AGRONOMY INSTITUTE

- For Northern Temperate Crop Research -

ANNUAL REPORT

2004-2005

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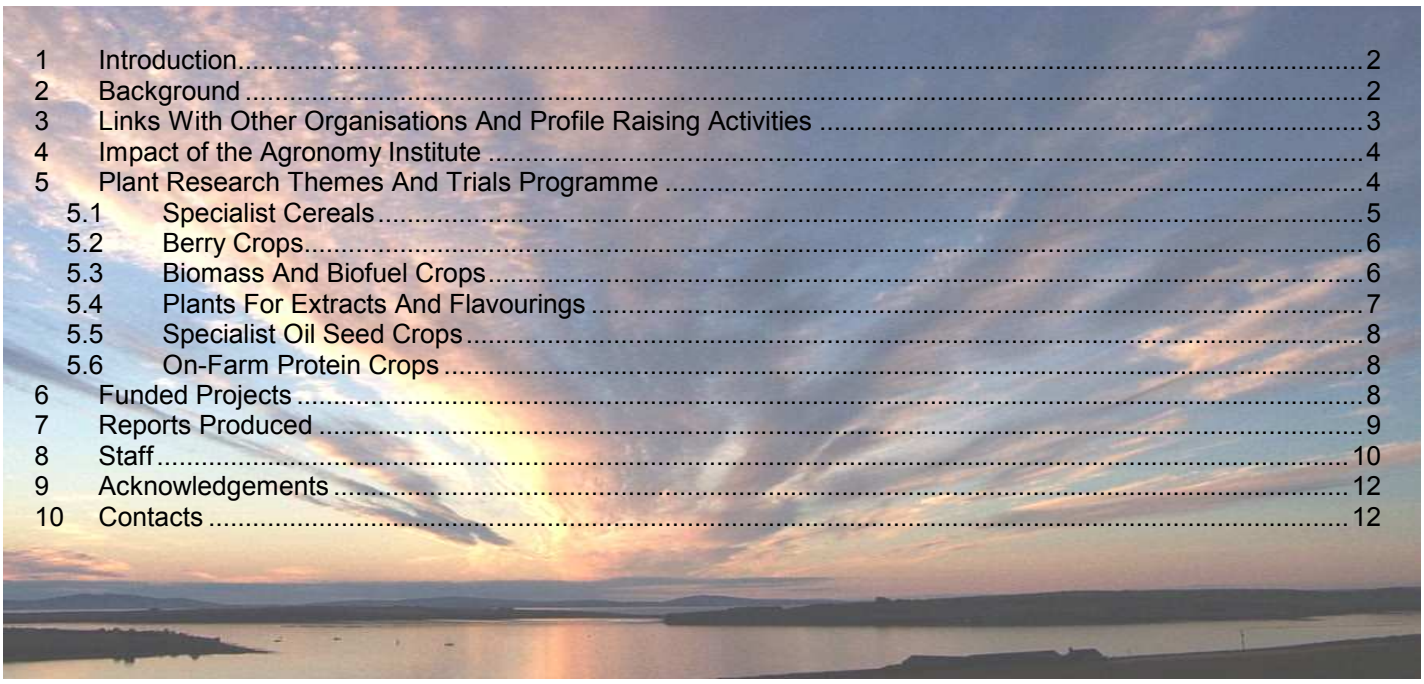

1 Introduction

This is the third annual report of Orkney College's Agronomy Institute (AI) and covers the period from April 2004 to March 2005. The year was a very successful one and saw an expansion of field trials, the winning of several funded projects and a growth in external interest in, and collaboration with, the institute. A general review of activities is provided in the following sections - more detailed information about specific areas of work can be obtained by contacting the AI and are provided in publications cited in section 7.

2 Background

The AI was officially opened at Orkney College in June 2002. Its establishment was made possible through funding from Orkney Islands Council (OIC), Orkney Enterprise (OE), UHI Millennium Institute and European Regional Development Funds (ERDF). The Institute was established to provide a crop-based research and development facility, specialising in northern temperate plant species, for the Highlands and Islands area of Scotland. Agricultural diversification has been identified as a priority for the economic development of this region and the institute's research and development programme has been developed to specifically address this issue. The main elements of the programme are:

- To identify novel crops (including unexploited indigenous species and old varieties of existing crops) and plant products with potential for exploitation.
- In collaboration with growers and commercial end-users, to screen these crops, identify those most suited for exploitation and develop agronomic recommendations for them.
- To encourage the establishment of new local organisations for the utilisation of these crops or their products.

