

# AGRONOMY INSTITUTE

- For Northern Temperate Crop Research -

ANNUAL REPORT 2009-2010



*Rosa pimpinellifolia* at Orkney College, 2010

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## 1 Introduction

The Agronomy Institute (AI) is a research centre at Orkney College UHI which is an academic partner in UHI Millennium Institute, the project to bring a university to the Highlands and Islands of Scotland. This annual report covers the period from April 2009 to March 2010. During the year, most of the AI's resources were focused on ongoing research projects investigating the agronomy of sweet gale (*Myrica gale*), the potential for growing crops as a source of pelleted fuel (PELLETime project) and developing Orkney cereals. In addition, a new Northern Periphery Programme (NPP) project (New Plants for Northern Periphery Market) started in July 2009. On the commercial side, substantial quantities of Bere barley continued to be supplied to Bruichladdich distillery for the development of a niche market whisky, and both wheat and oats were grown to provide locally milled flours for bakery companies. Collaboration with Highland Park Distillery has resulted, in 2010, in the development of a supply chain producing Orkney-grown malting barley for the distillery. Over the year, the research programme of the AI was supported by the activities of three postgraduate students conducting research on arnica, willow and Bere. These developments are described in the following sections.

## 2 Background

The AI was opened at Orkney College in June 2002. Its mission statement is "to establish an internationally recognised centre for the research, development and promotion of 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 & Islands, taking into account their potential impact on the environment and biodiversity.
- Collaborating with growers and end-users to develop Best Practice Guidelines and supply chains for crops and plants.





- Stimulating the market for crops and plants by collaborating with end-users to develop new products.

The AI's research programme is 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, the development of collaborative links with other organisations and individuals is very important and over the year the AI actively engaged with the following:

- *Research Organisations and Local Authorities:* Agricultural University of Iceland, Agri-Food and Biosciences Institute, Forestry Commission, Inverness College, MTT Agri-Food Research, National Non-Food Crops Centre, North Karelia University of Applied Sciences, Orkney Island Council, Oulu University of Applied Sciences, Piteå Municipality, Rothamsted Research, Scottish Agricultural College (SAC), Science and Advice for Scottish Agriculture (SASA), Scottish Agricultural Organisation Society Ltd (SAOS), Scottish Crops Research Institute (SCRI), Shetland Island Council, Swedish University of Agricultural Sciences, The Macaulay Institute, University of Aberdeen, University of Kuopio.
- *Commercial Companies and Individuals:* Agros Associates, Alzeim Ltd., Argo's Bakery, Liz Ashworth (Food Product Development Consultant), Bruichladdich Distillery, COPE Ltd, Essentially Scottish Botanicals Ltd, JF Groundwater Baker and Greengrocer, Highland Birchwoods, Highland Park Distillery, Isle of Arran Distillers, Isle of Skye Brewery, Lantmännen SW Seed, Technology Crops International Ltd, Shetland Heat Energy and Power Ltd, The Boots Company Plc, William Shearer.
- *Growers, Growers' Groups and Trusts:* Birsay Trust, Dunlossit Estate, Orkney Bere farmers, Orkney Renewable Energy Forum (OREF), Orkney and Shetland PELLETTime project stakeholder groups, Orkney Great Yellow Bumblebee Group, Shetland Amenity Trust, Willow Energy Group for Orkney (WEGO).

The AI held a well attended open day at the College in July 2009 and during the year received a number of other visitors and groups including international collaborators in the PELLETTime project, Orkney members of NFU Scotland and Scottish branch members of the Institute of Horticulture. In addition, AI staff also made presentations to the Orkney International Science Festival and to members of Scottish Development International.

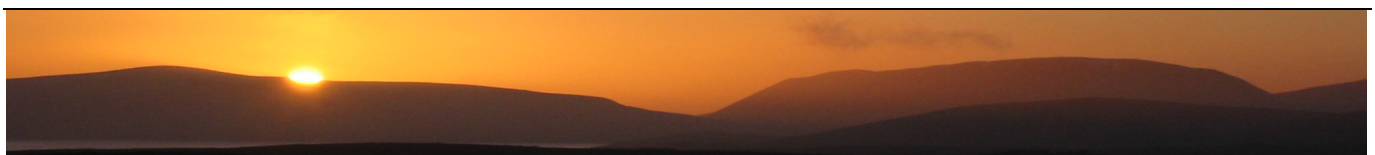
### 4 Impact Of The Agronomy Institute

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

- Growers and stakeholder groups have benefited from the AI's knowledge transfer activities, particularly with cereal and biomass crops. In 2009, and for the third successive year, Orkney growers planted about 20 ha of Bere for a specialist whisky market which the AI has helped to develop. In 2010, the AI has established a new supply chain in Orkney to produce malting barley for Highland Park Distillery. There has also been considerable interest from local farmers in early-maturing Finnish varieties of oats and wheat, which the AI has grown for several years. With funding from the Leader programme, the AI led a group from Orkney and Shetland to Northern Ireland to meet with growers and users of biomass crops.



