# Bring back neglected cereals

## From ancient grains to superfoods

by Professor Dr Thomas Miedaner, Research Scientist


**At the GRAPAS 2017 conference, one of the keynote speakers was renowned Research Scientist, Thomas Miedaner PhD., who co-authored 'Neglected Cereals: From Ancient Grains to Superfood' with Friedrich Longins, published earlier this year. Milling and Grain have selected his speech to feature in this month's edition, to share a snippet of the book's topical debate surrounding the renascence of these neglected cereals.**

**Thomas Miedaner studied Agrobiology at the University of Hohenheim and received his PhD in Resistance Genetics at a Federal Institute. He returned to the University of Hohenheim in 1987 to get the leader of the Rye & Biotic Stress Research Group at the State Plant Breeding Institute and got his Habilitation in 1998 in Plant Breeding.**

Why should we work with ancient cereals? We are working together with private plant breeders in Germany and a small part of our work is with ancient cereals. Our cereals that I want to introduce are European cereals that are neglected.

So we ask the question why should we work with ancient cereals? First of course, for diversity on the farm as well as gaining interesting and new features out of these cereals such as resistance to diseases or different flavours, but there are multiple others.

### Key advantages:

- Greater diversity on the farm (biodiversity)
- Resistances to diseases, abiotic stress, special traits
- Nutritionally valuable
- Regional specialties and cultural diversity
- Flavour and enjoyment
- However, there are not only advantages, there are of course disadvantages too.

### Key disadvantages:

- Low yielding
- Difficult to plant: smaller (hulled) kernels, uneven germination, early lodging, uneven ripening
- Special problems: Loss of grain, bird damage
- More difficult to process: Dehulling, different baking properties

The main one for the farmer is low yield although there is also the difficulty to plant these cereals because as you can see they are often rather tall, as well as bird damage and the loss of grains, as well as economic performance that isn't always good.

For the miller, farmer and baker, it is more difficult to process

because it's not this convenient product like bread wheat that we are all adjusted to. So we need an improvement by plant breeding for these cereals but we still want to take all of their original flavour and original characteristics. You can get very good products such as noodles and whiskey from spelt. But of course we have to know the characteristics of these different crops.

## Looking for the growth potential

As you know, it started about 10,000 years ago with the first cereal domestication in the region of Iran, Iraq, Israel, Palestine and Syria and the archeological findings show us that about 20,000 years ago wild cereals were being collected and grinded already and used for food. Then 10,000 years later, we have evidence of the first cultivation of barley. The neglected wheat that we are speaking of includes Emmer, Einkorn and Spelt.

Looking at the different characteristics, we have a wild cereal, which is brittle and has a split head so it is losing its kernels automatically, which is important for a wild crop. It also has hulls that we have seen in other cereals. The cultivated Emmer has no brittle head but still has the hulls, there is also the durum and the bread wheat.

All these wheats have a common history that is quite long, dating back about 300,000 years ago where Wild Einkorn and Aegilops sp., combined together naturally and produced wild Emmer wheat when 10,000 years this wild Emmer wheat was cultivated and that in turn produced Durum wheat and Khorasan wheat as well as others. Another lucky accident this cultivated Emmer combined with another wild wheat (T. tauschii) to produce our better-known bread and spelt wheat that are very narrowly genetically related.

This activity spread to Europe over the next 5,000 years here until it reached Scandinavia and Northern Great Britain or Scotland.

The neglected wheats that we are speaking of include:

- Emmer
- Einkorn
- Different cultivations of Spelt

Establishing an old crop anew means we have to look for the growing potential as well as risks for the farmer; we have to look for processing data, whilst keeping the special advantages of these cereals to market them; and we need the interest of the whole production chain from breeder, farmer, miller, baker and merchant. All of these people have to be interested in these things.

Starting with the growing potential, it is clear that the yield is much lower than we know it from bread wheat, as a result a reduced grain yield must be compensated by a higher price in order to attract the farmers interest.

You can yield eight tonnes of Bread wheat and six tonnes of Durum wheat and from there it goes down looking at the kernels because you cannot eat and cannot sell them, and so the yield is clearly inferior.

The processing is also different, Einkorn has a very high raw protein content but all other figures are much below the normal Bread wheat. It gets better with Emmer which has a similar baking volume and extraction rate, then the figures get even better with Spelt.

We must also consider that there are differences between these cultivars, one may have a large cultivar whereas one may have a small one and there can be large differences between the species. Another point would be that even if you know the protein content for a species that does not predict baking volume, it could be very different, so it is important to test the produce.

We can take a look at the advantages and disadvantages of two of the main species, Einkorn and Emmer:

**Millets**

Common millet (*Panicum miliaceum*) and the Foxtail millet (*Setaria italica*)

- Grown since Neolithic time in Europe
- Drought tolerant – lowest fertile soil
- Highly nutrient efficient
- C4 plant with high productivity
- Not "modern", but gluten free
- Very easy to grow
- Specialty breads and baby food – easily digestible

**Rye**

- Perennial crop (2-3 years)
- Low requirements, rapid growth
- No pesticides, low fertilisation
- Cultivation in marginal areas
- High straw yield

**Einkorn – Compared to bread wheat**

- Twice as much mineral salts (Zn, Se)
- Four to eight fold the amount of lutein
- Twice as much fat; especially, Mono-saturated fatty acids
- Low activity of lipoxygenase
- Low activity α- and β-amylase

**Processing properties (disadvantages)**

- Attention with dehulling reduces grain damage
- Less flour yield (70-75%) dough yield satisfactory
- Major part of gluten is gliadins, this can cause poor baking quality, low sedimentation value and moderate dough rising.
- Einkorn has very soft gluten, poor dough stability, gas retention capacity and the bread volume is small
- Emmer is nearly comparable to spelt

**Tips to help with disadvantages**

- Reduced dough temperature (water <20 degrees Celsius)
- Longer processing time (swelling time x2)
- Low kneading energy
- Ascorbic acid (Vitamin C), cherry juice powder helps

The disadvantages however lead to 'Artisan bakery' and a premium product, because essentially these, Einkorn and Emmer, cannot be industry baked, therefore you need special knowledge from the baker.

