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Machair corn: management and conservation of a historical machair component

Maria Scholten[1], Bill Spoor[1] and Niall Green[2]

[1]Crop and Soil Systems Research SAC West Mains Road Edinburgh, EH9 3JG, Scotland
[2]SASA (Science and Advice for Scottish Agriculture) 1 Roddinglaw Road, Edinburgh, EH12 9FJ
E-mail: maria_scholten@hotmail.com

ABSTRACT
The contribution of local cereal cultivation to machair wildlife is widely acknowledged. All three traditional machair corn species, small oat (*Avena strigosa)*, bere *(Hordeum vulgare)* and rye (*Secale cereale*) are locally produced. Local varieties that are maintained by farmers over generations are known as landraces and are rare, rapidly disappearing forms of agricultural diversity. Collecting seed for *ex situ* conservation and associated documentation of 27 samples provided by 24 seed growers gave insight into local seed production. There was found to be a dynamic pattern of seed movement between crofters, a trend towards specialisation in seed production and an overall robust seed quality albeit with high disease levels. The three corn varieties are mostly maintained as mixtures; the 'pure' component stocks are maintained by a smaller number of growers; and the number of keepers of the local rye was low. Although the last years have seen good seed harvests, there are no seed reserves.

Introduction
Cereal cultivation on the machair predates the first millennium (Parker Pearson, 2004). *Coirce béag* or small oat (*Avena strigosa* Schreb., rye (*Secale cereale* L. and bere (*Hordeum vulgare* L. have been grown here over centuries (Caird, 1979, Findlay, 1956) and have developed a tolerance to the nutrient deficiencies of the machair soils so that they can yield without extra input of nutrients. Such cultivation forms part of the extensive low-input system of cattle rearing, in semi-natural habitats and meets the 'High Nature Value' farming criteria as formulated by the European Environment Agency (2004). Its importance for machair wildlife has long been recognised (Angus 2001) and is acknowledged in the Habitat Action Plan for machair (http://www.ukbap.org.uk/UKPlans.aspx?ID=30). The Western Isles have a specific Cereal Fields Habitat Action Plan (http://www.cne-siar.gov.uk/biodiversity/planningprocess.asp#localactionplans).
The three corn landraces have survived into the twenty-first century on a scale likely unparalleled in North-west Europe (Scholten *et al.*, 2008). Landraces are comparable to rare animal breeds: local varieties developed under local conditions and maintained by local farmers over generations. Bere and small oat are not commercially available and the islands have to be self-reliant for seed. Small oat (*Avena strigosa* Schreb.), is a different botanical species from mainland oat (*A. sativa* L.) and a rare crop; the Uists form the largest remaining area of this crop in North-Western Europe (Scholten *et.al*. 2008). Often mixed together with local rye (*Secale cereale* L.) and bere (*Hordeum vulgare* L.), these mixtures form another speciality of the Uists. Mixed grain cultivation goes back to medieval times (Slicher van Bath, 1963), known under names as dredge corn or maslin. Species mixtures form a buffer against very risky, unpredictable environments and farmers' strategy of using mixtures to aim at yield stability rather than a maximised yield, has been seen as a defining element of landraces (Zeven, 1998). The combination of small oat and rye is known from former other traditional growing areas, such as Galicia in Spain (Vavilov, 1926) and West-Jutland in Denmark (www.ngb.no).

Worldwide, landraces have been largely replaced by modern cultivars that are bred and marketed by breeding companies and seed merchants. The survival of landraces has been associated with patterns of fragmentation, marginal agricultural conditions, economic isolation and cultural (linguistic) autonomy (Brush 1995). The Scottish landraces, surviving on the most remote islands, the Southern Outer Hebrides and Northern Isles, fit this pattern where crofters have retained historical landraces and the associated Gaelic and Norse words. Although the scale of Uist cultivation and seed production has remained substantial, seed shortages were observed in 2004-5 and future declines seem likely in the face of a decreasing and ageing crofting population and crofting agriculture facing abandonment and intensification. These trends elsewhere in Europe are seen as major problems for the long-term survival of landraces (Negri *et al.*, 2000). Fragmentation and isolation may affect the genetic diversity of the landraces and the resilience of local seed production. How much diversity is present has been studied so far only for bere and results showed high diversity within and between island populations (Southworth, 2007).

