

AGRONOMY INSTITUTE

- For Northern Temperate Crop Research -

ANNUAL REPORT

(April 2015 to March 2016)



Harvesting the Agronomy Institute's 2015 crop of 'Tartan' malting barley which was grown for Highland Park distillery

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1 Introduction

The Agronomy Institute (AI) is a plant-based research centre at Orkney College UHI which is an academic partner in the University of the Highlands and Islands (UHI). This report covers the year from April 2015 to March 2016. During this period, AI research activities were concentrated on two Northern Cereals projects which involved collaboration with researchers from other north European countries and which were funded by Nordic Atlantic Cooperation (NORA) and the Northern Periphery and Arctic (NPA) Programme. As part of the NPA project, the AI hosted a major conference in Orkney for project partners, associate partners and local stakeholders. Over the year, links were strengthened with The James Hutton Institute in cereal, legume and berry research and collaboration continued with Forestry Commission Scotland on short rotation forestry. On the commercial side, the AI continued to manage barley supply chains for Bruichladdich and Highland Park distilleries, and these produced almost 100 t of grain for making into specialist whiskies. The AI's work with Bere received important recognition in May 2015 when the Institute and Bruichladdich Distillery received a Scotland Food and Drink Excellence Award for Innovation as a result of their collaboration in developing Bere whiskies. Also during 2015, a new wine and liqueur were released by the Orkney Wine Company using fruit supplied by the AI, and Swannay Brewery released a new beer using malt produced in Orkney through collaboration with the AI.

2 Background

The AI was opened at Orkney College UHI in June 2002. Its mission statement is “to establish an internationally recognised centre for the research, development and promotion of northern temperate plants and their products which contributes significantly to the sustainable economic, social and environmental well-being of the Highlands and Islands of Scotland”. This is being achieved by a research programme which is focused on:

- Identifying and screening crops and plants with potential for commercialisation in the Highlands and Islands, taking into account their potential impact on the environment and biodiversity.
- Collaborating with growers and end-users to develop *Best Practices* and supply chains for these crops.



- Stimulating the market for crops grown in the Highlands and Islands by collaborating with end-users to develop new products.

The AI's development aims are delivered through a combination of field trials, research projects and commercial linkages which are outlined below.

3 Links With Other Organisations And Profile Raising Activities

As an emerging research centre in the north of Scotland, the development of collaborative links with other organisations is very important and over this reporting period the AI actively engaged with individuals in the following organisations:

- *Research Organisations:* Agricultural Centre (Faroe Islands), Agricultural University of Iceland, NIBIO (Norwegian Institute of Bioeconomy Research), Forestry and Agrifoods Agency (Government of Newfoundland & Labrador, Canada), Forestry Commission Scotland, Institute of Biological, Environmental and Rural Science (Aberystwyth University), MATIS (Icelandic Food and Biotech R&D), Rowett Institute of Nutrition and Health, The James Hutton Institute, University of Sheffield.
- *Commercial Companies:* Bairds Malt, Bruichladdich Distillery, Crisp Malt, Highland Park Distillery, Isle of Arran Distillers, Lantmännen SW Seed AB, McCreath, Simpson & Prentice Ltd., Orkney Wine Company, Swannay Brewery, Valhalla Brewery.
- *Growers, Grower and End-User Groups and Trusts:* Balfour Castle Estate, Birsay Heritage Trust, Institute of Brewing and Distilling, Mains of Loirston Charitable Trust, National Farmers' Union Scotland, Orkney Bere supply chain, Orkney 'Tartan' supply chain, Orkney Food and Drink, SAC Consulting, Shetland Livestock Marketing Group.

The AI was involved in several knowledge transfer events including hosting an international conference in Orkney on Northern Cereals as part of a Northern Periphery and Arctic (NPA) project. AI activities have also been covered by the local press and radio. A major highlight of the year was the joint award to the AI and Bruichladdich Distillery of the 2015 Scotland Food and Drink Excellence Award for Innovation as a result of their long-term collaboration in developing Bere whiskies.

