Preparatory action on EU plant and animal genetic resources

Beer brewed from a Victorian barley variety

Overview

1. Objectives

The objective of the present case study is to look into the work and partnership behind the development of a Victorian barley variety – Chevallier, and to understand which key factors enabled the success of this project. The project resulted in bringing this variety back to the market through partnerships between scientists, farmers, maltsters and micro-breweries. In addition to the specific taste of beer brewed from Chevallier, and the quality of the malt, it is also an interesting variety for breeding as it is resistant to the fungal disease *Fusarium*.

2. Description of the case

The research on Chevallier started off with a Biotechnology and Biological Sciences Research Council (BBSRC)[1] public engagement grant in 2001 awarded to Dr Chris Ridout at the John Innes Centre (JIC) under the name "Breeding Better Beer".

Initially, the objective was to demonstrate the role of barley improvement in beer production, and to bring some old "heritage" varieties of barley grown at the JIC's Genetic Resources Unit to a public exhibition. This event was hosted by the University of Sunderland and Brewlab Ltd. Following discussions with the brewing expert Dr Keith Thomas from Brewlab, it was agreed that it would be interesting to further investigate the properties of these heritage barley varieties that are no longer commercially grown.

In 2007, a PhD student (Amal Muhammed, Sunderland University) took on this project and her work demonstrated that one of these varieties, Chevallier, had a clear resistance to a fungal disease – Fusarium Head Blight (FHB) that contaminates grain with mycotoxins including deoxynivalenol (DNO) and causes damage to barley and wheat and reduces both yield and the quality of malt. Further research at JIC confirmed that this variety offered the possibility of combining high malting quality with strong resistance to this disease. Further BBSRC funding enabled research into the genetic basis of the FHB resistance and other traits to verify whether this could be bred into high-yielding commercial strains.

[1] Biotechnology and Biological Sciences Research Council - one of the UK's seven research councils, funded by the Government's Department for Business, Innovation and Skills (BIS).

Figure 1: Chevallier barley. Photography: Chris Ridout

With this potential agronomic value (disease resistance), an application to register Chevallier as a heritage variety was submitted and granted. Micro-malting trials of Chevallier were conducted and further floor malting was undertaken in this project by the Crisp Malting Group (CMG). So far, the Chevallier project has raised significant interest among researchers, industry and the public.

After completion of the Chevalier project (2012-2014), the activities were carried out for commercial purposes. A company was formed, New Heritage Barley Ltd, which carries the license for the Chevallier. Currently, all financial benefits made from cropping and harvesting the Chevallier are reinvested into the process as it takes a few years to reach a sufficient amount of seeds which will make malting possible in high volumes, and which in turn can attract breweries.

Analysis

3. Funding and support

The project 'New Heritage Breeding for accelerated trait development in barley' was awarded 250,000 GBP (340,000 EUR) by BBSRC which was a follow-up to an earlier project[2]. This follow-up funding was available only for those who had received previous funding from BBCRC. In this case, this was related to a 600 GBP grant (800 EUR) that Dr Chris Ridout received in 2001 for the public engagement project.

Figure 2: Dr Sarah de Vos in the Chevallier fields. Photography: Chris Ridout

Following the end of this project in 2014, a company was started with a twofold aim of bringing back into production some of the old varieties, while also researching the heritage material. The company, New Heritage Barley Ltd, is run by a colleague of Chris Ridout, Dr Sarah De Vos. Furthermore, the BBSRC is also providing funding worth nearly 40,000 GBP (55,000 EUR) for the collaborative project between the JIC and Michigan State University's Upper Peninsula Research and Extension Center (UPREC) in the US, which was initiated in 2014[3]. Further information about this project is included in the section on partnership and networking.

[2] BBSRC, http://www.bbsrc.ac.uk/news/food-security/2013/130424-f-breeding-better-beer/

[3] BBSRC, http://www.bbsrc.ac.uk/news/food-security/2015/150616-pr-transatlantic-science-connection-for-better-beer/

4. Positioning at local or regional level

The JIC has been working with a number of different local actors since the beginning of the first research project related to heritage barley. The JIC already had long lasting relationships with the key partners required for this work. These existing relationships are seen as a key factor for the success of the project. In particular, there was already a good working relationship with Morley Farm and it was easy to gain their interest in the possibility of growing an old variety. Generally, farmers are not willing to take the risks related to the growing of old varieties as this might not be financially sustainable for them. In the case of Morley Farm, they are supported by the Morley Agricultural Foundation which is a charity set up to support farming in the East of England by finding agricultural research and educational projects. Morley Farms Ltd is a commercial farming enterprise which principally farms the land owned by the Morley Agricultural Foundation. Morley Farms employs a manager and two full-time members of staff, and is well equipped with machinery to carry out all farming operations. Morley Farms also hosts field trials for several organisations.