As landraces became increasingly rare, international conservation legislation has been developed, such as the Convention on Biological Diversity (CBD, 1992)

and more explicitly the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, 2001), ratified by the UK in 2006. These treaties commit national governments to conserve agricultural diversity *ex situ* as well as *in situ*; Article 5.1. promotes or supports farmers and local communities' efforts to manage and conserve on farm their plant genetic resources for food and agriculture and Article 6.2 promotes, as appropriate, the expanded use of local and locally adapted crops, varieties and under-utilised species. In Scotland, the need to conserve landraces has been highlighted more in local conservation plans, such as the LBAP Western Isles, than at national level. Local action proposals in support of landraces have not been followed-up. However, a new Working Group on Scottish Landraces and Traditional Varieties was created in 2008 to report to the Scottish Biodiversity Committee on conservation and use in Scotland. Conservation of the genetic diversity of Scottish landraces is facilitated through the Scottish Landrace Protection Scheme which provides *ex situ* backup for local growers (www.scottishlandraces.uk).

Machair agriculture, has been coined "stern adversity" (Kerr, 1955), with land of the lowest agricultural capability (Hudson, 1982), highly exposed to winds, prone to soil erosion, with the high alkalinity causing nutrient deficiencies; low in organic matter, with periodic droughts, a heavy weed burden and harsh weather conditions. Harvest failures due to diseases or bad weather have been reported throughout the history of cereal cultivation and seed stocks had to be reintroduced from time to time, for example in the seventeenth century from Ireland (for the Hebrides), while Shetland imported from Orkney and Germany (Shaw, 1980). At least since early twentieth century the seeds were purchased and improved varieties were brought in. A Welsh bred small oat cross was grown on the Uists in the 1950s and yielded better than the local indigenous strains (Darling, 1955, Gray 1955, Grant 1979). In the 1970's Scottish bred lines were tested and locally released on Tiree at the end of the trial (Wright *et.al.*, 2002). The end of formal breeding of oat varieties for marginal environments explains the survival of the local strains of small oat (ibid.). The cessation of commercial seed supply meant that crofters were left with the task of producing local seed in sufficient quantity and quality and at the right time.

The term local or informal seed sector is used mainly in developing countries for farmers' seed production in situations where the formal seed sector (commercial seed companies, plant breeding institutes) fails to supply seeds or varieties; it is used as a diagnostic tool to analyse strengths and weaknesses of local seed systems in order to assess adequate support actions (Almekinders, Louwaars and de Bruijn, 1994, Sperling, 2008). The two sides of seed, the genetic value, such as for example the tolerance of Manganese deficient soils , as well as physical, planting value for farmers should be addressed in any study of the management of landraces. In order for farmers to be 'seed secure', key elements of seed availability, access and quality have to be ascertained (Sperling, 2008). Key questions are: how do farmers obtain seed, what technology is used to produce and select seed, what is the frequency of seed replacement and the nature of seed flow; and what mechanisms are in place to ensure seed quality? (Thiele, 1999).

This paper aims to describe and analyse how small oat, Uist rye and bere are maintained; how seed production and supply is organised and what constraints and weaknesses are present. It will focus on the physical value of the seed while the genetic diversity of the local strains will be the subject of further study.

MATERIALS AND METHODS

Data about local management and seed production were collected in 2008 simultaneously with seed collecting for *ex situ* conservation. Collecting for genebank conservation usually aims at acquiring maximum diversity within a region; combatting genetic erosion; acquiring gene/genotypes for breeding programs and analysis of agro-ecogeographical patterns of distribution of diversity (Hayward and Sackville Hamilton, 1997). Targeting isolated farmers is also recommended. As many farmers as possible were sought outside the core area of the Uists.
Collecting mixtures requires a special approach: individual components should be collected separately (Guarino *et al.*, 1995) and farmers consulted on how they maintain mixtures, species composition and mixture ratio (Guarino & Friis-Hansen, 1995). Seed production and selection methods, seed flow, variety and mixture maintenance, seed quality and genetic diversity, and farmers' evaluation of their own variety were based on methodologies summarised in Almekinders and Louwaars (1999).
The collecting strategy aimed at:

- representing all areas where cereal landraces are still grown
- targeting rarity: isolated growers and 'pure' or single stand crop stocks
- stratifying by island and machair townships in core areas
- documenting management practices with interviews with crofters and additional information.

