

# AGRONOMY INSTITUTE

- For Northern Temperate Crop Research -

ANNUAL REPORT 2008-2009



Harvesting Bere barley at Weyland Farm, Orkney

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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 Millenium Institute, the project to bring a university to the Highlands and Islands of Scotland. This annual report covers the period from April 2008 to March 2009. The year saw the continuation of considerable investment into the AI in the form of staff and equipment through UHI from the ARC (Addressing Research Capacity in the Highlands and Islands) project. During the year, most of the AI's resources were focused on delivering research projects investigating the agronomy of sweet gale (*Myrica gale*) and the potential for growing crops as a source of pelleted fuel (PELLETime project). 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 wheat and oats were grown to provide locally milled flours for bakery companies. 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. All 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 being 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:* Central Science Laboratory (CSL), Forestry Commission, Inverness College, MTT Agri-Food Research, National Non-Food Crops Centre, North Karelia University of Applied Sciences, Oulu University of Applied Sciences, Rothamsted Research, Scottish Agricultural College (SAC), Science and Advice for Scottish Agriculture (SASA), Scottish Crops Research Institute (SCRI), Scottish Natural Heritage (SNH), Swedish University of Agricultural Sciences, The Macaulay Institute, University of Aberdeen, University of Kuopio.
- *Commercial Companies and Individuals:* Alzeim Ltd., Argo's Bakery, Liz Ashworth (Food Product Development Consultant), Bruichladdich Distillery, Essentially Scottish Botanicals Ltd, JF Groundwater Baker and Greengrocer, Highland Birchwoods, Highland Park Distillery, Isle of Arran Distillers, The Boots Company Plc, Valhalla Brewery.
- *Growers, Growers' Groups and Trusts:* Birsay Trust, Dunlossit Estate, Orkney Bere farmers, Orkney Renewable Energy Forum (OREF), Orkney and Shetland PELLETime project stakeholder groups, Orkney Great Yellow Bumblebee Group, Willow Energy Group for Orkney (WEGO).

The AI held a well attended open day at the College in July 2008 and during the year was visited by a number of other visitors and groups including international collaborators in the PELLETime project in 2009.

In addition, AI staff also presented posters or papers at the Association of Applied Biologists conferences on Plant Genetic Resources for Food & Agriculture and Biomass and Energy Crops III and made presentations to the 2008 Orkney International Science Festival and the 2008 UHI Business Engagement Forum.

### 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 knowledge transfer (KT) activities of AI staff, particularly with cereal and biomass crops. In 2009, and for the third successive year, over 30 ha of Bere are being grown on Islay and Orkney for a specialist whisky market which the AI has helped to develop. 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. Within the PELLETime project, KT activities have included a study trip to Austria and Germany and Symposia which were held in both Orkney and Shetland.
- Commercial companies, particularly in the Highlands and Islands, are also benefiting as crops are being made available for the development of new products. With Bere, for example, supply chains have been established so that Bruichladdich Distillery can produce a specialist Bere whisky and Valhalla Brewery can



PELLETime project stakeholders from Scotland visiting the boiler manufacturer Windhager GmbH as part of a project study tour. The picture also shows some of the small household pellet boilers produced by the company.



produce a Bere beer. 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. In Orkney, oats and wheat grown by the AI have been milled by Barony Mills and have been used in new commercial products by local bakery companies since 2007. A new collaboration in 2009 with Highland Park Distillery is investigating the potential for growing modern malting barley varieties in Orkney.

- As a research centre within UHI Millenium 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 Brewery (Shetland), Essentially Scottish Botanicals Ltd (Invernesshire), Dunlossit Estates (Islay) 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 produced one of eight submissions from UHI to the 2008 Research Assessment Exercise (RAE). This was a milestone for the AI, as it was the Institute's first submission to the RAE and it was a significant achievement to have some of its work classified as 3\* ("internationally excellent"). Through its collaboration in the PELLETTime project, the AI is also establishing itself amongst research and development organisations in northern Europe.



Duncan McGillivray, Bruichladdich distillery manager, inspecting 2008 new-make Bere spirit. The supply chain for Bere was developed by the AI.

## 5 ARC and SRIF Funding Support For The Agronomy Institute

ARC (Addressing Research Capacity in the Highlands and Islands) and SRIF (Science Research Infrastructure Fund) funding to the AI through UHI Millenium Institute has contributed significantly to strengthening the AI since 2006. SRIF funding ended in 2007 and ARC funding will end in 2009. The two programmes have been used to provide the AI with a plant materials store, laboratory and office space and to purchase machinery and equipment. ARC funds also supported two research posts, one technical position and two postgraduate studentships.