Orkney and Shetland biomass stakeholders in front of a crop of the grass *Miscanthus* during a study tour to Northern Ireland in 2009.



- Commercial companies, particularly in the Highlands and Islands, are also benefiting as crops are being made available for the development of new products. With Orkney Bere, for example, a supply chain has been established so that grain from this ancient landrace can be used by Bruichladdich Distillery and Valhalla Brewery for the production of niche market whisky and beer. A new collaboration in 2009 with Highland Park Distillery investigated the potential for growing modern malting barley varieties in Orkney while in 2010 a wider range of north European cereals are being trialled in collaboration with the Orkney seed merchant William Shearer and the Swedish company Lantmännen SW Seed. Oats and wheat grown by the AI have been milled in Orkney by Barony Mills and have been used in new commercial products by local bakeries since 2007. Collaborative work on plants for skincare products and research into developing sweet gale (*Myrica gale*) as a plantation crop is also being undertaken with Essentially Scottish Botanicals Ltd and The Boots Company Plc.



A taste of things to come. A sample of Bruichladdich Distillery's 2006 Bere whisky.

- As a research centre within UHI Millennium Institute, it is particularly important that the activities of the AI are spread over the Highlands and Islands. In addition to the AI's strong Orkney links, it is clear from its collaboration with Bruichladdich Distillery (Islay), Valhalla and Isle of Skye breweries, Essentially Scottish Botanicals Ltd (Invernesshire) and from its contribution to sweet gale research (6 trials sites on mainland Scotland) and the PELLETtime project (one trial in Shetland and one in Orkney) that the Institute's activities impact on many parts of the Highlands & Islands.
- The AI makes a valuable contribution to the research capacity of UHI and the Institute was one of eight submissions from UHI to the 2008 Research Assessment Exercise (RAE).
- Through its collaboration in NPP projects (PELLETtime and New Plants for the Northern Periphery Market), the AI is also positioning itself amongst research and development organisations in northern Europe.

## 5 Plant Research Themes And Trials Programme

As a result of reviews of the market for novel crops in the H&I, 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. In the following sections, brief descriptions are given of the main plant research themes and the plants within each theme which were grown at Orkney College during 2009/10.

### 5.1 Northern Cereal Varieties

Under this theme, the Institute is investigating both modern and heritage cereal varieties which are suited to the Highlands and Islands' (H&I) northern environment. They are mainly being considered for bakery and drinks products. Heritage varieties are of particular interest because they are suited to low-input agricultural systems and often have distinctive taste or nutritional characteristics, which may have been lost in modern varieties. However, there are also modern varieties from northern Europe which are well-suited to the H&I and the screening of these expanded in 2010. The main crops under investigation in this theme during 2009 were the following:

#### **Barley (*Hordeum vulgare*)**

Bere is a 6-row barley landrace, the ancestry of which may go back to the 8<sup>th</sup> century or earlier. In recent years, its cultivation on any scale has been restricted to Orkney, although it was much more widely grown in Scotland in the past. Within the UK, Bere is unique in being the only barley grown commercially for milling although in the past it was also commonly used for malting. Bere flour is used traditionally in Orkney for making bannocks and is also





used locally in bread and biscuits. During 2009, as part of Syed Shah's postgraduate studies (see Section 7), formal replicated trials continued to investigate the effects of inputs like fertiliser, growth regulator and fungicide on yield and to compare the growth of Bere with modern varieties. Since 2007, a supply chain has been developed for Bere, making it available for specialist whisky products (see Section 6).

In 2009, five modern malting barley varieties were screened for suitability to Orkney growing conditions and for malt quality and in 2010 six early maturing north European varieties are being compared with Bere and standard UK varieties (see Section 6).

