



IMPROVING DIVERSITY IN CEREALS



This project is funded by
the European Union

<http://healthyminorcereals.eu/>

Impact Objective

- Deliver an integrated approach to diversify the genetic base, improve stress resistance, agronomic management and nutritional/processing quality of minor cereal crops for human nutrition in Europe

Cultivating variety

Dr Dagmar Janovská talks about the work of the pan-European collaborative five-year project HealthyMinorCereals, which is aiming to build knowledge and awareness about minor cereal crops - spelt, rye, oat, einkorn and emmer



How did the HealthyMinorCereals project come about?

In 2011, the Biosummit was held in Prague. This regular event is focused on policymakers as well as on farmers and producers in the organic sector. One of the speakers was Professor Carlo Leifert from Newcastle University. During the summit, a friend of mine and one of the organisers of this event, Jiri Urban, introduced me to Leifert. We discussed the importance of minor crops and we decided to look for opportunities to develop a European project and submit a grant application. The possibility of preparing an application to the European FP7 programme came in 2012 when the call for minor cereals was announced. The core consortium was made from partners involved in another European project due to their expertise and suitability for our project. However, several partners I found through their publications and activities published on scientific and institutional webpages. During this time, two meetings were organised each time with more partners. Finally, the consortium was created and the project

application was submitted in February 2013. We started the project in September 2013.

Could you talk a little about the stage you are at currently with this work?

The project lasts 60 months, and we are currently in the fourth year. We have almost finished the genetic and phenotypic characterisation of minor cereal species rye, oats, spelt, einkorn, emmer and their wild relatives, but all other Work Packages (WP) are still under progress. The main objectives for this last period are the evaluation of the data received from genetic characterisation and preparation of scientific publications from these results. There will be a statistical evaluation of data received from phenotypic evaluation and preparation of scientific publications from these results, as well as evaluation of tolerance/resistance of genotypes selected from this data. Data analysis and publishing is currently being conducted for all relevant WPs. In addition to scientific publications, we disseminate our results to a wide audience of researchers, farmers, cereal processors as well as consumers via seminars and field days. The final part of the project is focused on the demonstration activities where we would like to show to farmers and producers how to deal with minor cereals to achieve the best quality of grains from the field and food from processing.

Could you talk a little about the collaborative nature of the project? How valuable is this to your work?

HealthyMinorCereals is a collaborative project which means that there are research institutes, universities and SMEs (breeding companies, processors and producers)

involved from ten countries from the EU, Turkey and Switzerland. Each WP is led by an expert from a different country, which is important for wider knowledge. However, strong collaboration among partners within each WP is essential. Partners in the consortium are involved not just in one WP but in several WPs according to their expertise. The primary partners outside of the consortium of our project are small farmers, producers and processors who are interested in minor cereals or would like to widen their product portfolio. The main areas of our research cover genetic analyses, phenotyping, evaluation of biotic and abiotic stresses, evaluation of nutritional content of minor cereals grains, agronomic management, food processing and market potential evaluation. Through our project we would like to remind consumers in Europe that there are a lot of crops we used to cultivate and use for our traditional dishes.

Finally, can you share a little about how your research career has developed to lead you to coordinate this important initiative?

In 2004, I started working in the Czech Gene Bank in Prague as Curator of the minor crops collection, evaluating and maintaining crops such as common millet, common buckwheat, sorghum, etc. The work is focused not only on the evaluation and storing of selected genotypes in the gene bank, but also on promoting the cultivation of the cultivation of these crops and general awareness about them. As all these crops are cultivated mainly under the organic regime in the Czech Republic, my main interactions are with organic farmers. This led me to my interest in spelt, emmer, and einkorn which are very popular in the organic sector in the Czech Republic.

Improving diversity in cereals

A consortium of scientists across Europe are collaborating on the HealthyMinorCereals project to rediscover the benefits of more traditional cereal crops to tackle the lack of diversity in currently cultivated varieties

Agriculture has played an essential role in the development of the modern world since its advent approximately 15,000 years ago. Being able to cultivate plants, animals and fungi to create a surplus of food is considered an essential step in the creation of civilisation. It is unsurprising, therefore, that it is still as important today.

Yields of crops are at an all-time high thanks to the use of fertilisers, pesticides and herbicides. However, this has created impacts that the world is struggling to contain. Fertilisers can run-off fields causing major problems with eutrophication and overgrowth in waterways and wild areas. Pesticides are often indiscriminate, destroying a large portion of local insect populations which has an impact on animals that eat them and so on up the food chain. Repeated use of herbicides may lead to the occurrence of herbicide-resistant weeds that can quickly become dominant. One of the most understated problems, however, is the lack of diversity amongst plants that are cultivated. In Europe, the most notable grains grown are wheat and barley which dominate the production numbers and have led to a very small number of cereal crops.

Dr Dagmar Janovská of the Czech Gene Bank in the Crop Research Institute (CRI) is leading a collaborative EU-funded project which is aiming to address this very issue called HealthyMinorCereals. She points out that the dominance of these few cereals, and few varieties of these cereals, has the

potential to cause major problems in the future. Infection and disease is one such problem. 'The lack of genetic diversity means that a single disease agent could wreak havoc across the whole continent and prove very difficult to constrain.' The second major threat is the changing climate of the future. The appropriate climate and weather systems are essential to agricultural success and good crop yields. 'Climate change is bringing more erratic weather that will require a certain level of adaptability and survivability from the plants being cultivated,' Janovská observes. The work of the consortium is re-examining cereals that were extensively grown across Europe in the past, before wheat and barley dominated.

