



*The Scottish Landrace
Protection Scheme (SLPS):
Conserving Scottish Landraces*

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Plan of this presentation

- ❖ Drivers for the conservation of plant genetic resources
- ❖ Conserving Agro-biodiversity in Scotland – why conserve landraces?
- ❖ The UK National Inventory 2004
- ❖ What do we know about Scottish landraces?
- ❖ What do we want to know about Scottish landraces?
- ❖ The Scottish Landrace Protection Scheme (SLPS)
- ❖ The SLPS – how it works; experience with Shetland Cabbage
- ❖ Scottish landraces and their characterisation
- ❖ Seed collection and developments since 2004
- ❖ Movement of seed – does it effect population diversity?
- ❖ The boundary between landraces and traditional varieties
- ❖ Traditional varieties in SASA collections

The drivers to conserve plant genetic resources

The UK is responsible for describing, conserving and providing access to its plant genetic resources in its territory under the terms of:

1. Convention on Biological Diversity (CBD)

- Bilateral access system
- All biological material

2. International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

- Multilateral access system with material transfer agreements and system of benefit sharing
- Agro-biodiversity

Plant Genetic Resources is a devolved issue - Scottish Government is required to implement the UK's commitment in Scotland.

Conserving Agro-biodiversity in Scotland

- ❖ The CBD spurred recording of species distribution and assessment of wild habitats in Scotland within UK context.
- ❖ ‘Agro-biodiversity’ slipped through the net as Scottish Government set targets and actions for assessing/managing ‘natural’ diversity. Farming was seen as not contributing to biological diversity; conservation of rare animal breeds was recognised as having strategic significance.
- ❖ The ITPGRFA recognised the genetic resource contained in *ex situ* collections and required that these resources be documented, conserved and shared for the species governed by the treaty. This concerned public funded collections at SASA.

Why do we need to conserve landraces?

- ❖ Landraces are locally adapted populations which are actively maintained by growers/crofters; each population may be different and very diverse; potentially a very useful genetic resource.
- ❖ Conservation requires a detailed knowledge of distribution, growers, movement of seed between growers and the collection and storage of viable seed. If growers cannot harvest seed of their landraces, their landraces will disappear, unless seed is conserved in *ex situ* collections.
- ❖ In order to manage and develop effective strategies for conservation, it is necessary to understand the diversity within and between populations.
- ❖ *In situ* and *ex situ* characterisation and evaluation is required.

The UK National Inventory 2004

Before the UK National Inventory:

- ❖ A small number of landraces and traditional varieties known in UK genebanks and seed collections.
- ❖ Passport information limited and a relatively small number of populations were conserved.
- ❖ Characterisation of these populations was also limited.

2004: UK National Inventory:

- ❖ The UK National Inventory was commissioned by the Department of Environment, Food and Rural Affairs (Defra). It was a desk top survey undertaken by the University of Birmingham. Unpublished report 2004.
- ❖ Identified five Scottish landraces and a number of UK traditional varieties, some of which were in seed collections at SASA.
- ❖ Little detailed information about landraces and traditional varieties: number of growers, distribution, quantity of seed produced and whether threatened.
- ❖ Stimulation for surveying and setting up conservation measures.

Five Scottish landraces

❖ Bere barley:

- considerable diversity between populations and between island groups
- diversity within populations
- development of niche market products with regional branding (Orkney): flour, whisky and beer