## 6 Plant Research Themes And Trials Programme

As a result of reviews of the market for novel crops in the H&I, the AI identified several research themes on which it has concentrated. Within each theme, a number of potential crops have been tested on a small scale in observation blocks. Subsequently, 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 2008/9.

### 6.1 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). They are mainly being considered for bakery and drinks products. Local 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 which are well-suited to the H&I and a few of these are also being grown. The main crops under investigation in this theme during 2008 were the following:

**Bere 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 2008, as part of a PhD research programme (see Section 8), 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 to the niche whisky market (see Section 7).

**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 has identified the Finnish variety 'Anniina' as the most suited to 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. Small quantities of Emmer wheat (*T. dicoccoides*), Spelt (*T. spelta*) and Einkorn (*T. monococcum*) 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. Although it yields less than UK varieties, it is several weeks 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. A small area of the traditional crop, black oats (*A. strigosa*), is also grown.

**6.2 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 2008, 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 *stellarticus*; blueberries - high bush (*Vaccinium corymbosum*), low bush (*V. angustifolium*, *V. pensylvanicum*) and half-high hybrids; elder (*Sambucus nigra* and *S. racemosa*).

**6.3 Biomass Crops**

There is general acceptance that climate change is real, accelerating and that it is attributable to increasing levels of greenhouse gas emissions as a result of human activities. Most developed countries, including the UK, 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 biofuels and of the effects of taking land out of food production for biofuels, biomass crops like willow, which would be grown on more marginal land, are less controversial and have higher energy ratios than most liquid biofuels. In Orkney, there has



been a small potential market for biomass since 2003 when Orkney Housing Association Ltd (OHAL) installed a wood-fired boiler, supplying heat to its Lynn Road housing scheme.

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 identifying the viability of biomass willows in Orkney; monitoring of these trials is included in a postgraduate programme (see Section 8).



Chipping willow stems which have been dried in stacks outside to provide samples for analysis within the PELLETime project.

In 2008, the Institute was contracted to carry out research for a 3-year Northern Peripheries Programme project (PELLETime, see Section 7) 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.

#### 6.4 Plants For Extracts And Flavourings

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 a PhD which is being undertaken by Elizabeth Barron and is described in Section 8.

Collaborative links were developed in 2006 with Alzeim Ltd as a result of which the Institute has planted an observation block and trial containing 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 7).



Daffodils. A range of different varieties of daffodil are being grown by the Institute in collaboration with Alzeim Ltd to investigate their potential as a source of Galanthamine which is used to treat Alzheimer's disease.



## 6.5 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 2008 with Liz Ashworth, a food consultant, who used these for new product development.

## 7 Funded Projects And Commercial Activities

Since the Institute receives no core funding, funded projects and commercial activities are vital for providing sources of income. During the year, staff were involved in the following projects and commercial activities:

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

In 2008, as a continuation of a Hi Links feasibility study, the AI, Dunlossit Estate on Islay and growers on Orkney continued to collaborate to produce Bere for Bruichladdich distillery on Islay. The distillery is using the Bere to develop a specialist whisky and received over 60 t of grain from growers in 2008.



Sydney Gauld (right) in his field of Bere. Sydney is one of several Orkney farmers growing Bere for Bruichladdich distillery.

### **Orkney Flours**



A very successful HiLinks project which was completed in 2008 showed the potential for Orkney food companies to use wheat, oat and Bere flours produced locally from crops grown in Orkney to develop specialist bakery products. A range of these products was also very popular at a tasting session during an Orkney cereals event at the 2008 Orkney International Science Festival. Since then, commercial collaboration between the AI, Barony Mills and Orkney bakery companies has continued and local flours continue to be used in several local bakery products.

A range of biscuits (left) developed by JF Groundwater and the food consultant Liz Ashworth, using wheat, oat and Bere flour produced by Barony Mills from locally grown crops.

### **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 recently, the plant has attracted attention as the source of an oil (obtained from the leaves) which is being used for cosmetic products by Boots. Currently, most 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.

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 will be 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 will also be collected from these sites to see whether plant growth and leaf and oil production can be related to these environmental factors.

Agronomy Institute sweet gale trial at Blair Atholl investigating different weed control treatments.

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.