4 Impact Of The Agronomy Institute

The Institute has continued to make an impact at several levels:

- Growers and stakeholder groups have benefited from the new markets for crops and supply chains which the AI has developed as well as its knowledge transfer activities, particularly with cereals. In 2015,



Staff from Bruichladdich Distillery and the Agronomy Institute receiving the 2015 Scotland Food & Drink Excellence Award for Innovation.



Partners and associate partners in the Northern Cereals project visiting Highland Park in October 2015 during the project conference. An important theme of the conference was using local cereals for high value beverage production.



for the ninth successive year, Orkney growers planted about 20 ha of Bere for a specialist whisky market which the AI has helped to develop. Another group of five Orkney growers grew 12 ha of modern malting barley for the sixth year to supply Highland Park Distillery with local malting barley. Following the successful development of several new wines and liqueurs using novel fruits supplied by the AI, the Institute assisted the Orkney Wine Company to establish its own plantation of novel fruits in April 2015 and supplied the company with over 400 plants for this.

- Commercial companies are also benefiting as crops are being made available for the development of new products. Thus, new Bere whiskies, produced as a result of AI collaboration, were released by both Isle of Arran Distillers and Bruichladdich Distillery in 2012 and 2014 while Shetland's Valhalla Brewery continues to produce a beer first made from Orkney Bere in 2006. Orkney's Barony Mill has produced wheat flour and oatmeal from locally grown crops initially trialled by the AI and these are being used in bakery products by local companies. Collaboration between the AI and the Orkney Wine Company has resulted in the release of two new wines and a liqueur since 2012 while assistance from the Institute has also helped Orkney's Swannay Brewery develop two new beers, 'Scapa Bere' and 'Yardsook', from locally grown cereals. Both the Orkney Wine Company and Swannay Brewery have also developed very successful cask matured products using casks supplied by the Institute. Through its involvement in the NPA Northern Cereals project, the AI has helped promote links between Orkney companies and those in other partner regions. A particularly popular initiative arranged by the Institute has been placements at Highland Park distillery, to learn traditional floor malting techniques.



John Wishart of the Agronomy Institute (right) and Emile Van Schayk of the Orkney Wine Company inspecting young plants in the company's newly established fruit plantation.

- As a research centre within UHI, it is particularly important that the benefits of AI activities are spread over the Highlands and Islands. In addition to the AI's strong Orkney links, recent collaborations with commercial organisations in Shetland (Shetland Livestock Marketing Group and Valhalla Brewery), Islay (Bruichladdich Distillery) and Arran (Isle of Arran Distillers) demonstrate that the Institute's activities impact on several parts of the region. Collaborations between the AI and other research centres (e.g. The James Hutton Institute, The Rowett Institute and Forestry Commission Scotland) help these organisations deliver research projects benefiting remoter parts of the Highlands and Islands.
- With an aspiration for both national and international recognition, it is crucial, not only that the AI has international links (see Section 3) and is involved in trans-national projects (e.g. the Northern Periphery and Arctic Programme), but also that its research output is of a high quality and contributes significantly to UHI. AI staff have made important recent contributions to research on Bere, willow and natural products research and the Institute was part of UHI's submission to the 2014 Research Excellence Framework (REF).



Brewery and distillery associate partners from the Northern Periphery and Arctic cereals project visiting the Orkney Wine Company during the 2015 project conference in Orkney.



5 Plant Research Themes

As a result of reviews of potential markets for local crops in the Highlands and Islands, the AI has identified several research themes on which it is concentrating. Within each theme, a number of potential crops have been tested and subsequent research has focused on those crops and themes for which funding or commercial opportunities have been available. The main plant research themes are listed below:

5.1 Early-Maturing Cereal Varieties

Under this theme, the Institute is investigating both modern and heritage cereal varieties which are early-maturing and therefore suited to growing in the Highlands and Islands' short growing season. They are mainly being considered for food and drink products and include varieties of barley, wheat and oats. Northern varieties from Scandinavia are thought to be very suitable for the north of Scotland and Finnish, Swedish and Norwegian varieties have been grown successfully in Orkney for several years. The AI has also tested several UK varieties of malting barley and identified some which are early and also have potential for the Highlands and Islands. AI research and commercialisation activities have focused particularly on the ancient Scottish barley landrace, Bere, which is also very early-maturing and has a long association with Orkney.