Semi-structured interviews were held, the duration attuned to available time and interest of the crofter. These were supplemented with observations from previous fieldwork in 2006 and historical and 'grey report' documentation.
Seed quality data were provided by the Official Seed Testing Station (OSTS) at SASA where seed samples were cleaned and seed purity, mixture composition, germination and disease levels analysed.

RESULTS

Fieldwork was conducted in May and October 2008 and focused on the Uists starting with a list of 19

'bigger producers' provided by SAC Balivanich. In addition, other Uist crofters were approached by snowball effect, previous contacts or serendipity, i.e. chance encounters on the machair. On Tiree, Lewis, and Orkney contacts were via SAC or RSPB. Islay, Colonsay and Oronsay had corn imported from Orkney whereas Harris was provided through the RSPB reserve on North Uist. An overview of geographical varieties and their names is given in Table 1.

Twenty seven seed samples were collected from 24 different growers, selected according to seed availability, the originality of the seed stock and geographical representation. Twenty-two of the seed donors were on the Uists and three of them donated two stocks: one rye and small oat separately; two others bere and small oat, with rye. From Table 2 it can be seen that three people did not grow their own seed stock and two shared seed. Reasons given for not growing own seed by these three and others were lack of machinery and lack of help on time, destruction of seed crops by geese, weed contamination of own seed, and old age.

Most seed was collected as mixtures. From previous fieldwork single stand oats and bere were known but a chance discovery of a pure stand of rye, was a novelty and led to a further emphasis on collecting single stand stocks. An overview of seed samples, species composition, seed source, seed supplied to others, and seed swap information is presented in Table 2 and will be discussed in the following section.

Varieties, Names, Perceived Diversity And Evaluation

A first indication of diversity of landraces is the variety of local names. An overview of landrace names in contemporary use is given in Table 1. Small oat or *coirce béag* is likely one of the older Scottish names for *A. strigosa*. In his historical overview of oat cultivation in Great Britain, Findlay (1956) lists 'small oat' as the name in 17th century oat classifications, distinguishing it from 'gryt' (big) oats and mixed oats. The Gaelic name for small oat was *coirce béag* on Uists and Tiree, in contrast with big oat or *coirce mor*. In contrast, the interviewed Lewis crofter and his wife named their seeds black oat or *coirce dubh*[1]. On Orkney two traditional types of black oats were mentioned, Murkle oat, an *A. sativa* type and the traditional (hairy) black oat, an *A. strigosa* strain, which were grown together on Orkney in the past (Findlay, 1956). Only two growers were found with either of the two types. Shetland *aet* was mentioned by two Uist crofters as being darker than the small oat. In contrast to the small oat, there were no specific local names for the Uist rye nor for the Uist barley which was sometimes named bere, sometimes barley or Uist barley. Given the prevalence of mixtures, the absence of a specific Gaelic word for the cereal mixtures is striking. Gaelic dictionaries, i.e. Clyne (1989), Dwelly (1902) do not list any. The word corn is however used as a general term for either bere, oats or rye or all three (Anon, 2003).

Asked about variation within the Uist small oat, Uist crofters were unanimous in their opinion that there was only 'one island variety', which was 'the same all over the islands because it has been mixed many times'. Using alternatives, i.e. spraying mainland oat with manganese was often mentioned as not being an option, as it was too risky and too expensive. The most frequently mentioned reasons for growing small oat were its ability to stand the soil nutrient deficiencies and its volume. Rye and bere were mixed in for volume; the rye was seen as good in dry years and good standing support for the small oat. Some crofters were experimenting with different mixture components: Triticale, peas and mainland oat. Three occurrences of Shetland oats introduction to the Uists and Tiree were mentioned. Asked about the most desirable improvement to the small oat, increasing crop volume was most frequently mentioned.