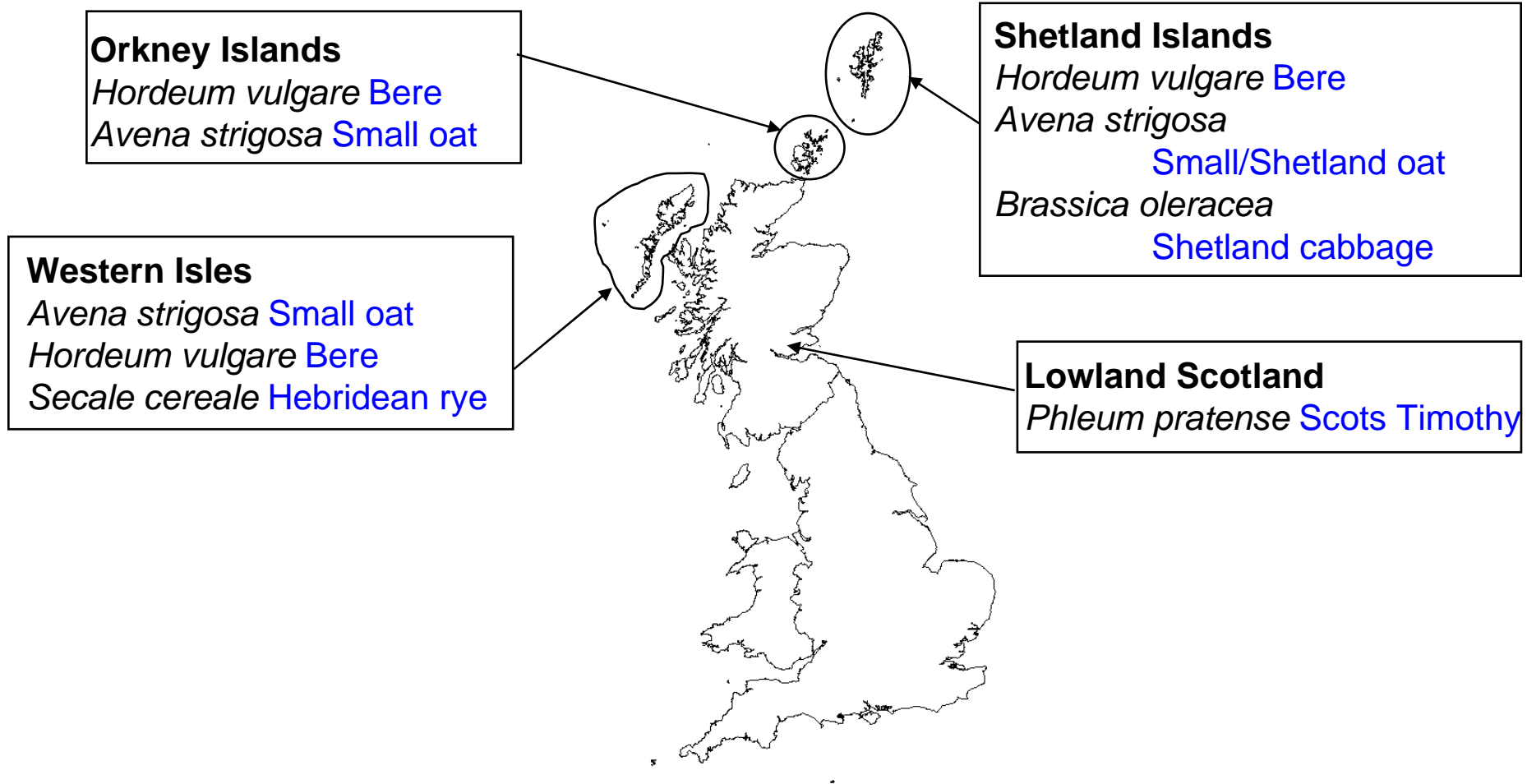
❖ Shetland Cabbage:

- number of growers is declining; sale of seed/plants between growers is reducing number of diverse populations - threatened.

❖ Small oat, rye and Scots timothy:

- little is known about their diversity; few samples collected

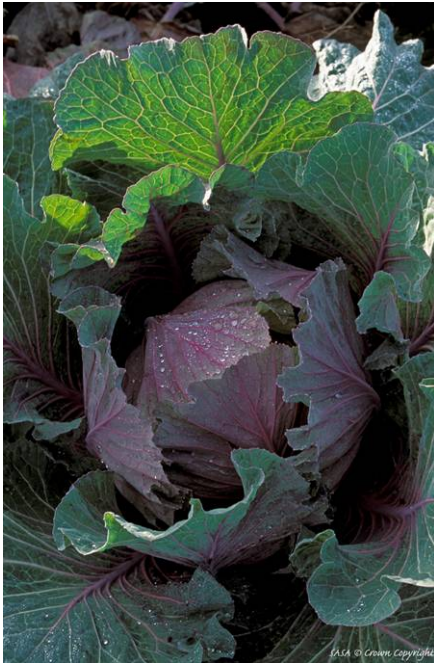
Distribution of extant Scottish Landraces



What do we know about Scottish Landraces?