### Wheat (*Triticum spp*)

In the past, wheat has seldom been grown in Orkney, but surveys of food companies within the H&I indicated an interest in obtaining local supplies and since 2007 there have been major increases in the costs of flour and of transporting it to Orkney. The Institute has grown several different varieties of spring wheat (*T. aestivum*) since 2006, but found the Finnish variety 'Anniina' very suitable for Orkney because it has the big advantage of being ready for harvesting about three weeks earlier than UK varieties. Flour from 'Anniina' has been produced by Barony Mills and has been used commercially by local bakery companies since 2007. In 2010, five other north European wheat varieties are being grown for comparison with 'Anniina'. Small quantities of Emmer wheat (*T. dicoccoides*) and Spelt (*T. spelta*) are also being grown as potential crops for specialist food products.

### Oats (*Avena strigosa* and *A. sativa*).

The AI has grown the Finnish oat variety 'Fiia' for several years and although it yields less than UK varieties, it is considerably earlier maturing. Since 2007 the AI has supplied grain of this variety to Barony Mills for the production of oat meal, the quality of which is considered particularly good by local bakers. In 2010, five other north European oat varieties are being grown for comparison with 'Fiia'. A small area of the traditional crop, black oats (*A. strigosa*), is also being grown.

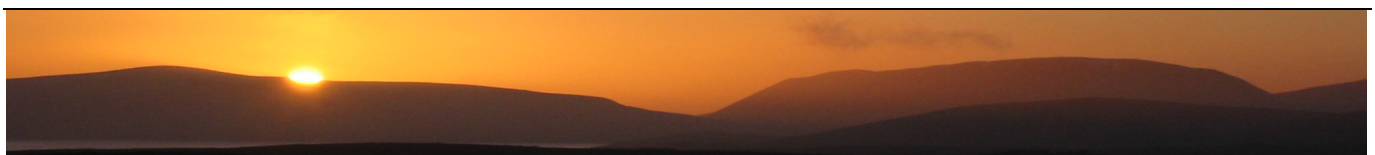
## 5.2 Biomass Crops

There is general acceptance that climate change is a significant environmental threat and is attributable to increasing levels of greenhouse gas emissions resulting from human activities. Most developed countries are now committed to reducing their greenhouse gas emissions, of which CO<sub>2</sub> is one of the most important. This is being done in a number of ways including increasing the use of renewable energy resources (wind, wave, tide, solar, hydro and biomass) for producing electricity and heat and by promoting liquid biofuels (biodiesel and bioethanol) to replace fossil transport fuels. While there is concern about the CO<sub>2</sub> emissions savings of some liquid biofuels and of the effects of taking land out of food production for biofuels, biomass crops like willow, which can be grown on more marginal land, are less controversial and have higher energy ratios than most liquid biofuels. In Orkney, a small potential market for biomass was created in 2003 when Orkney Housing Association Ltd (OHAL) installed a wood-fired boiler, supplying heat to its Lynn Road housing scheme. Orkney Islands Council is currently considering the possibility of installing a biomass boiler at Orkney College.



Arranging willow bundles for drying at Weyland Farm following harvest in February 2010.

As a result of promising results from a small-scale willow (*Salix spp*) trial at Orkney College between 2002 and 2005, the Institute established 2.5 ha of short rotation coppice (SRC) willow at Muddisdale in 2006 and 2 ha at Papdale in 2007. Both areas include clone trials and a total of 13 different clones are being grown. The Institute is promoting its activities with willow through a local stakeholder group, the Willow Energy Group for Orkney (WEGO) which is chaired by Dr Geoff Sellers from the Institute. Since the enterprise margin for willow is very dependent on



yield and wood chip price, the clone trials established by the AI will make an important contribution to improving the viability of biomass willows in Orkney; monitoring of these trials is an important part of a postgraduate research programme undertaken by Fay McKenzie (see Section 7).

In 2008, the Institute was contracted to carry out research for a 3-year Northern Peripheries Programme project (PELLETime, see Section 6) to investigate the potential of a number of crops as a source of material for producing pelleted fuel. Amongst the species under investigation are the biomass crops, willow and reed canary grass (*Phalaris arundinacea*). This research was supplemented by a reed canary grass variety trial in 2009.

### 5.3 Plants For Natural Products

Plants in this theme could have a wide range of end-uses, but those currently being investigated are for the pharmaceutical and cosmetic market.

Research on the medicinal plant arnica (*Arnica montana* and *Arnica chamissonis*) forms the basis of postgraduate studies undertaken by Elizabeth Barron which are described in Section 7.