This programme is being delivered through a combination of field trials, research projects and commercial linkages which are described in the following sections.

3 Links With Other Organisations And Profile Raising Activities

As a new research institute, AI staff have put considerable effort since the institute was opened into raising its profile. This is now starting to bear fruit and in 2004 the institute was approached about collaboration by several potential partners in both Scotland and other parts of Europe. In addition to links established in previous years with other organisations, 2004/5 saw active collaboration between the AI and the following organisations:

- *Research Organisations:* British Nutrition Foundation, Inverness College, National Non-Food Crops Centre, Scottish Agricultural College (SAC), Scottish Agricultural Science Agency (SASA), Scottish Crops Research Institute (SCRI), Scottish Natural Heritage (SNH), The Macaulay Institute, Circumpolar Agriculture Association, The Eden Project, MTT Agrifood Research Finland, Swedish University of Agriculture University, Agricultural University of Iceland.

- *Commercial companies:* Crantit Dairy, Highland Natural Products, Holgran Ltd., Isle of Arran Distillers, Orkney Housing Association Ltd., Shetland Spirit Co., Springdale Crops, Valhalla Brewery.

- *Growers, Growers' Groups and Trusts:* Birsay Trust, Orkney Bere farmers, Highland Berry Growers Group, Crofters Commission, Shetland Bere and Aets Living Heritage Project, Shetland Organic Producers' Group, Skye and Lochalsh Horticultural Development Association, Westray Development Trust.

Some of the visitors in 2004:
Left: Ross Finnie MSP, Minister for Environment and Rural Development (centre) examining Black oats with Bill Ross, Orkney College Principal (left) and Peter Martin, AI Senior Researcher (right).
Right: Members of the Scottish Enterprise & Culture Committee who visited the AI's willow and poplar trial as part of a fact-finding mission on renewable energy with: Bill Ross, Orkney College Principal (left); John French, AI Director (fourth from right) and Peter Martin, AI Senior Researcher (right).

The AI received a number of visitors during 2004 and its profile was also raised through several staff presentations:

- *Visitors:* Ross Finnie MSP, Minister for Environment & Rural Affairs; Scottish Executive Enterprise and Culture Committee; Easter Ross Farmers Discussion Group; Social Housing Energy Forum; SEPA North Regional Board; Dr Ian Law, National Non-Food Crops Centre, Tim Smit CBE, Eden Project Chief Executive;Torsteinn Tomasson, Director of the Agricultural Research Institute, Iceland; Planning To Succeed Steakholders Group (Dumfriess & Galloway farmers); Crofters Commission Development Managers.

- *Presentations to*: National Non-Food Crops Centre (York); Weleda (Germany); Bere and Aets Heritage Project (Shetland); Fifth Circumpolar Agriculture Association (Sweden); Orkney Agricultural Discussion Society; Skye and Lochalsh Horticultural Development Association; UHI Millenium Institute Agriculture Subject Network. In Shetland, two presentations were given to the general public (Lerwick and Unst) outlining the results of a project on Unst plants (see section 6).

In addition, the AI was very active in the 2004 Orkney Science Festival. It organised a very successful afternoon session with the theme "Plants For the Future" which included presentations from Richard Constanduros (Highland Natural Products Ltd), Dr June Morris (Manchester Metropolitan University), Dr Ian Law (National Non-Food Crops Centre, York) and Elizabeth Barron (Inverness College). This was followed by a morning session devoted to the work of the AI which included tours of the field trials. The final day of the Science Festival coincided with the UHI Millenium Institute Annual Lecture in Orkney which was given by Tim Smit (Chief executive of the Eden Project), ensuring a high profile for plants and the work of the AI.

To build up contacts with potential collaborators in other countries, AI staff also made a number of trips overseas during the year, visiting the following organisations - Weleda (Germany), MTT Agrifood Research Finland, Swedish University of Agriculture and the Agricultural University of Iceland. Advanced discussions took place between the AI and several of these organisations about collaboration.