- ❖ Associated with local tradition and culture, but landraces can be grown using modern farming methods
- ❖ Mostly grown in the Northern and Western Isles
- ❖ Grown as single crops in Northern Isles, but often as mixtures Western Isles
- ❖ Growing landrace mixtures is integral to habitat maintenance in the Machair area of the southern Hebrides
- ❖ Small number of growers in Northern Isles (Bere barley, small oat, Shetland cabbage) and mainland Scotland (Scots timothy).
- ❖ Higher number of growers in Western Isles (single crops or various mixtures involving small oat, rye and bere barley for winter feed).

Shetland cabbage landrace



Landraces grown in the Western Isles



Bere barley grown as a single crop (© Maria Scholten)



Landrace mixture (small oat/rye/bere) grown on sandy, nutrient poor Machair soils (© Maria Scholten)



Hebridean rye and small oat mixture
(© Maria Scholten)

Landraces grown as single crops



Scots Timothy grown in lowland farms near Stirling and Perth

Bere barley growing on the Orkney Island of Eday
(© Cathy Southworth)

What do we want to know about Scottish landraces?

- ❖ Are there more populations of existing landraces being grown?
- ❖ Are there other landraces being grown?
- ❖ Who are the growers, where are landraces grown, how much seed is produced, what is the threat status of populations?
- ❖ What is the diversity (phenotypic, genetic, molecular) within and between populations of each landrace?
- ❖ Does diversity of populations change with time?
- ❖ Why do growers use landrace mixtures in specific proportions?
- ❖ Can existing landraces be improved or developed to secure continued use?

To answer these questions we need to survey and interview farmers and crofters, collect more seed samples, undertake further research and conserve samples *ex situ* collections.

How do we encourage the use of landraces?

1. Provide advice to growers on seed on:
 - harvest, drying and storage methodologies
 - quality of harvested seed
- ❖ Encourage collaboration between growers in the local community – sharing machinery, communal seed storage etc
- ❖ Provide growers access to seed adapted to their local area in the event of harvest failure to ensure continued use.
- ❖ Consider crop improvement, particularly disease resistance

Without continued seed harvest, landrace populations will disappear

The Scottish Landrace Protection Scheme

The Scottish Landrace Protection Scheme (SLPS) was set up in 2006 to conserve and describe collected seed of the Shetland Cabbage landrace and to provide a seed safety deposit system for donors.

Since 2006, cereal landraces have been submitted to the scheme.

SLPS is a voluntary scheme which aims to:

- conserve a representative sample of seed in *ex situ* storage
- collect passport information about the donor and the landrace
- characterise the accessions
- seek consent for general distribution of seed
- provide access to third parties for genetic resource purposes
- provide donor access to their stored seed in the event of harvest failure (safety deposit system)

SLPS: Requirements for participation

Each stored sample should have sufficient viable seed for:

- monitoring future germination and seed quality
- characterisation (field/glasshouse trials and molecular)
- re-supplying the donor in the event of crop failure (quantity is dependent on size and quality of the original sample)
- safety duplication for emergency regeneration outwith the local growing area

The predominant component of a species mixture should have sufficient viable seed

SLPS participation: Shetland cabbage

To qualify for SLPS participation: 5000 viable seeds minimum

Viable seeds	Minimum Requirement
1500	Return to grower in the event of crop failure
1000	Safety Duplication/emergency regeneration at SASA
1000	Germination and/or seed health tests
1500	Characterisation (Field and Molecular)
5000	TOTAL