Harvesting a small area of a Tibetan black barley landrace with Robbie Spence's 1938 McCormick Deering binder. Vintage machinery like this can still be very useful for harvesting small crop areas.

5.2 Woody Biomass Crops

These are being investigated as a possible source of local renewable heating fuel to help reduce dependence on fossil fuels. Initial AI research into biomass crops investigated the potential for using willow (*Salix* spp) grown as short rotation coppice (SRC) and willow trials were planted in 2002, 2006 and 2007.

Since 2011, the AI has been collaborating with Forestry Commission Scotland and Orkney stakeholders to investigate the potential for short rotation forestry (SRF) in Orkney. For SRF, trees are planted at a closer spacing (c. 2,000-3,000 trees/ha) than for normal forestry. Fast growing species are used, with the objective of harvesting them at about 15-20 years. Several of these species can be coppiced and should therefore regenerate after harvesting. SRF systems are considered to be particularly suitable for the establishment of small areas of woodland on farms, where the wood could have a number of end-uses, including firewood. A major advantage of SRF for small-scale growers in remote areas is that harvesting and processing into a fuel (e.g. split logs) does not need costly, specialised machinery. In contrast, willow SRC does not usually reach a diameter suitable for burning as logs, is normally processed into wood chips and requires access to an expensive, dedicated harvester and, depending on harvesting method, a wood chipper.



Short rotation forestry trial at Muddisdale in July 2015 in its third growing season.

5.3 Plants For Natural Products

Plants in this theme could have a wide range of end-uses, but several of those investigated in recent projects have



been grown for the pharmaceutical and cosmetic market. These include sweet gale (*Myrica gale*), the source of a high-value cosmetic oil and *Narcissus* cultivars as a source of galanthamine for treating Alzheimer's disease.

Several northern berry crops have the potential for supplying high-value extracts for the nutraceuticals / health food supplements sector as well as products for the food and drink industry. Species being grown by the AI include cranberry (*Vaccinium macrocarpon*), sea buckthorn (*Hippophae rhamnoides*), aronia (*Aronia melanocarpa*), Saskatoon (*Amelanchier alnifolia*), low-bush blueberries (*Vaccinium angustifolium*), salal (*Gaultheria shallon*) and elder (*Sambucus nigra*).



The Institute's aronia bushes carried a good crop of fruit during 2015 and were supplied to Orkney Wine Company for production of the wine, *Orkney Rosé*.

6 Projects And Commercial Activities

Income from research projects and commercial activities are vital for ensuring the financial sustainability of the AI. In 2015 the AI was involved in the following projects and commercial activities:

6.1 Cereals

RESAS Food And Drink Strategic Partnership

This project involves collaboration between some of the main research providers to the Scottish Government (The James Hutton Institute and the Rowett Institute of Nutrition and Health) and several Higher Education Institutes (UHI and the Universities of Aberdeen and Dundee) to investigate the health benefits of oats and barley. A high consumption of whole-grain foods is associated with a lower risk of coronary heart disease, hypertension and type 2 diabetes. One of the most important factors determining the health benefits of whole grain foods is thought to be their β -glucan content and the ratio between high and low molecular weight fractions. Low molecular weight β -glucans may have a particularly beneficial effect because they are highly fermentable in the gut and have toxin binding activity. The project is looking at the range of factors which can influence cereal β -glucan content – from genes to varieties, growing conditions and grain processing – as well as investigating effects of specific cereal products and different β -glucan fractions on gut microbiota and health parameters.

The AI supported the project by providing it with a north of Scotland research and trials facility between 2012 and 2014 where different varieties of oats and barley, including traditional landraces and north European varieties, were grown. This allowed the agronomic characteristics and grain nutritional composition of the varieties to be compared under Orkney's hyper-oceanic climate. A subset of varieties was also grown in more southerly parts of the UK so that the effects of northern growing conditions on nutritional composition could be investigated.



Some of the food products made from Orkney cereals provided to delegates at the 2015 conference of the NPA Northern Cereals project.