As a result of the above activities, very good coverage has been given to the institute's activities in the local press and radio. Articles have also appeared in the national press and members of the AI featured in a special Boxing Day edition of BBC Radio's Gardeners World Question Time.

4 Impact of the Agronomy Institute

Although, it is only three years since its establishment, there are clear indications that the AI is having an impact at several levels:

- At the crop level, there are some promising contenders for commercialisation (particularly Bere, arnica and willow) and the first new commercial product, a Bere whisky, has been made. Other commercial products with Bere are close to being developed.

- Growers have also started to benefit through involvement in on-farm trials (Bere) and by producing material for testing in new commercial products. Grower awareness about alternative crops has also been raised by the publicity given to AI activities, presentations made by staff and by the visits which several growers groups have made to the institute.

- Inevitably, because of its location, the greatest impact of the AI has been in Orkney, but the past year has seen activities being undertaken in Shetland and several staff visits to the mainland. With the gradual development of links with other organisations, more projects elsewhere in the Highlands and Islands can be anticipated. The importance of the institute's research to the Highlands and Islands is recognised by the priority given to it by UHI Millenium Institute and, increasingly, by the Highlands and Islands Enterprise network.

Bere Whisky. This is the first new commercial product developed by the AI and involved collaboration with the Isle of Arran Distillers Ltd.

5 Plant Research Themes And Trials Programme

As a result of annual reviews of the market for novel crops, the AI has identified several research themes on which it is concentrating and within each theme, a list of potential crops for investigation has been drawn up. Since most of

these plants have no history of cultivation in Orkney, plant performance is usually first monitored in small observation plots and, subsequently, the most promising species are taken on to larger scale field and on-farm trials. In the following sections, brief descriptions are given of the main plant research themes and the plants within each theme which were grown in observation blocks or trials at Orkney College during 2004.

5.1 Specialist Cereals

Under this theme, the institute is investigating both modern and heritage varieties which are suited to the Highlands and Islands (H&I). Heritage varieties are of interest because they are suited to low input agricultural systems and often have distinctive quality characteristics which have been lost in modern varieties. On the other hand, advances in plant breeding have produced many modern varieties, some of which may also be suited to the H&I. The main markets identified for this theme are specialist bakery and drinks products. The main crops grown during 2004 were the following:

Bere. Bere being grown at Bigton in Shetland as part of the Shetland Bere and Aets Living Heritage Project.

Bere Barley *(Hordeum vulgare)*.
Bere is a 6-row barley landrace, the ancestry of which may go back to the 8th century or earlier. Its cultivation on any scale is currently 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. Bere flour is used traditionally in Orkney for making bannocks and is also used locally in bread and biscuits. During 2004, formal replicated trials were established investigating the effects of date of planting and inputs like fertiliser and agrochemicals on yield. On-farm trials with local growers were also continued and AI staff continued to provide an advisory input to the Shetland Bere and Aets (Black oats) Living Heritage Project. As part of his M Phil, John Wishart continued his investigations into soil trace elements and the levels found in Bere.

Oats & Wheat. The 2004 harvesting season was made very difficult by protracted periods of wet weather. Under these conditions, later maturing oats lodged and germinated in the ear (Left: Black oats in October). In contrast, several spring wheat varieties (Right) in trial were remarkably resistant to lodging even though they received no growth regulator.

Oats (*Avena strigosa* and *A. sativa*).
During 2004, the AI grew Black oats (*Avena strigosa*) and two old varieties of *A. sativa* - Murkle and Ayr Bounty - in addition to some modern varieties. Like Bere, Black oats have a traditional association with Orkney and were valued because they produced crops on land where modern varieties failed. The very durable straw is still used for the straw backs on traditional Orkney chairs and is also good for thatching and producing "simmons", a straw rope. Murkle oats are thought to have originated in the Murkle district of Caithness while Ayr Bounty oats were released in 1937 and are still grown on a few farms in Orkney. During 2004, attempts to increase seed stocks of all three types of oat were frustrated by the very wet autumn which resulted in difficult harvesting conditions and low yields. A replicated trial of modern oat varieties ('Argyll', 'Amigo' and 'Firth') had similar problems although two varieties were successfully harvested.