If consent is given for general distribution, 5000 viable seeds will be retained for the SLPS and any additional seed will be made available on request for *bona fide* use (breeding, research, education etc)

SLPS: Information sought from the collector or donor

- ❖ Species/Common Name e.g. *Brassica oleracea* / Shetland Cabbage
- ❖ Collection date (COLLDATE)
- ❖ Collector name
- ❖ Collector sample number (COLLNUMB)
- ❖ Donor
- ❖ Donor Address
- ❖ Donor phone number
- ❖ Donor Email
- ❖ Donor wants protection in the SLPS?
- ❖ Donor agrees to sample being made available for General Distribution?
- ❖ Harvest Year
- ❖ Area of crop grown
- ❖ Density of plants grown
- ❖ Notes

SLPS: Consent Form

PARTICIPATION IN THE SCOTTISH LANDRACE PROTECTION SCHEME

I want seed of the variety/varieties listed below to be included in the Scottish Landrace Protection Scheme

YES

☐

NO

☐

CONSENT FOR GENERAL DISTRIBUTION

I give my consent for seed of the variety/varieties listed below to be freely available for distribution to third party users

YES

☐

NO

☐

Varieties to which this agreement applies:

e.g. Shetland Cabbage (2006 harvest)

e.g. Bere Barley (2007 harvest)

e.g. Small oat/rye/bere mix (2007 harvest)

Signed..... Date.....

PRINT NAME.....

ADDRESS.....

POST CODE.....

TEL.

EMAIL.....

SLPS: Processing collected or donated seed

On receipt at SASA, seed is

- registered
- examined for seed health
- a representative sample is removed from a mixture to determine the proportion of the component species
- a sample is removed for germination/seed health tests
- cleaned and dried at 15°C/15% RH
- a representative sub-sample (up to 10% of the original) is removed for storage at a different site (safety duplication)
- stored at -22°C

SLPS: Processing landrace seed mixtures for ex-situ conservation

- Seed collected or donated as mixtures are stored as mixtures
- Mixtures sampled for seed testing (according to ISTA rules)
- Components in each mixture are counted as a proportion of the total sample
- Each component is tested for germination and seed health
- The number of viable seeds per component is calculated

SLPS: SASA sample information

- ❖ **Sample receipt date at SASA (ACQDATE)**
- ❖ **Sample name (ACCENAME)**
- ❖ **SASA Cultivar Number or unique identity number (ACCENUMB)**
- ❖ **SASA accession number (for multiple samples within one unique identity number)**
- ❖ **Official Seed Testing Station Number**
- ❖ **Stock (sample quantity recorded as seed weight)**
- ❖ **100 seed weight**
- ❖ **Germination %**
- ❖ **Germination test: % dead**
- ❖ **Germination test: % abnormal**
- ❖ **Germination test date**
- ❖ **Assumed Seed Number based on 100 seed weight**
- ❖ **Assumed Viable Seed Number**
- ❖ **Seed diseases**
- ❖ **Pest infestation of sample**
- ❖ **Notes**

SLPS Experience: Shetland Cabbage

❖ Number of growers donating seed	17
❖ Number of seed samples received	25
❖ Samples with insufficient seed for SLPS participation	6
❖ Samples qualified for SLPS participation	19
❖ Samples with consent for general distribution	19
❖ 1000 seed weight range from 2.43g to 4.65g	
❖ Approximate number of viable seeds (calculated) (number of seeds x % germination)	
• 8 samples with 5,000 - 10,000 viable seeds	
• 3 samples with 10,000 – 15,000 viable seeds	
• 2 samples with 20,000 – 30,000 viable seeds	
• 5 samples with 30,000 – 40,000 viable seeds	
• 1 sample with > 40,000 viable seeds	