HealthyMinorCereals is a five year project that was kicked off in September 2013. It is ambitious in scope and scale. The project aims to conduct a broad analysis of cereal varieties – such as einkorn, rye, spelt, emmer and oat. This includes looking at genetics, survivability in the field under different conditions, downstream processing of the mature grain, nutritional analysis and the marketing of the grain. Janovská says that crop diversity might limit the spreading of pests and diseases without using high chemical inputs. 'However, for this, the

evaluation, exploitation, and development of these minor cereals will be a key.'

CEREAL CHARACTERISATION

The work encompasses 16 major partners across academia and industry based in 10 European countries. This breadth of resources means there is a wide-range of expertise and facilities available to the project. These resources have allowed HealthyMinorCereals to characterise more than 800 genotypes of minor cereals – both domestic and wild – available from seed banks. 'This step provides a wealth of data on the genetics of cereal crops which has proved invaluable for the project and will also be important in future work,' observes Janovská. In addition to genotype, the team has also characterised the phenotypes of these species under different conditions. From these analyses, 200 genotypes were selected and tested for their tolerance to both biotic and abiotic stressors, e.g. infection and drought conditions. 'This characterising process is invaluable in identifying tolerant and hardy strains. Genotyping and phenotyping provides the scientific foundations for the future use of minor cereals in agriculture and the basis from which to conduct a wide variety of experiments.'

Our results indicate that the minor cereals investigated compare favourably to the market-dominating cereals

In order to accurately phenotype the cereals by testing them under different conditions, the researchers have planted crops in five locations across Europe. This process has been aided by farmers who are also stakeholders in the project along with millers and other processors. Multiple statistical analyses have been used to process this fieldwork and it has proved essential to the successful progress of the project. However, this work in the field has also provided the team with one of their few major setbacks, as Janovská explains: 'The biggest problem we have faced is the really harsh winters in Estonia. Estonia is one of the European countries where rye is still the traditional crop, grown mainly for bread, and where a breeding programme still exists. Unfortunately, from the beginning of the project, the winters have been unpleasant and caused not over-wintering the selected genotypes of rye.' Despite this, she says, the testing of different cereals is essential in educating farmers in how to grow them and demonstrating that they can be done so at a profitable level, which is a key objective of HealthyMinorCereals.

EXPANDING THE MARKET FOR MINOR CEREALS

The minor cereals investigated through this project had previously been grown for years up until the end of the World War II. However, accurate nutritional analyses of food have only been developed in the second half of the 20th century. This means that, for many of the cereals, little is known as to how they compare nutritionally to wheat and barley. The researchers have worked to characterise the nutritional value of these cereals. 'Our results indicate that the minor cereals investigated compare favourably to the market-dominating cereals', Janovská says. This information will be essential in working with consumers and farms to switch to other forms of cereal. She describes the impact of this nutritional work: 'We would

like to make farmers and consumers in Europe aware that there are other cereal species available, with a long tradition of cultivation and premium nutritional quality, which can be an alternative to major cereals'.

Allied to the nutritional value of the cereals is the investigation conducted by the consortium into the downstream processing of grains. How cereals are milled and ground is crucial for their nutritional value by the time they reach the consumer. Additionally, the level of processing required will directly affect how costly the grain is to produce. Minor cereals need to be competitive in both of these aspects to be embraced by farmers, millers and consumers. 'We are working closely with millers and other processors to figure out the best way to process these cereals. At this relatively early stage, the results compare well to those of the major cereals,' notes Janovská.

A final aspect of the project that is vital to the long-term aims of HealthyMinorCereals is the investigation into how best to market minor cereals to the various stakeholders. Part of this work has been based on the information on growth, resistance, nutritional value and processing generated by the scientific branch of the project. However, a significant part of the marketing research has focused on how best to package the products across Europe, especially when taking into account regional differences and preferences in diet and lifestyle.

The work is now entering its final year; however, Janovská is already keen to build on the successful outcomes. All of their results will be the subject of the final recommendations for farmers, processors, producers and for consumers. 'The success I see is in the obvious potential of minor cereals and the people I have around within consortium. Together we can show how minor cereals might be beneficial for all of us.'

The HealthyMinorCereals project consortium collaborate during a field visit



Project Insights

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SCIENTIFIC COORDINATOR BIO

Dr Dagmar Janovská works as Curator of minor crops collection in the Czech Gene Bank in Crop Research Institute (CRI) in Prague, Czech Republic. She is the coordinator of the HealthyMinorCereals project. Janovská has previously participated in other European projects and has experience in coordinating several national R&D projects dealing with minor crops. Her research is mainly focused on evaluation and selection of minor crops suitable for improving human nutrition, and assessment of their potential for organic farming. Janovská is a vice-head of the Czech Technological Platform for Organic Agriculture, which is dedicated to the transfer of scientific knowledge and results to farmers as well as processors.



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