Collaborative links were developed in 2006 with Alzeim Ltd as a result of which the Institute has planted an observation block and trial of several different *Narcissus* cultivars. These are under investigation as a potential source of the chemical Galanthamine which is used to treat patients suffering from Alzheimer's disease.

Several plants included in this theme are being developed in collaboration with The Boots Company Plc for which the AI maintains an observation block of plants as a potential source of skincare products and runs a major project on sweet gale (*Myrica gale*), the source of a high-value pharmaceutical oil (see Section 6).

### 5.4 Culinary Herbs And Salad Plants

Within the Highlands & Islands, wind and the cool growing season are often major constraints limiting the range of plants which can be grown outside. Protected cropping using polythene tunnels provides a relatively cheap way of dramatically improving the microclimate, allowing the production of a number of high-value crops. Local production also has the advantage of reducing the carbon footprint of these products. Building on research in 2007 into the identification of suitable species and varieties of culinary herbs for local growing, the AI collaborated in 2009 with Liz Ashworth, a food consultant, who used these for new product development in collaboration with local companies.

### 5.5 Northern Berry Crops

These make an important contribution to the rural economy of other countries at a similar latitude (e.g. Scandinavia and North America) and are therefore thought to have considerable potential for the H&I area. They are an attractive option because they can be used in a number of ways to produce a range of added value products (e.g. jams and drinks). There are very well-documented health benefits from eating fruits and berries and this has resulted in the recent promotion of their role in a healthy diet. A number of these crops have also attracted attention as sources of high-value extracts for the nutraceuticals / health food supplements sector.

In 2009, monitoring of existing plots continued (cranberry, *Vaccinium macrocarpon*; juneberry, *Amelanchier canadensis*; sea buckthorn, *Hippophae rhamnoides*; black chokeberry, *Aronia melanocarpa*; all-fieldberry, *Rubus arcticus* Ssp. x *stellarcticus*; blueberries - high bush (*Vaccinium corymbosum*), low bush (*V. angustifolium*, *V. pensylvanicum*) and half-high hybrids; elder (*Sambucus nigra* and *S. racemosa*).



Black chokeberry. One of the northern berry species which produces a good crop of berries under Orkney conditions.





## 6 Funded Projects And Commercial Activities

Since the Institute receives no core funding, income from research projects and commercial activities is vital for ensuring the sustainability of the AI. During the year, staff were involved in the following projects and commercial activities:

### 6.1 Cereals

#### ***Development Of A Supply Chain For Bere Whisky***

In both 2009 and 2010, as a continuation of a Hi Links feasibility study with Bruichladdich distillery on Islay, the AI and a group of Orkney growers continued to grow and supply Bere to the distillery for specialist whisky production.

#### ***Screening Modern Malting Barley Varieties For Orkney***

In a collaborative project with Highland Park Distillery funded by HI Links, the AI tested five modern varieties of malting barley in Orkney during 2010. The aim of the research was to find an early maturing variety which grew well under Orkney conditions but which also produced a high quality malt. As a result of the trial and micromalting analyses, the variety 'Tartan' was selected as being the most suitable and in 2010 this is being grown by the AI and four local growers to supply to the distillery. The supply chain is being organised by the AI and receives assistance from the Scottish Agricultural Organisation Society Ltd (SAOS).

#### ***Study Of The Market For Orkney Flours***

Orkney's Barony Mill has traditionally produced Bere meal but recently, in collaboration with the AI, it has started to produce oatmeal and wheat flour from locally grown cereals. With funding from the Scottish Executive's Food Processing And Marketing Co-operation Grant Scheme, the AI carried out a study of the market for locally produced flours for the Mill. The study indicated the significant contribution these flours make to the local economy and it was estimated that in 2009 they were used by local bakeries to produce added value products worth about £100,000. A number of constraints were also identified in using local flours, however, and a follow-on project is being developed to address these issues.