Wheat (*Triticum aestivum*)
Wheat is not a crop which is normally grown in Orkney, but surveys of food companies within the H&I indicated an interest in obtaining local supplies. To provide an indication of likely yields and quality, 3 spring wheat varieties ('Morph', 'Samoa' and 'Paragon') were grown in replicated trials. They proved to be surprisingly resistant to lodging, even though they were not harvested until late October, and gave yields of from 5-6 t ha^{-1} (15% moisture content) with few inputs.

5.2 Berry Crops

These are thought to have considerable potential for the H&I area because of the important contribution they make to the rural economy of other countries at a similar latitude (e.g. Scandinavia and North America). They are an attractive option because they can be used in a number of ways and have considerable potential for producing "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 2004, small plots of Blaeberry (*Vaccinium myrtillus*) and Lingonberry (*Vaccinium vitis idaea*) were established in addition to maintaining plots of the following plants established in previous years: 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.*

All Fieldberry. A small crop of fruit was produced from this in 2004.

5.3 Biomass And Biofuel Crops

There is increasing 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_2 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 renewable fuels like biodiesel and bioethanol to replace fossil transport fuels. Biomass and biofuel crops have the added attraction of providing farmers with a new crop diversification opportunity. In Orkney, there is already a market for biomass since Orkney Housing Association Ltd (OHAL) has installed a wood-fired boiler, supplying heat to its Lynn Road housing scheme while, on the island of Westray, the local Development Trust has developed a small-scale capacity for producing biodiesel.

In March 2005, the AI trial investigating the growth and biomass production of recent clones of willow ('Ashton Stott', 'Sven', 'Tora' and Torhild) and poplar ('Trichobel') was harvested. Large differences have been observed between the performance of the willow clones, indicating the need for additional variety trials to identify those most suited to Orkney conditions. For the best clones, biomass production for years two and three after establishment was equivalent to between 6 and 10 oven dry tonnes per hectare per year in some plots. 'Trichobel' has not grown well and is not suitable for biomass production in Orkney.



Willow And Poplar Biomass Production Trial. Following good growth in 2004, the second season after cut-back (left), this trial was harvested (centre) and the rods (right) will be used in a drying trial.

The observation plots of biomass grasses - Miscanthus (*Miscanthus x giganteus)* and Switchgrass (*Panicum virgatum)* -established in 2003 were removed as both species grew weakly in the spring of 2004 and could not compete with weeds.

As part of the Orkney Biofuels Project, Westray Development Trust (WDT) commissioned the AI to conduct baseline research on selected biofuel crops including the establishment of about 1.6 ha of a range of biofuel crops in April 2004. This comprised replicated plots of oil seed rape (*Brassica napus* 'Landmark'), turnip rape (*Brassica rapa* 'Kulta'), linseed (*Linum usitattissimum* 'Laser') and sugar beet (*Beta vulgaris* 'Roberta') and at the end of the trial small quantities of oil seeds and sugar beet were supplied to WDT for processing. The photograph on the front cover of this annual report shows the trial in mid-July. Although the sugar beet yields were low and it was not possible to harvest the linseed because the crop matured late and the autumn was very wet, the rape grew well and its yields were comparable with spring rape yields elsewhere in the UK. The study identified several factors which would improve the profitability of rape as a local biofuel crop.

Swathing Turnip Rape. Turnip rape was grown by the AI within the Orkney Biofuels Project and almost one tonne was supplied to Westray Development Trust for processing into biodiesel.

5.4 Plants For Extracts And Flavourings

Some of the plants grown in this theme already have a clear commercial outlet while others are more speculative but of considerable interest because of their history of traditional use.

During 2004, considerable attention was given to the medicinal plant Arnica (*Arnica montana*) which seems well-suited to the Orkney

environment. Research into chemical constituents of this plant is the subject of a PhD, undertaken by Elizabeth Barron within a collaborative project with Inverness College and funded by Inverness and Nairn Enterprise. Other plants being grown include Scotch Lovage (*Ligusticum scoticum*), Dog Rose (*Rosa canina*), Aquatic Mint (*Mentha aquatica*), Meadowsweet (*Filipendula ulmaria*) and Bitter Vetch (*Lathyrus linifolius*).