### **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.



The PELLETime project 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 November 2008, stakeholders from both Orkney and Shetland participated in a study tour to Germany and Austria which included visits to pelleting plants, boiler manufacturers and growers of biomass. In 2009, two very successful PELLETime Biomass for Energy Symposia were held in



PELLETime trial in Orkney in 2009 (top). Reed canary grass growing at Orkney College (bottom).



Orkney and Shetland in April and the research trials component was expanded to include a comparison of 4 different reed canary grass (RCG) varieties ('Aquatika', 'Banse', 'Palaton' and 'Chieftain') and a commercially available RCG mixture.

### **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* and birds foot trefoil, *Lotus corniculatus*) for seed multiplication.

## **8 Postgraduate Research**

As a developing research centre within UHI Millenium 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. 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 2006/7, the Institute hosted and provided supervisory support to Burkart Dieterich who undertook an MSc by research on biomass willows. In 2007, two full-time postgraduate students (Fay McKenzie and Syed Shah) started studentships with the AI. Progress over the year with the current 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 covers 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. In 2008, she also established a trial at Papdale investigating the need for first year cutting back and used harvested stems from the college trial to investigate outside drying of willow rods. At Muddisdale, she started a new trial on two-year-old stools to compare the biomass production of four different clones (Ashton Stott, Sven, Tora and Resolution) under different fertiliser regimes – none, mineral fertiliser and slurry.



*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.

## 9 Staff

The following staff worked at the AI over the year:

Dr Xianmin Chang - Post Doctoral Research Assistant  
 Mr Arthur Cromarty - Field Trials Officer (until November 2008)  
 Mr Billy Scott - Field Trials Officer (from November 2008)  
 Mr Ronnie Johnson - Development Officer (until November 2008)  
 Dr Peter Martin - Director  
 Dr Geoffrey Sellers - Research Fellow  
 Mr John Wishart - Technician.

Agronomy Institute postgraduate students. Fay McKenzie (top) measuring willow plants in their first season after cutback at Papdale. Syed Shah (bottom), measuring stem angles of Bere for research into lodging.



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.

## 10 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. (2008).** Solar irradiance levels alters the growth of basil (*Ocimum basilicum* L.) and its content of volatile oils. *Environmental and Experimental Botany* **63**, 216-223.
- 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.
- Dieterich, B. and Martin, P. (2008).** Influence of planting depth and orientation on sprouting of willow cuttings. *Aspects of Applied Biology, Biomass and Energy Crops III*, 233-238.
- Martin, P., Constanduros, R. and Galley, E. (2008).** Final report to HI Links on a feasibility study investigating the potential of selected Scottish plants as a source of chemical compounds for skincare products. Commissioned Report.
- Martin, P., Chang, X., Reynier, M. and Randall, M. (2008).** Final report to HI Links on a feasibility project to investigate the development of a supply chain for Bere to produce niche market Bere whisky at Bruichladdich distillery. Commissioned Report.
- Martin, P., Chang, X., Ashworth, L. and Groundwater, P. (2008).** Final report to HI Links on a feasibility study investigating the potential of producing specialist biscuits from locally grown and processed grains in Orkney. Commissioned Report.
- Martin, P., Wishart, J., Cromarty, A. and Chang, X. (2008).** Orkney Bere – developing new markets for an old crop. In *International Symposium on New Crops and Uses: Their role in a rapidly changing world*. (Eds J. Smartt and N Haq) Centre for Underutilised Crops, University of Southampton. Success, Failures And Lessons Learned – Food And Nutritional Crops: Case Studies, 359-372.
- McKenzie, F., Sellers, G. and Martin, P. (2008).** Willow (*Salix viminalis*) short rotation coppice (SRC) as a potential biomass energy crop in Orkney. *Aspects of Applied Biology, Biomass and Energy Crops III*, 35-40.



- McKenzie, F., Sellers, G. and Martin, P. (2008).** Short rotation willow (*Salix viminalis*) coppice as a potential biomass energy crop in Orkney. *Aspects of Applied Biology, Biomass and Energy Crops III*, 61-66.
- Sellers, G. (2009).** Annual PELLETime report for the Orkney and Shetland crop trials. PELLETime Project Commissioned Report ( [http://www.pelletime.fi/publications/study\\_reports.htm](http://www.pelletime.fi/publications/study_reports.htm) ).
- Sellers, G. and Martin, P. (2008).** Farm based study investigating the effects of alternative crops on biodiversity in Orkney. SNH Commissioned Report (ROAME No. F05LA11).
- Sellers, G and Wishart, J. (2008).** Short report on the Pelletime study tour of Germany and Austria: 10<sup>th</sup>-14<sup>th</sup> November. (<http://www.agronomy.uhi.ac.uk/html/reports.htm>)