In addition to the existing partnerships, the enthusiasm and personal involvement of the people involved in the project are reported as one of the key reasons of its success. Furthermore, the interest from the public was important, as well as the current growing interest for craft beer. Finally, the involvement of a variety of actors, from both the research and business sectors is seen as a key combination. The objective of New Heritage Barley Ltd is indeed to consult and involve all parts of the supply chain in their work to introduce the heritage barley on the market and to improve other commercial varieties through breeding activities.

5. Partnerships and networking

As mentioned in the previous section, the partnerships developed at national level were crucial to the success of the Chevallier project. No specific European projects were mentioned by the interviewees.

In relation to partnership and networking activities outside of the EU, a recent development is the cooperation between the JIC and Michigan State University's Upper Peninsula Research and Extension Center (UPREC) in the US. They have together received partnering awards from BBSRC to develop collaborations for malting barley research. The partnership is aiming at the development of a technique for genomic selection, an advanced DNA analysis method to speed up the breeding process.

Barley is traditionally grown in the Western states, and farmers and maltsters have found it difficult to identify varieties that are well suited to the humid climate in the East. However, the increasing focus on using locally sourced raw material, provision of tax incentives in US the to encourage local production have increased interest in malting in the East. Since barley has not been grown in these areas for 50-100 years and the climate is very different compared to the Western states - is warm and humid and thus favorable for fusarium. For this reason, British varieties deriving from a cross with Chevallier are being tested.

Dr Chris Ridout is also working to involve training young researchers in this project, enabling them to travel between the countries and to benefit from the barley research in two different places.

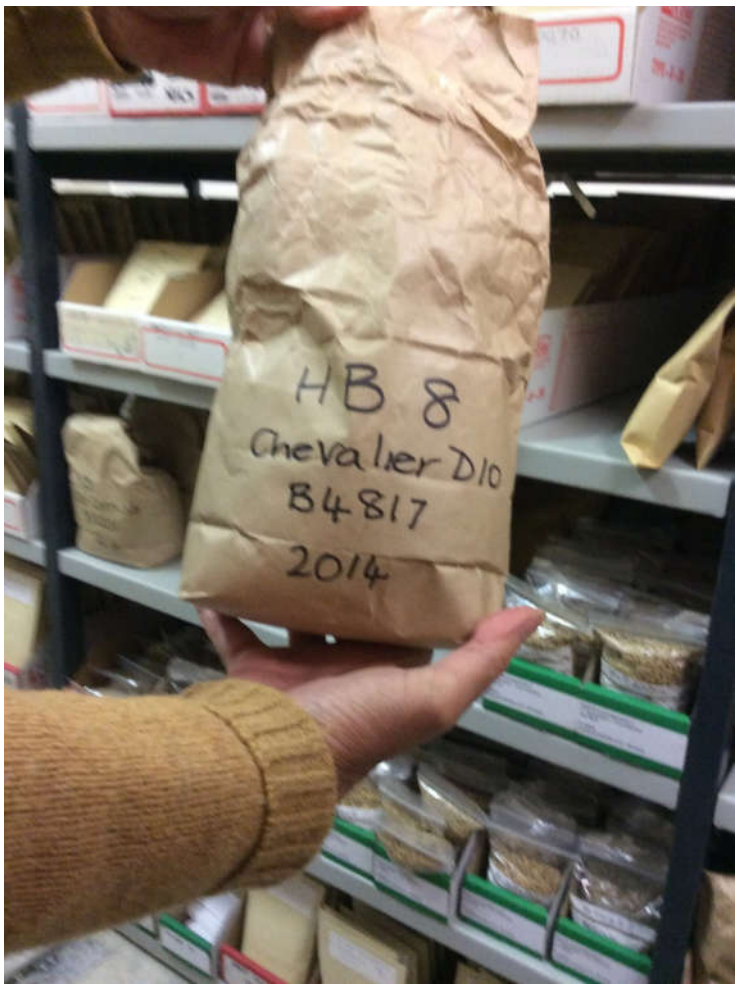

Figure 3: Chevallier in the JIC genebank

6. Communication

As the work on Chevallier started off from a public engagement project, the interest from the public was an important factor from the beginning. There seems to be a will among researchers in charge to disseminate and make research results accessible to different populations, including researchers, businesses, and the public. Communication channels include the JIC website, as well as the BBCRS website and articles published online. Furthermore, social media were used in order to raise awareness.

7. Outputs and added value

Beer brewed from Chevallier was marketed to date only at a small scale and at local events. Currently, more time is needed to grow barley so as to reach sufficient amounts to use for malting/beer brewing. The creation of the company New Heritage Barley Ltd demonstrates that there is an interest to take this initiative forward, continuing to involve both research and industry sectors in the process.

Compared to initial expectations, when the first activities of this project were performed, the outputs exceeded expectations. This seems to be linked to *inter alia* the specific traits of Chevallier, the existing network of partners in the research and business sector, as well as the public's interest for craft beer.