Research On *Arnica montana*. Within a project part-funded by Inverness and Nairn Enterprise, Elizabeth Barron (left) is using the institute's gas chromatography mass spectrometry equipment at Inverness College to investigate quality aspects of arnica grown in Orkney.

5.5 Specialist Oil Seed Crops

Although yields of crops in northern parts of the UK are often lower than those from warmer, more southerly parts, quality - especially of plant oils - is often very high. This is probably a result of the long day length during the growing season. In recent years, a number of new oil crops have been developed to provide specialist oils in the food, industrial and cosmetics sector.

In 2004, observation plots of Camelina (Gold of Pleasure or False Flax, *Camelina sativa*), Crambe (*Crambe abyssinica*), Echium (Viper's Bugloss, *Echium plantagineum*) and Borage (*Borago officinalis*) were grown.

5.6 On-Farm Protein Crops

With fears of GM seed contamination from bought-in animal feed, many farmers are interested in growing their own protein crops. Recently, new varieties of narrow-leaved lupins (*Lupinus angustifolius*) have been developed which require a shorter growing season than older types and some of these are thought to be suitable for northern regions. Bacteria in the roots of Lupins fix nitrogen which is released into the soil after harvest. This can benefit crops planted in the following year so that lupins can be an important component in a crop rotation. A small area of the variety 'Borweta' was planted in 2004.

6 Funded Projects

The year was a busy one for the institute during which several new research projects were initiated while others were completed. These projects are described briefly below:

Identification Of Varietal Traits And Market Potential Of Bere Barley

This project was funded through HIE's Research Challenge Fund and ended in June 2004. The project supported agronomic trials with Bere, investigations into the nutritional and baking characteristics of Bere flour and research into identifying potential new products made from Bere. As a result of the project, the

Orkney Bere Trademark. This has now been registered and will be used for new bere products made from bere supplied by the AI.

possibility of using bere in alcoholic and non-alcoholic drinks is being explored with commercial companies and a trademark has been registered for “Orkney Bere”.

Growth And Biomass Production Of Willow And Poplar Grown As Short Rotation Coppice
This 3-year project, partly funded by Orkney Housing Association Limited (OHAL) ended in March 2005 when the trial was harvested (see section 5.3). Biomass production by some clones has been sufficiently good to justify larger scale research and funds will be sought for this.

Drying Trial With Willow
Willow is normally harvested and chipped in one operation. With a moisture content of about 50% at harvest, however, chips do not store well for long periods without drying. An alternative is whole-rod harvesting in which rods are harvested, bundled, stored and dried in the field and then chipped as they are needed. The possibility of the latter approach is being investigated in a drying trial using willow rods harvested from the biomass trial. This research is part-funded by OHAL.

Research On Unst Plants
This project was funded by Shetland Enterprise and finished in April 2004 although a follow-up visit was also made to Shetland by AI staff in November 2004. As a result of the study a number of potentially commercialisable plants have been identified and links developed with Shetland companies.

Orkney Biofuels Project
This project was funded by the Scottish Community and Householder Renewables Initiative and ran from March 2004 to April 2005. Apart from the trial described in section 5.3, the AI developed an energy balance for the crops grown and reviewed potential alternative biofuel crops.

Plant Production Blueprints
The AI was commissioned by Highland Natural Products Ltd to write production blueprints for cultivating and wild harvesting four plant species (Thrift, *Armeria maritima*; Wild Angelica, *Angelica sylvestris*; Meadowsweet, *Filipendula ulmaria*; Water mint, *Mentha aquatica*) being used as flavourings.

Effects Of Selected Alternative Crops On Biodiversity
This project was part-funded by the Crofters Commission and Scottish Natural Heritage to investigate some of the effects of alternative crops on biodiversity. The research will involve the establishment of trial plots at Orkney College and on Sanday and is scheduled to start in April 2005.

Grain Dryer. With funding from the Orkney Biofuels Project, the AI purchased a dryer for drying oil seeds. With the wet harvesting season, it was put to good use.

