left behind by Noah when he had to flee from the area rescuing him and his family and taking with him only a narrow genepool on the Ark to the Turkish mainland when the Mediterrenean water masses broke through the Bosporus.

In contrast to all other cultivated wheat species, einkorn is diploid. All others have a double or triple chromosome set. Einkorn is very resistant to all plant diseases, hardly being infected by anything. Quite boring for a plant pathologist, but interesting for a plant breeder. Einkorn has a beautiful canopy colour, and even though it is lightly slow early in the season, it is an easy crop to grow. Unfortunately, it is pretty hard to dehull, and after milling the gluten is extremely soft. It is almost impossible to bake a free standing bread, but baked in a form it works. The taste is wonderful and the high protein content ensures a fine volume.

Einkorn has a close relative, naked einkorn (*T.sinskajae*), that doesn't need dehulling. Unfortunately, this crop has a problematic trait, it is more or less self sterile, which is not too smart for a self pollinating species, and the yield is therefore very low. Einkorn also has another close relative, the Two seeded einkorn (*T.uratu*) which is a wild grass. This grass once, long before Cain became a farmer, crossed with another wild grass of the aegilos genus and fromed wild emmer (*T.dicoccoides*). As two grasses from different genus cannot cross, a doubling of the chromosomes was needed to make it happen. Wild emmer therefore does not have only half of the genes from the mother and half from the father, but has the entire genome from both mother and father. Similar so for the domesticated emmer (*T.dicoccum*) and later descendants like durum and turgidum.

Zanduri

Zanduri was in Mesopotamian antiquity called the Kings Wheat because of the superior quality fit for Nebukadnesar and other kings of Babylon. At that time the comparison was most likely emmer, and if superiority still holds today is debatable and depends on the recipe in the bakery. Zanduri (*T.timopheevii*) belong to a different genus group of wheat, not developed from emmer like other European wheat species, and zanduri therefore cannot cross with these without some degree of chemical help in the lab. Zanduri can best be compared with einkorn, but with more diversity in kernel morphology, including hardiness, and we now propagate different zanduri varieties to investigate which varieties are fit for which purpose. The plants have characteristic hairy leaves, and the crop is healthy, not being infected by leaf diseases. For a bunt nerd like me it is worth noticing that some are susceptible to common bunt, whereas others are resistant. Maybe new resistance genes can be found in zanduri, now present in the AABBDD genome of bread wheat.

Zanduri is hard the dehull but zanduri has a close relative, *T.militinae*, which is naked. I grew that previously, but I gave up as the yield was too low and uncertain for practical farming. However, not a new naked form of zanduri has emerged in my nursery, looking somewhat more promising. Future will tell the potential.

Makha

Makha (*Triticum macha*) is a hexaploid wheat from Caucasus, with smaller and more wheat like kernels, but in my opinion better baking quality than spelt. Makha has never been grown commercially outside Caucasus, and even here it has mainly been grown in remote mountain regions. here, it survivedfor 6000 years until industrialisation of agriculture finely erased the last spots of makha production. Luckily, seed savers and scientists collected grain and stored them in genebanks where some can still be found. Also our Makha comes from genebanks, and a Landsort farmer is now growing some 3ha for Aurion.

Spelt

Spelt is very similar to wheat, but the glumes sits tightly around the kernels and need to be removed mechanically before milling. In Denmark, spelt and in particular organic spelt is more or less synonym the Swiss variety Oberkulmer Rotkorn, as this has been very much promoted by Aurion who re-introduced spelt on the Danish marketsome 30 years ago and still is the main organic producer in Denmark. NordGen being responsible for genetic resources in Danmark and toerh Nordic countries has no accessions of spelt with Danish origin, but 10 years ago, I managed to get an accession from the Vavilov Institute in Russia, collected in Denmark in 1928. As far as I know, this is the only spelt variety of Danish origin. In quality it is similar to Oberkulmer Rotkorn. It can be grown as a spring crop, but I recommend it to be sown as a winter crop in our climate.

From Spanish and Swiss spelt accessions, I have developed a new spelt variety, that is resistant to common bunt and has larger seed size and a firmer gluten better fit for baking without mixing with bread wheat flour.

Many consumers have problems eating wheat. This can have many different causes, and celiac disease and wheat allergy is far from being the only problem, and neither are they the most common problems. Fructan is a carbohydrate slowly digestible. Consumption of such FODMAPs, also present in onions, leek and Jerusalem Artichoke, can lead to IBS (Irritable Bowel Syndrome). Some consumers feel less affected by consumption of spelt, which can be explained by a lower fructan content in many spelt varieties.

Some consumers have allergic reactions wben consuming wheat. Allergies are reactions to proteins and not carbohydrates like fructans, but wheat contains many other proteins than gluten, and specific wheat allergies are seen by patients without having reactions to barley or rye, even these also contain gluten.

Some allergies are related to hay fever caused by a reaction to expansin present in grass pollen. Wheat flour also contains expansin, and some consumers react with allergic symptoms to this expansin.

From Australia, we have achieved a spelt variety called E3. This line has a mutation making the seed free of expansin, and it is also one of the spelt varieties with the lowest content of fructan. Therefore, some consumers unable to consume normal wheat flour can tolerate products produced from E3. We've tested it on a few wheat sensitive patients, and they all tolerated the E3 which was very encouraging and helped the decision to propagate it.