Northern Cereals – New Markets For A Changing Environment

This project started in June 2015 and is funded by the Northern Peripheries and Arctic Programme (NPA). Other partners in the project include Iceland (MATIS and Agricultural University of Iceland), northern Norway



(NIBIO), the Faroes (Agricultural Centre) and Newfoundland & Labrador (Forestry and Agrifoods Agency). The project has developed as a result of a mutual perception amongst the partners that cereal growing in their regions, although still very challenging, has been favoured in recent years by a number of factors, including new varieties, warmer growing conditions and increased interest in “local” production and sustainability. The aim of the project is to increase cereal production in the partner regions in order to promote greater self-reliance and to facilitate the development of new markets. The project builds on the collaboration and experience developed by the partners in a NORA-funded cereal project which is described later.

Within the project the AI leads work packages on beverages and market analysis. Another major contribution made by the AI to the project in 2015 was to host the annual project conference in Orkney. The conference was wide-ranging but had a strong beverages component and provided an opportunity for project partners to visit Orkney distilleries and breweries and learn about their collaborations with the AI and local growers.

Orkney collaborators in the project include Highland Park distillery, Swannay Brewery, Birsay Heritage Trust and Orkney Food and Drink. During 2015, the AI helped Swannay Brewery source locally produced malt made from Orkney-grown ‘Golden Promise’ barley which the brewery used to develop a new beer, *Yardsook*. The AI has also contributed to knowledge transfer between associate partners by arranging placements at Highland Park distillery for partners to learn the skills required in floor malting. This could allow breweries and distilleries in remote areas to make their own malt from local grain.



Some of the delegates from the Northern Periphery and Arctic cereals project visiting the Orkney Brewery during the 2015 project conference.

Northern Cereals – New Opportunities

This project ran from July 2013 to December 2015 and involved the same partners as are participating in the NPA project described in the previous section. The project was part-funded by Nordic Atlantic Cooperation (NORA) and has been instrumental in initiating a collaborative research relationship across the region. Partners have tested several common barley varieties, carried out a baseline study of the current cereal growing situation in the region and developed guidelines for growers. Within the project, the AI carried out cereal-related activities in both Orkney and Shetland. The work in Shetland was in collaboration with Shetland Livestock Marketing Group and SAC Consulting and was supported by a grant from the Mains of Loirston Charitable Trust.



Harvesting a plot of Bere in the 2015 NORA variety trial.

Researching The Origins Of Bere

This is an initiative which is being developed by the Agronomy Institute in collaboration with the Archaeology Institute at Orkney College and other archaeologists and biomolecular archaeologists at the Universities of Manchester and Sheffield, Bradford, Cambridge and Durham and molecular geneticists at The Hutton Institute. The collaboration is investigating whether grain morphometric and DNA extraction techniques can be used to investigate possible relationships between today’s Bere and dated samples of 6-row hulled barley grains from selected archaeological sites in Scotland. It is hoped that this may provide information about the antiquity of Bere and perhaps indicate the route by which it was introduced to Scotland. So far, a range of grains from archaeological sites has been sourced and morphometric techniques are being assessed at the University of Sheffield.

Supply Chain For Bere Whisky (Bruichladdich Distillery)

For the ninth year, the AI managed a supply chain with local growers which produced about 50 t of Orkney-grown



Bere for Bruichladdich distillery. This is being used to produce a series of high provenance Bere whiskies. *Bere Barley 2008*, the first Bere whisky produced from Bere grown by the Orkney supply chain (during 2007) was released in autumn 2014. The next product, *Bere Barley 2009*, is scheduled for release in 2016.

Supply Chain For An All-Orkney Whisky (Highland Park Distillery)

Since 2009, the AI has been working with Highland Park distillery to help it produce an “all-Orkney” whisky. The project started with a malting barley variety trial run by the AI in 2009 which identified the variety ‘Tartan’ as having a good combination of agronomic and malting characteristics under Orkney conditions. The distillery then asked the AI to develop a local supply chain for growing the variety and since 2010 five local farms have each been growing 2.0-2.5 ha of ‘Tartan’ annually. About 50 t of grain have been delivered to Highland Park each year and this is malted and distilled at the distillery and the spirit put into casks and stored on site. The Orkney supply chain produces the UK’s most northerly modern malting barley and, to meet the challenges that this poses, the distillery funds the AI to carry out research for the supply chain aimed at ensuring high grain quality.