7 Reports Produced

The following reports were produced over the year:

Plant Blueprint For The Cultivation Of Thrift, Armeria maritime. (August, 2004).

Plant Blueprint For The Cultivation Of Wild Angelica, Angelica sylvestris. (August, 2004).

Plant Blueprint For The Cultivation Of Meadowsweet, Filipendula ulmaria. (August, 2004).

Plant Blueprint For The Cultivation Of Water mint, Mentha aquatica. (August, 2004).

Summary Of Research Challenge Fund Project: Identification Of Varietal Traits And Market Potential Of Bere Barley. (June 2004)

Report On A Monitoring Visit To The Shetland Bere & Aets Living Heritage Project. (November 2004).

Report To Westray Development Trust On Biofuels Crop Research At Orkney College During 2004/5. (May 2005).

Growth And Biomass Production Of Willow And Poplar Grown As Short Rotation Coppice At Orkney College From 2002 To 2005. (May 2005).

8 Staff

Dr John French is Director of the Agronomy Institute and was largely responsible for establishing it at Orkney College. He graduated from London University with a degree in Applied Biology and then went on to do plant-based agricultural research at the Department of Applied Biology at the University of Cambridge where he completed his PhD on pest control in potatoes. Shortly afterwards he worked in Malaysia on Heart Rot disease of Pineapples and then on tropical cropping systems in Peru. Following a career lecturing in plant and environmental sciences and then academic administration at a number of UK institutions he became UHI Dean of Environmental and Natural Systems Sciences. Since February 2005 he has also been Director of the Centre for World Crops at Writtle College.

Dr Peter Martin is Senior Research Officer and took up his position in June 2002. After graduating with a BSc (Hons) in Plant Sciences from Wye College (University of London), he worked as Forest Botanist in Sarawak with the Sarawak Forestry Department. He did a PhD on barley at Long Ashton Research Station and then continued his overseas career as an agronomist – working on ODA (DFID) projects in Zanzibar and Tanzania on cloves and cashew. In 1996 he was appointed Assistant Director (Research) of the Tea Research Foundation (Central Africa). He returned to the UK in 1999 and, prior to coming to Orkney, was involved in research on biomass crops at Cranfield University Silsoe.

Arthur Cromarty is Field Trials Officer. He was educated in Orkney and did an HND in Agriculture with the North of Scotland College of Agriculture in Aberdeen. He worked for two years as assistant farm manager on a 3,000 acre dairy, beef and arable farm in Aberdeenshire before returning to Orkney where he became a lecturer in the Agriculture Department of the Weyland Agricultural Centre. In addition to his work with the Agronomy Institute, Arthur is also the Farm Manager of Orkney Island Council's Weyland farm and assists with the training of agriculture students. In his spare time, he runs a small beef farm with his wife and in the past has commercially grown ware potatoes, field vegetables and various crops under polythene.

Arthur Cromarty (right) examining flax prior to retting during a visit to Iceland funded by the Northern Peripheries Programme. (Torsteinn Tomasson, Director of Agricultural Research

John Wishart is the Institute's Technician. He was born and educated in Orkney. After graduating with a BSc (Hons) in Animal Science from De Montfort University, he returned to Orkney and worked for a local creamery and farming contractor for a year, followed by a year as a self-employed contractor. John was appointed as Agronomy Technician in February 2002. In his spare time, he takes an active role in the local Riding and Rugby Clubs and produces haylage at his farm for local horse owners. During 2003, John started an M. Phil at the AI, investigating soil trace elements and their levels in Bere barley.

Ronnie Johnson is Orkney College's Development Officer. Upon leaving school, Ronnie joined the National Commercial Bank of Scotland Ltd (now The Royal Bank of Scotland plc) in Hawick where he obtained his professional banking qualifications. After working in a number of branches and Head Office Departments he was appointed Senior Manager of the Bank's Orkney Branches, retiring from that position in May 2000 after 32 years' service. During this period, he worked closely with farmers and farming organisations and built up a good knowledge of farming conditions in the area. In July 2000 he was appointed Development Officer at Orkney College and amongst his duties, he is responsible for building up the commercial activities of the College. With the formation of the Agronomy Institute at the College, Ronnie has been involved in looking after its financial and marketing aspects.