#### ***Identification Of North European Cereal Varieties For The North Of Scotland***

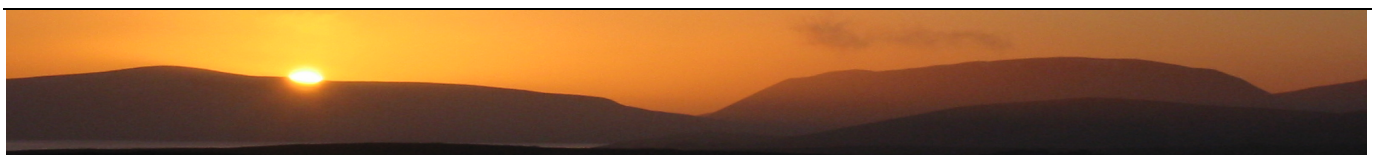
In collaboration with the Orkney seed merchant William Shearer and the Swedish seed company Lantmännen SW Seed, the AI is testing a range of north European varieties of wheat, barley and oats in Orkney in 2010 in comparison with standard UK varieties. The aim is to identify early maturing varieties which are well-suited to the north of Scotland and to obtain sufficient grain to allow the quality of the different varieties to be compared for a range of end-uses.



Harvesting an undersown crop of Bere for Bruichladdich distillery at Magnus Spence's field in Burray.



Orkney's Barony Mill. Recent collaboration between the mill and the Institute has resulted in the production of wheat flour and oatmeal from local cereals, in addition to the traditional Bere meal.





## 6.2 Biomass

### PELLETime Project

There has been considerable expansion in the market for pelleted wood fuel in the UK over the last few years because it is a clean, convenient, renewable fuel for small scale users. However, increased demand for pulverised wood fuel, particularly for co-firing in power stations, can sometimes result in shortages of raw materials for pellet production and there is a need to explore the possibility of obtaining the raw material for pellets from a range of sources, including agricultural crops. In peripheral locations, like Orkney, where the costs of importing pellets are high, there could be major sustainability advantages in encouraging the development of local, small scale pelleting using a mixture of raw materials.



Sheaves of reed canary grass drying at Weyland farm in 2009 prior to sending samples to Sweden for pelleting trials.

The PELLETime project ([www.pelletime.fi](http://www.pelletime.fi)) is a three-year Northern Periphery Programme (NPP) project involving Scotland, Finland, Sweden and Iceland which aims to address shortfalls in pellet production by expanding the raw material supply and increasing productive capacity by encouraging SME participation in this market. The AI has been involved in the project since May 2008 and is conducting growing trials in both Orkney and Shetland investigating the potential of several on-farm sources of biomass for producing pelleted fuel. These include reed canary grass (*Phalaris arundinaceae*), a forage grass mix (60% perennial ryegrass (*Lolium perenne*) and 40% timothy (*Phleum pratense*)), barley (as a source of straw) and willow. The programme also includes a wide range of related topics including an environmental impact assessment of the crops, economic analysis of them, knowledge transfer activities and small scale pelleting trials. In 2009, two very successful PELLETime Biomass for Energy Symposia were held in Orkney and Shetland and the research trials component was expanded to include a comparison of 4 different reed canary grass (RCG) varieties ('Aquatika', 'Bamse', 'Palaton' and 'Chieftain') and a commercially available RCG mixture.

### Biomass Stakeholder Study Tour To Northern Ireland

Although there is considerable interest in the potential of growing biomass crops for heat in the northern isles, few people in these islands have had an opportunity to see examples of such projects. In the UK, some of the most successful have been implemented in Northern Ireland and in order to promote biomass further, the AI organised a study tour to Northern Ireland for key Northern Isles stakeholders. The visit was funded jointly by the Leader programme, Community Energy Scotland and UHI. The tour included visits to willow and renewable energy research centres (Northern Ireland Horticulture and Plant Breeding Institute (Loughall); College of Agriculture, Food and Rural Enterprise; Agri-Food and Biosciences Institute) and to commercial users of biomass (Cookstown Leisure Centre; Rural Generation Ltd; BALCAS). As a result of the visit, stakeholders gained a detailed insight into



Northern Ireland Horticulture and Plant Breeding Institute (Loughall). This was visited by the biomass study tour to Northern Ireland and the photograph shows plots of energy grasses (foreground) and willow (centre)





the whole supply chain and into important related economic issues. A comprehensive report has been produced on the visit (see section 9), including a summary of the most important lessons learned.

### 6.3 Natural Products

#### **Sweet Gale Research Project**

This project started in December 2007 and is funded jointly by the AI, The Boots Company Plc, Essentially Scottish Botanicals Ltd and HIE. Sweet gale, or bog myrtle (*Myrica gale*), is a shrub which is native to the UK and is particularly common in high rainfall areas like north-west and north Scotland where it can be found from sea-level up to about 500 m. It has a tradition of use in many countries but has recently attracted attention as the source of an oil (obtained from the leaves) which is being used for cosmetic products by Boots. Currently, sweet gale oil is obtained by harvesting leaf from wild stands, but to increase production to meet growing demand for the oil, interest is focusing on developing sweet gale as a planted crop. Since very little is known about the growth of sweet gale under cultivated conditions, this project has been developed to investigate the crop and develop recommendations for growing it.