Mixtures, species composition, single component stocks and maintenance

Most Uist corn nowadays is grown in oat-rye mixtures and the seed is also harvested from these mixtures. There were broadly two types of mixtures: oat-rye and oat "with a bit of rye". For the first type some crofters would give as guideline a mixture ratio oat to rye of 70:30 or 60:40 for dry machair. The second type of mixtures was closer to single stands that had been contaminated in harvesting equipment with other corn. Both forms show the problems associated with mixture maintenance: very few growers had access to individual component species of the mixture to adjust component ratios while unintentional mixing during harvest is impossible to reverse as there is no seed cleaning equipment. This led to a wide range in mixture ratios, apparent during field visits in 2006 (Scholten, unpublished data) and clearly visible in the mixture ratios found in seed analysis at the Official Seed Testing Station (OSTS) at SASA with for example rye ratios ranging between 4% and 54%. The lower level represents contamination through harvesting equipment, while the latter may be a mixture in which rye is taking over, assuming no sampling bias in the seed sample.

Depending on the growing season, harvested seed mixtures will often be different from the sown original. Some crofters felt that rye had a tendency to take over and one person had seen this actually happen in his mixture and had had to add oat to balance. Two crofters felt that combine harvesting of the seed was causing changes in the mixture composition, leading to an increase in the rye component. Some crofters grew the mixtures as they were, while others would check the mixture composition before sowing and adjusted the ratio with either single stocks or a mixture with a higher oat ratio; or adjusted the ratio before harvesting by choosing a proper mixture ratio for seed harvesting.

[1] In contrast, Dwelly (1902) gives *coirce-dubh* as applied to all kinds of oats when black with blight (probably smut, M.S.) especially *Avena strigosa*.

Mixtures with a lot of rye were called 'strong mixtures' by one crofter. Approximately one third of crofters used a three-cereal mixture, with bere mixed in before at sowing time. Bere ripens earlier than small oat and rye, hence the need and practice to grow pure bere for seed. Seed surpluses were bruised for feed or fed to hens. The number of bere seed growers on Uist is estimated at a dozen. Of the other 'pure' stands, nine 'clean' oat samples were collected, i.e. samples with other components less than 5%. One crofter with single oat observed that 'clean' seed was in big demand. The number of pure oat growers is probably higher than this.

Pure rye was the rarest stock. Only three sources were found, of which two could be collected. One crofter used a clean rye, stock inherited from his father, on the driest part of the machair and 'for rabbit holes'. The third source, 'very good rye seed' source on South Uist was not available anymore due to a tragic farm accident a few years ago.

From historical accounts and mentioned by one crofter, it appears that single stand crops were grown on inbye or *dubhthalamh* while mixtures were used on *talamh gainmheach*, machair land. Single stands had specific uses, for example traditionally oat was used for cows having calved (Anon, 2003). *Carmina gadelica* mentions different months for winnowing each of the bere, small oat and rye (Carmichael, 1992), an indication that separate seed crops were kept for each of the mixture species. On Tiree, seed was traditionally produced on the inbye (Anon, 2003). The practice of growing single stands seems to have declined in parallel with the decrease in cereal cultivation on the inbye land.

From historical sources it is not clear how old the practice of mixed cultivation is on the Hebrides. For Lewis only pure oats, *Coirce béag* on the machair, and barley were mentioned by McDonald in 1919. The absence of rye on Lewis was confirmed in 2008 by two crofters. The Lewis stock collected had been sourced from Ness 22 years ago and was originally grown as a single stand small oat to which Uist rye, oat and bere had been gradually added. The same McDonald describes for the Uists machair in 1919 a rotation of barley or potatoes, followed by oats followed by rye, but did not mention mixtures. These appear in mid-twentiest century observations such as Darling (1955) reporting small oat mixed with bere as typical for Uists and Tiree. Robberts, Kerr and Seaton (1959) in their description of machair grasslands of the Hebrides, mention 'pure rye' being used on the dryer areas and bere on the heavier soil while small oat with or without rye was the main cereal. Tiree mixtures of small oat with rye were described by Grant (1979).