In addition to the above, the Institute has also benefited from inputs from the following research associates in its projects:

Ken Abraham has a BSc in maths and computing and has over 30 years experience in the development and running of family and small businesses across the Highlands and Islands. Most recently, Ken has been involved in developing and running European Research and Technical Development projects and acts as a consultant to the HIE network.

David Burnie (MA, MBA, ACMA) is a freelance management consultant and has fifteen years experience of financial management with major international organisations engaged in pharmaceutical research and development.

Richard Constanduros has a BSc in Agriculture and is a Fellow of the Institute of Agricultural Consultants. Through Agros Associates, a consultancy which he established in 1984, he has worked worldwide on the utilisation of plants for the production of intermediate products for use by the healthcare, food, cosmetic and chemical industries. Richard has a particular interest in northern temperate plant species and is Technical Director of Highland Natural Products Ltd which was established to source materials from indigenous Highland plants and to process them to produce a range of intermediate products.

Hazel Gordon holds a BSc in Food, Textiles & Consumer Studies and is the head of FINDS, a food technology consultancy based in the Highlands. FINDS works across the Highlands and Islands with both small and large companies dealing with all aspects of product development, food safety systems and quality assurance. To date, this service has assisted over 50 companies in implementing, developing and progressing various products, systems and projects.

Fay McKenzie graduated in 2003 from UHI Millenium Institute with a BSc in Sustainable Development and Environmental Management. Fay now lives in Fife and is a qualified horticulturalist who trained at the Royal Botanic Garden Edinburgh in Plantsmanship. Having specialised in botany, agriculture and conservation within the Highlands and Islands, one of her main interests is northern temperate plant species, particularly those occurring in this area.

Gina Penwarden graduated in 2003 from UHI Millennium Institute with a BSc in Sustainable Development and Environmental Management. Gina is currently studying for an MSc in Marine Resource Management with Heriot Watt University in Stromness. On completion of her studies she aims to continue living in Orkney, starting a new career as an environmental consultant. Gina has a particular interest in renewable energy, including the potential offered by commercial energy crops to meet local electricity and heating needs.

9 Acknowledgements

The Institute has been very fortunate in receiving assistance from a large number of people and organisations in the past year. While it is not possible to acknowledge everyone, we are especially grateful to the following:

Advisory Board Members: Cliff Bichan, Graham Bichan, Richard Constanduros, Clr Jim Foubister, Andy Geddes, Bill Ross, Peter Scott, Kerr Walker

County Plant Recorders: Elaine Bullard (Orkney), Walter Scott (Shetland)

Crofters' Commission: Jane Thomas; Uilleam Smith

Bairds Malt Ltd: Mark Kinsman

Barony Mill & Birsay Trust: Rae Phillips, Johnny Johnston

Brooms Barn Research Station: Prof. Keith Jaggard

Farmers: Eric Donaldson, Irvine Flett, John Lye, Martin Robertson, Magnus Spence

HIE: Calum Davidson, Laura Dingwall, Stephen Graham, Jeff Howarth, Bob Kass

Highland Berry Growers' Group: Colin Stirling

Inverness & Nairn Enterprise: Richard Myers

Isle Of Arran Distillers Ltd: Gordon Mitchell

Macaulay Institute: Barry Thornton

Machinery: David Harper (Avon Engineering)

Meteorological Data: Clr Keith Johnson

National Institute of Agricultural Botany: Bob Jarman

National Trust for Scotland: James Fenton, Sue MacKenzie

Photographs: Laura Cromarty, John Wishart

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Orkney Enterprise: Ken Grant

Orkney Housing Association Ltd: Sally Inkster, David Murdoch

Orkney Islands Council: Shona Croy, Jeremy Baster

Orkney Wine Company: Emile van Schayk

Outreach Incubator: Bruce Morrison

SAC: George Baikie, Elaine Booth, Katya Svoboda, Kerr Walker

SCRI: Rex Brennan,

SNH: John Uttley

Shetland Enterprise: Rachel Stove

UHI Millennium Institute: Neil Chisholm

Valhalla Brewery: Sonny Priest

10 Contacts

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