Two-year-old sweet gale plants growing in an AI trial at SAC Craibstone, Aberdeen.

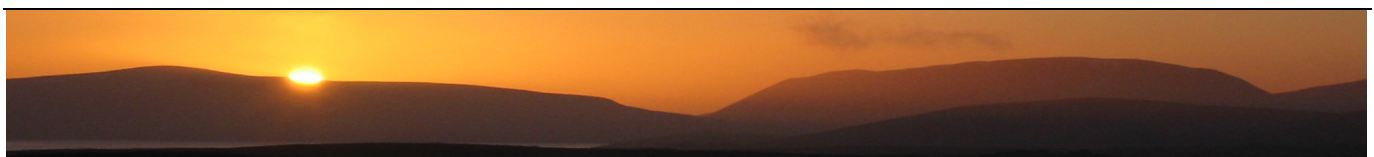
As a first step in providing information about the growth and oil yield from newly planted sweet gale, trials containing about 1,000 plants were established at seven different locations in the Highlands during 2008. These are being monitored over the 3 years of the project to provide basic information on site-to-site variation in growth, leaf yield and leaf oil content. Soil and weather data are also being collected from these sites to see whether plant growth and leaf and oil production can be related to these environmental factors.

Other topics being investigated within the project include the use of different types of planting material, management of plants in their early years, the use of fertiliser, the development of weed control strategies and the incidence of pests and diseases.

### 6.4 Biodiversity

#### **Great Yellow Bumblebee Project**

Historically, the Great Yellow Bumblebee (GYB, *Bombus distinguendus*) occurred all over Britain but is now mostly restricted to Orkney, and a few other sites in north Scotland and the Western Isles. The decline in the bee's range is blamed mainly on loss of habitat as meadowland rich in wildflowers was brought into intensive farming during the 20<sup>th</sup> Century. Its survival in the north of Scotland is associated with the presence of floristically rich "machair" grassland. In Orkney, a GYB Group which includes representatives from the Royal Society for the Protection of Birds (RSPB), Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH) and Orkney Islands Council (OIC), has been set up to help conserve the GYB. A major element of this strategy involves the establishment of seed multiplication plots of wild flower food-plants of the GYB to allow the distribution of seed to help maintain flower-rich grasslands for the GYB. Within this project, the AI is establishing plots of several species (especially red clover, *Trifolium pratense*; meadow vetchling, *Lathyrus pratensis*; bush vetch (*Vicia sepum*); tufted vetch (*V. cracca*) and birds foot trefoil, *Lotus corniculatus*) for seed multiplication.





## 6.5 Amenity Horticulture

### ***New Plants For The Northern Periphery (NPNP)***

This project is funded by the Northern Peripheries Programme and includes partners in Sweden, Finland and Iceland as well as the AI. The aim of the project is to develop new business opportunities within the region's horticultural sector by identifying and promoting new hardy ornamental plants for public spaces and private gardens. Within the project, each partner has selected a number of hardy ornamental plants which grow well in their own region. Based on a questionnaire sent out to stakeholders and discussions with specialists, each partner has selected a number of plants for testing from the other partners. These plants will be established in demonstration areas / gardens in all the partner countries where they will be shown to the public through open events. Links with the commercial sector, which will be built up during the project, will then be used to market the best of these plants. Plants being grown by the AI will be tested in Shetland as well as in Orkney.



Black chokeberry. In addition to producing berries (see p. 6), the plant also has spectacular red autumn foliage.

## 7 Postgraduate Research And Training Programmes

As a research centre within UHI Millennium Institute, hosting postgraduates is an important part of the AI's work and, at the same time, postgraduates make a valuable contribution to the AI research output. The AI also provides traineeship placements for students who gain important work experience through helping with the AI research programme.

Since 2004, the Institute has been involved in supervising and supporting the field work on arnica of Elizabeth Barron, a part-time PhD student. In 2007, two full-time postgraduate students (Fay McKenzie and Syed Shah) started studentships with the AI. Progress over the year with these postgraduate projects is described briefly below.