Carl Reavey and Kate Hannett (second and third from the left) from Bruichladdich distillery visiting Thorfinn Craigie (right) and George Stout (left) at the Brig Larder in Kirkwall, one of the first retail outlets in Orkney to stock *Bere Barley 2008*.

6.2 Woody Biomass

Short Rotation Forestry (SRF) Project

Since 2011, the AI has been collaborating with Forestry Commission Scotland (FCS) in a project to investigate the potential of SRF in Orkney. As part of the project, two SRF trials were established in 2013, one at Muddisdale near Kirkwall and the other at Newfield on the island of Shapinsay. Both trials contain the same nine species (sycamore, *Acer pseudoplatanus*; Italian alder, *Alnus cordata*; common alder, *Alnus glutinosa*; downy birch, *Betula pubescens*; beech, *Fagus sylvatica*; aspen, *Populus tremula*; goat willow, *Salix caprea*; mountain ash, *Sorbus aucuparia*; whitebeam, *Sorbus intermedia*) and have a similar experimental design. Monitoring of the trials continued in 2015 in collaboration with FCS and results from the trials are being included with those from others established by the Forestry Commission in Scotland to provide a nation-wide data set and recommendations for growers (<http://scotland.forestry.gov.uk/supporting/strategy-policy-guidance/climate-change-renewable-energy/woodfuel-and-bio-energy/energy-forestry-exemplar-trials>). Although survival at the end of the first year was very good at both sites, by the end of 2015 there had been many more tree deaths at the more exposed site at Newfield. In both trials, common alder, aspen and goat willow are the tallest species while sycamore, mountain ash and beech have made least growth.



Trees of aspen in their third year of growth at the Muddisdale SRF trial (July, 2015). This species has made good growth and shows little branching.

6.3 Plants For Natural Products

Northern Berries For Orkney Wine

Orkney Wine Company (OWC) produces a range of fruit wines and liqueurs using non-grape ingredients. Since 2012 the AI has been helping the company source unusual, locally grown ingredients to produce unique wines with



a high content of local fruit. Several of the species being used have been in Institute research trials since 2004. The collaboration has been assisted by chemical analyses of the fruit species and wines carried out by the James Hutton Institute. During 2015, the Institute helped the company establish its own fruit garden so that it can increase the production of wines made from local fruit. Commercial products which have resulted from this collaboration include the wines *Orkney White* and *Orkney Rosé* and the liqueur *Kvasir*. These products include fruits of cranberry, aronia, elder and salal and flowers of elder, all supplied by the Institute.

7 Staff

The following staff contributed to the work of the AI over the period:

Dr Peter Martin - Director

Mr John Wishart – Field, laboratory and technical support; supply chain management

Mr Billy Scott – Additional support

8 Publications

The following papers and reports were produced over this period by AI staff:

Martin, P. (2016). Report to Highland Park Distillery on the performance of an Orkney supply chain for malting barley in 2015. Orkney College UHI.

Martin, P. (2016). North Atlantic Cereals. *Brewer & Distiller International* 12 (2), 37-39.

Martin, P. (2015). Report to Forestry Commission Scotland on Monitoring of Short Rotation Forestry Trials In Orkney During 2015. Orkney College UHI.

Martin, P. (2015). Developing fruit wines in Orkney from novel, locally grown fruit. *SCRR Newsletter* 83, 3.

Martin, P., Reykdal, O., Halland, H. (2016). Report on the current cereal growing situation in five northern regions and the potential for using local cereals in food and drink products. Project Report. Northern Periphery and Arctic Programme: Northern Cereals – New Markets for a Changing Environment. CAV Diary Number 304-8673-2014.

Martin, P., Wishart, J., McDougall, G. and Brennan, R. (2015). Fruit production and polyphenol content of salal (*Gaultheria shallon* Pursh), a potential new fruit for northern maritime regions. *Fruits* 70, 377-383.

Stokes, V. and Martin, P. (2015). Exploring the potential of short rotation forestry in Scotland. *Forestry & Timber News* June 2015, 16-17.



The liqueur *Kvasir* which was released in 2015 by the Orkney Wine Company and which contains a range of Orkney-grown fruits supplied by the Agronomy Institute.



Harvesting Bere at Orkney College in September 2015



9 Contacts

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