## SHORT ROTATION WILLOW COPPICE AS A POTENTIAL BIOMASS ENERGY CROP IN ORKNEY.

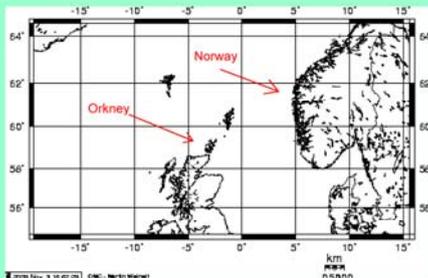
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Location of Orkney in UK

### Orkney's Location

Orkney is an archipelago of about 80 islands located off the north coast of Scotland. At 59° North, the islands are at the same latitude as southern Norway. Domestic heating is mostly dependant on fossil fuel imported to the islands. Homes in Orkney need to be heated for longer than elsewhere in the UK due to the climatic conditions and wind chill factor. Orkney is largely treeless and has no forest resource to exploit for biomass fuel supply. Any potential biomass fuel for heat in Orkney must be grown on the islands, or brought to Orkney by sea.

### The Orkney environment

Orkney has productive soils and a climate which is characterised as 'hyper-oceanic'. The Orkney landscape very low lying and open due to the prevailing environmental conditions, particularly frequent strong to gale force salt laden winds. In spite of these conditions, willows are common native trees in Orkney, other factors limiting tree growth are:

- Low spring temperatures
- High annual rainfall (900-1000 mm)
- Waterlogged soils
- Short cool growing season



Lapwing in traditional Orkney meadow

### Orkney's Natural Heritage

Orkney has a rich resource of agricultural land set amongst a mosaic of habitats that have been designated locally, nationally and internationally for their valuable environmental and archaeology interests.

The climate and current agricultural farming systems, dominated by livestock grazing, are important in maintaining the unique habitats and species within the landscape. Any change in agricultural practice such as growing specialist biomass crops must be evaluated to establish their effects on the environment.

### SRC and the environment

SRC willow could provide a woody farmland crop complementing the open pastoral environment of Orkney's traditional arable and livestock systems. SRC can provide shelter and food sources for birds, mammals and invertebrates and have enhanced ground flora, with the potential to increase local biodiversity.



SRC and Common Rampion  
Fumaria muralis ssp.

### Willow SRC in Scotland

SRC is successfully grown in areas of central Scotland. However, little is known about the suitability of biomass energy clones for growth in the climatic conditions of the north of Scotland.



Muddisdale Short Rotation Willow Plantation (highlighted inside the white oval), looking North eastwards towards Kirkwall Bay

### SRC in Orkney 2002 - 2008

In 2002, four Willow clones and one Poplar clone were selected by the Agronomy Institute, for a field trial programme on Orkney. Initial results in 2005 suggested willow could be a viable biomass crop in Orkney, but poplar was unsuitable. In 2006, the trials programme was expanded from one to three sites in Orkney, 6.5 ha in total, cultivating a selection of thirteen clones.

- Swedish clones (5): Olof, Tora, Torhild, Tordis and Sven
- UK clones (8): Ashton Stott, Ashton Parfitt, Beagle, Discovery, Endeavour, Nimrod, Resolution and Terra Nova.

### PhD programme

In 2007 a PhD research programme began, focusing on the agronomy of SRC, an assessment of effects on local biodiversity and the potential to develop a biomass market in Orkney. Initial investigations include:

- Assessment of planting density and success of 2-row step planter
- Investigation into the need for an initial cut back
- Outdoor drying of stacks of 3 year old whole rods
- Investigation into the effect of 3 different fertiliser treatments on 4 biomass clones
- Assessment of pests and diseases affecting the clones in Orkney
- Assessment of local biodiversity associated with SRC In Orkney



Planting using a 2-row step-planter  
J. Turton Engineering Ltd. April 2007



Three year old SRC willow in Orkney,  
September 2007.

### Conclusions

Despite the climatic challenges facing SRC in Orkney, it may have the potential to provide the region with a sustainable biomass fuel, assist agricultural diversification and potentially benefit local biodiversity. A holistic and comprehensive strategy for growing and utilising willow SRC as a renewable energy fuel for heat in Orkney is needed. The research being undertaken by this PhD project will make an important contribution to this.

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