*Quantitative analysis of active compounds found in Arnica in relation to varied environmental, agronomic and genetic factors (Elizabeth Barron).* Liz's research focuses on the plants *Arnica montana* and *A. chamissonis*, the main sources of the herbal medicine, Arnica. The increasing popularity of this medicine has led to over-harvesting of *Arnica montana* in the wild so that it has become an endangered species in many parts of Europe. As a result, there is considerable interest in growing *A. montana* and the closely related *A. chamissonis* under cultivation. Liz's research has shown that, in Orkney, *A. montana* is very prone to a fungal crown rot disease associated with *Phytophthora* and *Pythium spp* but this does not infect *A. chamissonis* which also seems to be agronomically better suited to Orkney conditions. Liz completed her field trials programme in 2007 and since then has concentrated on the chemical analysis of flower extracts from these trials and writing her thesis.

*Investigating the potential of willow short rotation coppice as a biomass crop for the Northern Isles of Scotland (Fay McKenzie).* Fay's research has covered a wide range of topics but it initially focused on collecting baseline survival and yield data from willow clone trials established in previous years at Orkney College, Muddisdale and Papdale. She has also established trials investigating the need for first year cutting back and comparing the biomass production of four different clones (Ashton Stott, Sven, Tora and Resolution) under different fertiliser regimes – none, mineral fertiliser and slurry.



Amélie Viard helping with a botanical survey in one of Fay McKenzie's willow trials.





*The effects of soil types and agricultural inputs on yield, grain quality and economic returns of Bere barley in Orkney (Syed Shah).* Syed's research programme is investigating the effects of selected agricultural inputs (fertiliser, growth regulator and fungicide) on growth, yield and grain quality of Bere in comparison with a modern malting barley variety, 'Optic'. He is also studying the effects of different types of growth regulator, and the stage at which they are applied, on the lodging and yield of Bere.

During the year the AI provided a traineeship placement to Amélie Viard from Agrocampus Ouest in Rennes and work experience for Kirstin Wishart from Kirkwall Grammar School. Amélie and Kirstin both made valuable contributions to the Institute research programme.

## 8 Staff

The following staff worked at the AI over the year:

Dr Xianmin Chang - Researcher  
 Dr Peter Martin - Director  
 Mr Billy Scott - Field Trials Officer  
 Dr Geoffrey Sellers - Research Fellow  
 Mr John Wishart - Technician.

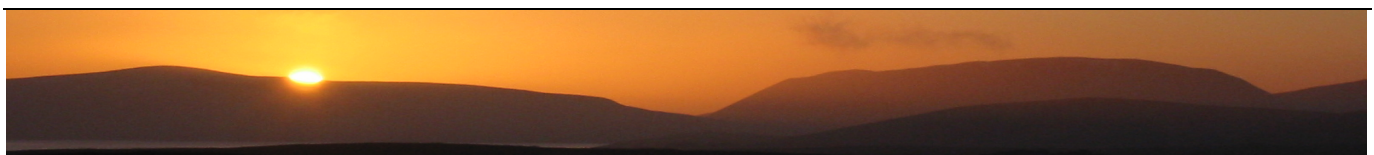


Agronomy Institute staff and students in 2009. From left to right, Xianmin Chang, Peter Martin, Geoff Sellers, Billy Scott, Fay McKenzie, Syed Shah and John Wishart.

## 9 Publications

The following papers and reports were produced over the year by AI staff and students:

- Chang, X., Alderson, P.G. and Wright, C.J. (2009).** Variation in the essential oils in different leaves of basil (*Ocimum basilicum* L.) at day time. *The Open Horticulture Journal* **2**, 13-16.
- Chang, X., Alderson, P.G. and Wright, C.J. (2009).** Enhanced UV-B radiation alters basil (*Ocimum basilicum* L.) growth and stimulates the synthesis of volatile oils. *Journal of Horticulture and Forestry* **1**, 027-031.
- Doick, K.J., Sellers, G., Castan-Broto, V. and Silverthorne T. (2009).** Understanding success in the context of brownfield greening projects: The requirement for outcome evaluation in urban greenspace success assessment. *Urban Forestry and Urban Greening*, **8**, 163-178
- Martin, P. (2010).** Report to Birsay Heritage Trust on a study of the actual and potential market for stone-ground flours from locally grown cereals in Orkney.
- Martin, P. and Chang, X (2009).** Summary of results from Agronomy Institute research on sweet gale in 2009.
- Martin, P. and Chang, X (2009).** Final report to Highland Park Distillery on results from a malting barley variety trial in 2009.
- Martin, P. and Chang, X. (2010).** Developing sweet gale (*Myrica gale*) as a new crop for the cosmetic industry. Aspects of Applied Biology 101, Non Food Uses of Crops, pp. 115-122.
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## 10 Posters Presented By Staff And Students