Xinchang rice

Despite the name, Xinchang rice (*Triticum petropavlovskyi*) is a wheat species, but it is an extremely rare one. As far as I'm informed, it is not grown anywhere anymore, except for research purpose. We found it inn a genebank, who collected during expeditions to oasis in the dessert of the Xinchang Province in Western China. It has also been found a few places in Tibet. Thousands of years ago, it developed from a cross between bread wheat (*Triticum aestivum*) and Polish Wheat (*Triticum polonicum*). From Polish wheat, it inherited the large glumes and big kernels. In the original form, we could not grow it as realistic crop in our humid and cold Danish climate because of logding and diseases, but after a single backcross to bread wheat, and selection of offspring with the characters of Xinchang Rice, it was possible to develop a decent crop that in appearance is just like the original Chinese type.

Xinchang Rice is a good alternative to spelt, as it has the same large kernels, but needs no dehulling, and therefore is easier to handle in the mill, and also, it has a less soft gluten than do spelt, and baking is therefore also easier.

The only thing that still puzzles me is that I haven't found out why the scientific name is *T.petropavlovskyi*, which sounds like Russian meaning Peter og Pauls wheat. The Town Petropavlovsk on the eastern shore of Kamchatka, is named after the two ships, Peter and Poul, that was used by the Danish explorer Vitus Berings (1681–1741) when he sailed around in that area to figure out if Siberia was separated from Alaska by water or not. However, most like this is pure

accidental and has nothing to do with Xinchang Rise. If you know the true story behind the Latin name, please let me know!

Indian Short wheat

Indian shot wheat resembles spring wheat, but it has a mutation that makes the kernels short and circular, hence the German term Kugelweizen. Also the heads looks different with very short glumes with or without awns. In Asia, Indian short wheat is used for puffy pasta as the because of a special starch composition, but just for the shape of the seed it is interesting also used as intact kernels. Aurion has started t production in Denmark, and Agrologica continues to improve and breed varieties fit for growing in our climate. We hope next year to have a purple short wheat ready for propagation.

Triticale

Triticale is a cross between wheat (genus ***Triti****cum*) and rye (genus *Se****cale***). As they belog to two different genus, they should not be able to mate, but in nature, there the is only one rule withour exemptions: There are always exemption! So, if you try hard enough and keep trying, some times things are sometimes possible anyway, and in particular with a little help from selected chemicals in a laboratory.

Agrologica at the moment only grows one varietiey of triticale, and we call it Crown Princess Mary's triticale. The story is that Jason Cotter from Australia makes seed collections and research similar to Agrologica, and he submitted a collection of his germplasm to the demonstration field at the international cereal Festival 2019 at Kalø, . This line was collected as a very vital off type from at Khorasan field on Tasmania, and was therefore called Tasmanian Khorasan. It was only later that we found out that it was not a Khorasan atall, but a triticale. However, it also grew very well in Denmark too, but to prevent confusion, we renamed it Crown Princess Mary's triticale, named after the vital and beautiful Mary who also came from Tasmania before becoming Crown Princess of Denmark.

Triticale is in Denmark mainly used for feed, but it can also be used for baking, where the properties is somewhere between wheat and rye. There are big differences in baking quality between triticale varieties, depending on how closely it is related to wheat or rye. In recent decades, the European triticale varieties have become more wheat like, which has resulted in a higher susceptibility to rust diseases, but it is likely that this has also resulted in more wheat like baking quality. At least, I think it would be worth trying out different triticale varieties for baking properties. Our Autralian friends seems to like Crown Princess Mary's triticale fro baking, but so far we have used all seed for multiplication, and only little has been left for baking analysis.

Tritordeum

Whereas triticale is a cross between wheat and rye, tritordeum has been developed from a cross between wheat (genus ***Trit****icum*) and barley (genus *H****ordeum***). in further detail, it is duru wheat that has been crossed with the wild barley species

Wild type selection of tritordeum is very vital in growth. Maybe it can also have a potential as a green manure or feed crop like rye?

Hordeum chilense. In contrast to triticale that is mainly used for feed, tritordeum is mainly used for baking, and it has the surpurb gluten structure of wheat, but also the content of the healthy β-glucans characteristic to barley, and which can contribute to self life of the bread as it can absorb a lot of water.

Tritordeum is developed by researchers in Spain, and all available varieties are adapted to Mediterranean climate. Bornholms Valsemølle has required seed of triticale and grown it on the island of Bornholm, Denmark, and it is now offered at many supermarkeds in Denmark. Agrologica has grown Tritordeum for the past 8 år in Northern Jutland. Our experience is that it has very straw, and yield is most unstable and normally low. We've made som selections with improved performance, and in particular one plant with odd appearance. The head looks like a wild grass, but seed are big and fine and free threshing. Growth is vital, and extremely early compared with other cereals. So far, we have only grown this as a spring crop, but it survived the hard frost in February this year where many other varieties suffered hard.

Recent publications

De nyeste og mest spændende artikler fra den økologiske frontforskning

Borgen, A , P. Sarup og H.Haldrup 2021: Yield potential in organic and conventional seed. In: Eucarpia conference marts Online: https://www.agrologica.dk/filer/publikationer/Vitality_Eucarpia2021.pdf

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Our wish for a fertile growing season for all in 2021