Figure 4: Chevallier seeds from the JIC genebank

8. Sustainability

The Chevallier project has greatly developed since the first activities in 2001 and the existing partnerships with businesses and farmers have enabled this process. These partnerships in combination with the enthusiasm of the people involved will most probably contribute to the sustainability of the project's results. The recently initiated partnering activities with Canada and the US will also contribute to this objective.

Furthermore, while the activities around Chevallier have continued to grow, the interviewees indicated that one of the key difficulties for this kind of project, is the collaboration with farmers. In this case, the JIC had a good working relationship with the Morley Farm and the farm was on board from the start as the project was broadly in line with the work carried out

by the farm. In addition, potential results from the cooperation could be used as an example in the educational activities conducted by the farm. Furthermore, the Morley Farm is experienced in agricultural research and thus had the knowledge required to grow an old variety which can be challenging due to a number of factors that must be taken into account, e.g. weather conditions, rotation of land, flexibility of machinery etc. Scientists do not generally have this knowledge, and thus the involvement of the Morley Farm had been crucial for the success of the Chevallier project.

The efforts made by New Heritage Barley Ltd to involve everyone in the supply chain, by e.g. consulting brewers in order to develop the varieties and particular characteristics they are looking for will also be important for the sustainability of the project's results. Currently, breeders do not meet (micro) brewers' expectations (in terms of taste) since modern breeding is more focused on yield than flavour. The initiative to start New Heritage Barley Ltd is indeed an important step, following the end of the BBSRC funded project, and in a way implies that this is still the beginning of working with heritage barley.

9. Upscaling and out-scaling

Since the work on Chevallier was successful, Dr Chris Ridout and his team at JIC are looking into other old varieties that demonstrate key valuable indicators for the food and drink industry. In this context, two partnering grants from BBCSR enabled collaboration with Canada and the US (for further details, see section on partnerships and networking). Those two projects make the out-scaling possible in other countries than the UK.

According to the interviewees, one main challenge in the area is the fact that researchers sometimes must choose between their research career and the upscaling of their projects into a commercial venture. In some cases, scientists want to concentrate only on research and thus the out-scaling of research projects becomes difficult. At the same time, for those scientists that do want to explore the upscaling of the research results, there is a lack of support for such activities. In this case, it seems like both the initiative and the enthusiasm of the researchers involved, combined with available BBSRC funding enabled them to overcome this potential obstacle.

Conclusions

STRENGTHS	WEAKNESSES
Existing partnerships with industry, farmers, and researchers; Involvement of a variety of stakeholder types; Enthusiasm and engagement of stakeholders; Funding from BBSRC; Specific traits of Chevallier, such as disease resistance.	In some cases, scientists want to remain within the research area rather than out-scaling to commercial ventures; Low yield of heritage varieties; Difficulty of maintaining and cropping old varieties.
OPPORTUNITIES	**THREATS**
Product development and consumer interest; Collaboration with Canada and the US; Training exchange with young researchers; Breeding activities including cross breeding of Chevallier with modern varieties.	Difficult cooperation with farmers who are not interested in working with old varieties due to low yield and difficulties such as different cropping compared to modern varieties; Lack of interest of business in case there is not sufficient consumer interest.

The activities around the re-discovery of Chevallier constitute a successful example of the valorisation of genetic resources on the market, as well as collaboration between the research and the business sector. Funding from BBSRC was crucial from the start, and had supported the project along the way. Currently, a company was set up to take some of the activities forward, however, BBSRC is supporting the cross-border collaboration between the JIC and the US and Canada. While it was confirmed that Chevallier has valuable traits regarding quality, taste and disease resistance, it still unknown how it will be received on the market in larger quantities. The consumer interest for craft beer might be a key factor of success in the coming years. In addition to product development, there are also breeding activities aiming to cross Chevallier with modern varieties to improve their disease resistance, and in particular in relation to Fusarium. Potential threats and weaknesses include the low yield of the variety which might result in a lack of interest among farmers to work with these varieties, in combination of other difficulties such as the different cropping methods. However, for Chevallier this was not the case thanks to the cooperation with Morley Farm. Another threat might be the lack of interest among businesses if the consumer interest is not sufficient. On the other hand, a very high consumer interest can instead lead to difficulties related to the low yield and thus a production which will not satisfy consumer demand on time.

Based on this case, there seems to be possibilities for follow-up developments. Indeed, the interviewees mentioned the interest to work on other old barley varieties to understand which valuable traits they may have. The scientists involved in the project are enthusiastic and have underlined the importance of working together with the industry to understand their needs. Furthermore, they are also eager to share knowledge through dissemination and public engagement events, and through the media.

Annex 1 – List of interviewees

- Dr Chris Ridout, John Innes Centre
- Dr Sarah De Vos, BBSRC Enterprise fellow, director of New Heritage Barley Ltd
- Mike Ambrose, Head of Germplasm Resources Unit, John Innes Centre
- David Jones, Manager, Morley Farm
- Dr David Griggs, Technical Director, Crisp Malting Group Ltd

Annex 2 – List of references

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