### POTENTIAL BIOMASS ENERGY CROPS IN ORKNEY AND SHETLAND

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**Location in Europe**  
 Orkney is an archipelago of 80 islands, located off the north coast of Scotland. At 59° north, the islands are at the same latitude as southern Norway. Orkney has a cool climate with a rich resource of agricultural land and fertile soils.

To the north of Orkney, at 60° north the Shetland Islands have a slightly cooler climate, with less agricultural land and thinner peaty soils.



**Biomass in the Orkney and Shetland environment**  
 Due to their location, these islands are frequently exposed to adverse weather conditions, such as frequent gale force, salt laden winds. The factors which may also influence biomass growth in such environments are:

- Short, cool growing season
- Low spring temperatures
- High annual rainfall
- Waterlogged soils



**Short Rotation Coppice (SRC) Willow trials in Orkney**  
 SRC Willow energy clones are fast growing hybrid varieties of willow, which can be planted at high densities and harvested in short rotations, every 2-4 years. The crop has a commercial lifespan of 20-25 years.

Willow is a native tree in Orkney and Shetland which grows particularly well in the local environment; although currently there are only SRC willow trials established in Orkney.

The initial Agronomy Institute SRC willow trials programme began in 2002 to assess performance of 4 willow clones in the local environment. The initial results reported were very encouraging, leading to the willow trials being extended in 2006 and 2007.

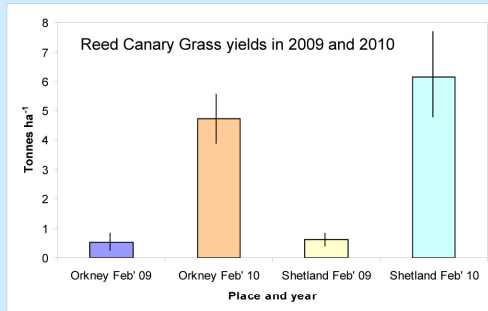
There are now 13 willow clones being investigated at two further sites in Orkney. The first harvest results from the largest trial were obtained in early 2010.

**Reed Canary Grass**  
 This perennial grass grows naturally in Orkney in wetter areas. It can grow up to 2 m high and has a high straw yield

As a crop Reed Canary Grass lasts for 10 years with commercial cutting beginning 2 years after sowing.

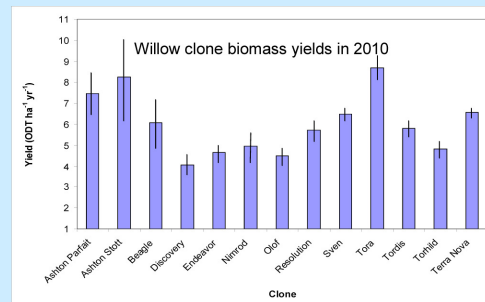
Trials investigating its potential as a biomass straw crop for energy were planted in spring 2008 at the Agronomy Institute in Orkney and at Sandwick in Shetland.

A commercial variety trial began in 2009 to investigate which varieties are most suited to commercial production under Orkney conditions.



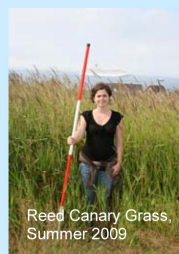
**SRC Willow results**

- First rotation yields for the 13 clones average between 4-8 ODT (Oven Dried Tonnes) ha<sup>-1</sup> Yr<sup>-1</sup>
- Ongoing monitoring of clones at all Orkney sites are showing similar trends



**Reed Canary Grass results**

- Yields have been promising at around 5 tonnes / ha in 2010
- Yields were significantly greater in Shetland than in Orkney in 2010



**The potential for Willow and Reed Canary Grass in Orkney**  
 Despite the challenges, Willow SRC and Reed Canary grass have the potential to provide Orkney and Shetland with reliable, renewable heating fuel. Development of these crops for biomass energy production may assist agricultural diversification, rural employment and the potential to increase farmland biodiversity.





## 11 Contacts

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