Perennial crops in general mean that no re-seeing is necessary and has efficient water use. There is a high composition of nutrient reserves in the deeper soil layers and has year round land planting, there is protection again erosion from wind or water.

We don't really see a market in Europe for perennial crops because the grain yield is very low, so for high production agriculture this might not be the first option.

Lutein is a carotenoid and it plays an important part in preventing eye disease (age-related macular degeneration) and it might have a positive effect on further degenerative diseases also.

Mostly healthy ingredients are also in the end product, they're visible and possible to taste – this makes the produce functional food.

Is the up soar in "Gluten Free" foods and diets necessary, and how does this impact the reintroduction of neglected cereals?

Only very low amounts of people suffer from wheat intolerance even though a lot of people think they have to be gluten free.

I have found this citation from the Internet where someone has said, "I've gone gluten free and now I feel so much better, now I only eat spelt or Kamut."

Yet both of these have the same amount of gluten as bread wheat and for 95 percent of the population, whole grain wheat would be beneficial.

Obviously Coeliac Disease is a disease and if you have it you are not allowed to eat gluten but on average less than one percent of the population is affected. It is similar with allergies, allergies are also a disease and can be tested by the normal allergy tests and the sufferers of this have to also stay at least 'wheat-free', this means they are not allowed to eat all wheats and in the case of Coeliacs that means also not rye or barley. My third point on this is about 'sensitivities', which has not really been known until now. Not knowing about it until recently also means not really knowing how to compete with this problem, at the moment it is believed that up to five percent could be affected by sensitivity – but as we have no real diagnosis yet, no one really knows. Nor do we know how to combat the problem, perhaps by reducing wheat in the diet that will help.

Pseudo cereal grains can be used nearly like cereals, although they have nothing to do with cereals they are belonging all to different families. They are always gluten free too, which is used often in their advertising. To grow them in Europe however would need a lot more effort and plant-breeding as they are usually much better off being grown in Asia and Africa. You could possibly grow them in your garden but not on a farming level.

**Pseudocereals – Gluten free**

Chia – C3 plant, very late ripening, small kernels, rich in lipids and linoleic acid, can be used as vegan produce thickener.

Quinoa – C3 plant, needs heat, small kernels, high protein content, saponins must be eliminated or it will be bitter and anti-nutritious.

Buckwheat – C3 plant, not cold tolerant, large kernels, rich in complex carbohydrates, contains Rutin, high content of multiple vitamins and minerals.

Amaranth – C4 plant, needs heat, very small kernels, very high protein and fat content, high content of multiple vitamins and minerals.

We have been eating cereals since the times of the Neanderthals; you can even find the remains of kernels between the teeth. This shows that cereals are the basis of all civilisation until the Andes cultivated the potatoes, this notes the importance of the grains combined with the immense health benefits they bring.

Having said this, there is still a long way to with the re-introduction of neglected cereals; we have to look at the agronomy, the risks, and the product quality, what type of product we want, what the costs are, alongside the health implications.

And last but not least, what has to be established is a functioning whole production chain. Going back to what I said earlier everyone has to be involved to bring back the neglected cereals and ancient grains, from the miller to the farmer to the baker, all actively involved in the production chain – and with all the specialist knowledge they need to be getting the appropriate money for the services or the system will not work.

Germany presents one success story in terms of Spelt, we are currently producing 50,000 hectares of spelt, compared to wheat where there is 3.5 million hectares – but it is a nice niche. The estimated turn over for the farmers as a result is 175 million euros, the same for the traders and millers (2015) but for the bakery's it is estimated at a one billion euro turnover. Emmer is much lower in terms of production but there is multiple types with red, white and black Emmer being available to grow, so there is a possibility to grow it in the future to a success.

If you want to buy today Emmer bread or spelt bread this has to be grown by the farmer and produced by the breeder of the seeds, it cannot just be bought on the market like bread wheat, this cannot be forgotten.

## Summary

All neglected cereals and pseudocereals have positive aspects, but provide also high challenges concerning farming, processing and marketing.

They must be sold for higher prices in excellent (organic?) quality to give rise to a premium product, they cannot be sold for normal supermarket prices. This means that special niches must be found for marketing, especially; health, flavour and regions of origins.

If you want to read more about unlocking the potential of these ancient grains, please consider Mr Miedaner and Mr Longin's publication 'Neglected Cereals: From Ancient Grains to Superfood'.

You can also see Professor Miedaner's full speech on our Global Miller blog under the title "The GRAPAS Conference live!"

**For further reading:**
Neglected Cereals: From Ancient Grains to Superfood
*by Thomas Medaner and Friedrich Longin*
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