SLPS Experience: Shetland Cabbage

Seed quality: Germination

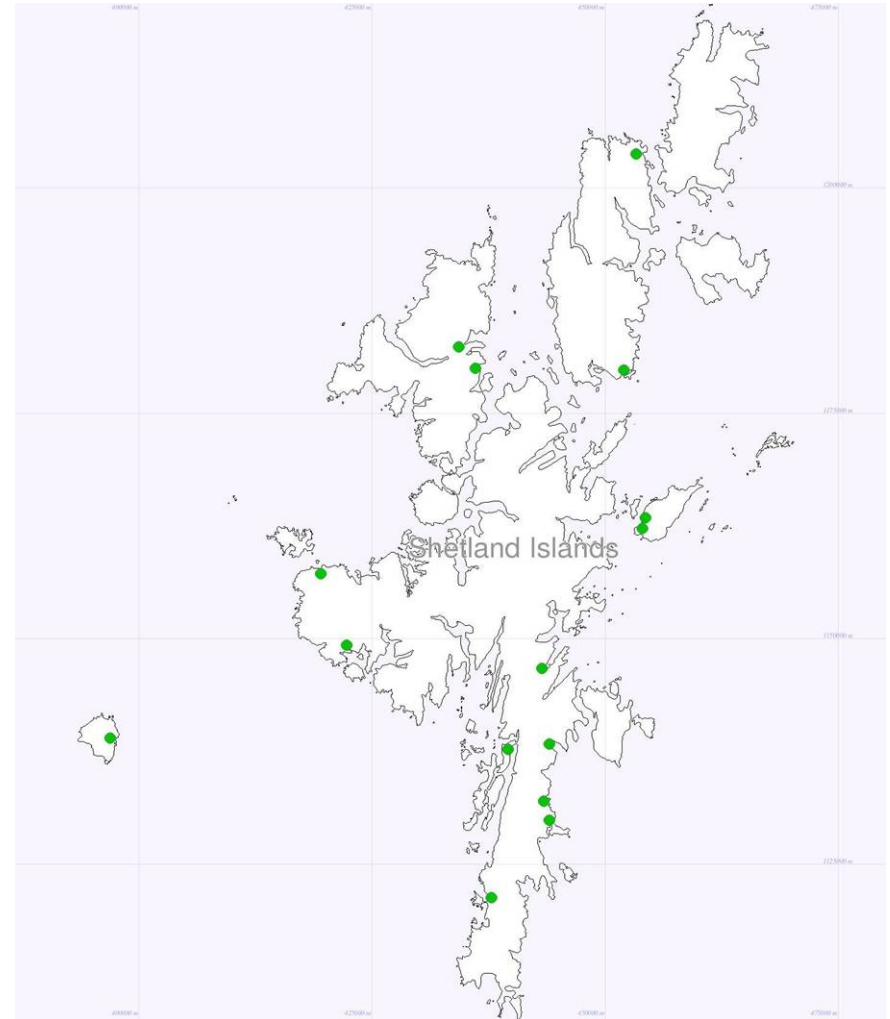
Samples	% Germination
1	Nil
3	< 40%
6	40% – 59%
1	60% - 69%
4	70% - 79%
6	80% - 89%
4	> 90%

SLPS: Shetland Cabbage Origin of Samples

Seed samples collected in 2006:

❖Foula	2
❖North Yell	3
❖South Yell	2
❖North Mainland	4
❖Central Mainland	4
❖South Mainland	5
❖West Mainland	3
❖Whalsay	3

Aim: To collect as many unique samples from as many islands as possible with follow up samples in subsequent years



Landraces in the SASA Collections

5 Scottish Landraces

Accessions

Bere barley (*Hordeum vulgare*)

43 (2 mixed with small oat)

(32 small samples were collected for PhD research)

Small oat (*Avena strigosa*)

10 (2 mixed with bere &
2 mixed with rye)

Rye (*Secale cereale*)

2 (Both mixed with small oat)

Shetland cabbage (*Brassica oleracea*)

25

'Scots' timothy* (*Phleum pratense*)

1 *registered UK National List

(certified seed produced annually)

30 landrace mixtures (mostly small oat/rye/bere) collected in Western Isles
2008: seed tests not complete; component proportions not yet determined

Characterisation of Scottish landraces

- ❖ Description of 'Scots' timothy for seed certification purposes – no known study of within or between population variation.

Cathy Southworth's PhD Thesis 2007 (Heriot Watt University and SASA)

- ❖ Barley varieties and Bere landrace
 - Morphological and molecular characterisation indicated considerable diversity, both within and between populations in the different island groups (Shetland, Orkney and the Western Isles).

Maria Scholten's PhD current research (Scottish Agricultural College/SASA)

- ❖ Accessions of Shetland cabbage grown at SASA in 2007/8
 - Morphological characterisation complete – data being analysed
 - Single plant samples have been collected for molecular characterisation in 2009
- ❖ Characterisation of small oat and rye planned for 2009.

Seed collection and developments since 2004

❖ Seed collection

- 2004 Bere barley (Northern and Western Isles) for PhD research project
- 2006 Shetland Cabbage (Shetland) MSc project University of Birmingham
- 2007 Bere barley (Orkney) – Orkney College (commercial development)
- 2008 Bere/Small Oat/Rye (Western Isles) for PhD research project

❖ SASA website on Scottish Landraces (went live 2008):

www.scottishlandraces.org.uk

❖ A Scottish Working Group on Landraces and Traditional Varieties was set up in February 2008 with a remit to advise Scottish Government

Does movement of seed affect diversity?

1. Exchange of seed

- Exchange is mostly between neighbouring farms or within island communities. Some seed is exchanged between islands or with mainland Scotland

Does exchange broaden or diminish variability in the population?

We are not sure; if it happens sporadically, or if mixed with seed of an existing population from earlier harvest, diversity may be maintained.

2. Sale of seed or seedlings to other growers

- The population being sold replaces the local population. Sale diminishes the number of unique populations and reduces diversity

3. Sale of seed to develop commercial products

- Population is usually maintained separately and is rarely exchanged
Subject to EU Conservation Varieties Directive EU/2008/62/EC

The boundary between landraces and traditional varieties

- ❖ The boundary is blurred and there are no clear definitions which separate landraces from traditional varieties.
- ❖ Landraces and traditional varieties contain diversity not found in modern varieties, have not been part of a formal breeding programme, and are usually maintained by mass selection over many generations
- ❖ The five Scottish landraces identified in the UK National Inventory exist as multiple populations with one name, are grown locally and are mostly regenerated in the area in which they are grown.
- ❖ Such landraces have all but disappeared, but many traditional varieties still exist, although these may be the remnants of, or a selection from, a landrace.
- ❖ Traditional varieties can be defined as varieties in existence before the introduction of statutory legislation (national list, plant breeders' rights and seed marketing regulations) in the EU. Many are sold outside their area of origin.
- ❖ As seed of landraces and traditional varieties are conserved, diversity is still accessible for breeding.

Traditional Varieties in the SASA Collections

- ❖ SASA stores seed and tubers of varieties currently marketed for the statutory testing (National List and Plant Breeders' Rights) of 40 crops (vegetables, potatoes and three agricultural crops - field pea, turnip rape and swede).
- ❖ SASA also stores other genetic material (genetic lines, wild and primitive populations and a large number of 'obsolete' (no longer sold commercially) varieties, some of which are traditional. [Information on these accessions will be made available on the Scottish Landrace and Traditional Varieties website when passport information is classified.](#)
- ❖ SASA is the official maintainer of traditional varieties registered on the UK National List: 40 potato varieties and 140 varieties of vegetable species. Seed will be made available to meet *bone fide* requests (breeding, research or education) once sufficient seed has been regenerated.



Thatching Wheat: Squarehead's Master

Ex situ conservation: Traditional Varieties in SASA collections



Traditional Potato varieties

Foula Red (left), Lumpers, Shetland Black (right)



Acknowledgements

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- ❖ Thanks also to SASA staff: collection curators George Campbell and Rachel Tulloch for providing information, advice and comment, and to staff in the Official Seed Testing Station for Scotland for seed testing, cleaning, counting and seed health assessments.