Seed production and seed movement

Historically, corn seed would have been produced as part of the crop itself, on stooks, with a thresher to separate seed from straw and chaff, which also removed the smaller seeds. Nowadays, traditionally binder-harvested seed, slowly dried in three stages on stooks is confined to Benbecula and South Uist. Most seed was combine-harvested. When harvesting the crop as silage, seed has to be harvested separately, left to ripen in the field after the black bales are harvested. Many crofters with combine-harvested seed mentioned problems with drying the seed. This was done in the shed on the shed floor, on trailers or in containers by turning the seed regularly. Only one crofter used an electric fan.

There was general agreement amongst crofters and farmers that there had been sufficient seed in the last couple of years thanks to good weather and more combines available. None of the seed growers kept a seed reserve as a rule. Most of the seed of the Uist seed growers was for own use but 16 of the 22 seed growers supplied neighbours or some regular customers with up to one third of their own seed harvest.

Findlay (1956) describes oat seed replacement, the swapping of seed between farmers, as historically done with the aim to refresh degenerated (weed infected) seed; to replace grain damaged by weather during harvest and in general that it was considered good practice to change seed between 'warm' and 'cold' soils and vice versa. Some of these practices were still remembered or even present. Seed exchange between heavier and lighter soils had been common practice on Tiree according to a Tiree crofter. One Uist crofter mentioned the (past) practice to swap seed between machair and *dubhthalamh* as the latter produced seed with less weeds than the machair with its heavy weed burden, especially of charlock. A variety of reasons for seed swapping was given in 2008. Most crofters had swapped or replaced seed for quality reasons (cleaner seed) or for seed health reasons; one farmer had exchanged his complete stock with Tiree oat because of its superior volume; one stock had to be replenished after the 2005 January gale; another after geese had eaten an entire seed crop. Crofters with pure bere, small oat or rye stocks tended not to swap their seed stocks.

The regional pattern of seed movement showed a geographical limit to the Hebrides: between Uists and Tiree and to Lewis and Harris, but not beyond. Orkney bere is coming to Islay from the Agronomy College. Of the two remaining growers on Lewis, only one had his own seed stock, his neighbour's original stock had been eaten by rats and both were supplemented with additional seed sourced from North Uist by the local RSPB. A small group of crofters in Northton, South Harris, were supplied with the same stock.

Seed quality

The quality of the seed (dryness, good filling, free of weeds and diseases) was an apparent source of pride for many; 'good seed' and 'good seed producers' were often mentioned and one crofter refused to donate seed because he thought the seed of insufficient quality. Most seed was taken from the main silage crop by

leaving weed-free patches or the area with the best ratio oat to rye for seed harvesting. Producing a good seed head requires a different agronomy than producing straw for volume. The practice of using the best land - inbye if available - mentioned earlier, was confirmed by some growers who used the best fields for seed production, for example a field used as night meadow by cows in the previous year; or fields on wetter machair or a field in the first year after ploughing. Lower seeding density rates, fertilizer in formulas 16-16-16 or 17-17-17, for good grain heads and to lessen the risk of lodging, were applied. Herbicide was used by a couple of growers to prevent charlock choking the seed crop.

Seed quality data presented here are preliminary, based on OSTS analysis of one third of the samples. Germination rates ranged from 94% to 65% and 47% at the lower end, the latter likely due to moisture problems mentioned by the donors as seed having gone fusty. Moisture problems showed up as *Penicillium* infection rates as high as 98%. Snow mold (*Fusarium nivale* and *Microdochium nivale*) and smut (*Ustilago* spp) were the most prevalent with infection rates ranging from 1 – 76%, respectively and from 0 to over 600000 smut spores per sample. Loose smut is the most prevalent disease on oat and some growers had used seed treatment against smut prior to seeding in the past; few had used it this year. Not all samples had smut and of the smut-free samples twohad had seed treatment but one none. On rye seed, ergot, *Claviceps purpurea*, was prevalent in all analysed samples in quantities far above accepted tolerance levels (SAC Disease Notes www.sac.ac.uk/mainrep/pdfs/tn601ergotcereals.pdf.)

DISCUSSION AND CONCLUSION

Fieldwork in 2008 set out to collect a representative collection of local corn seed for *ex situ* conservation while documenting the management and seed production of local varieties. The focus was qualitative, i.e. on different management styles of a group of active seed growers and suppliers on Uist, rather than surveying overall seed production. Of the two aspects of seed, the physical or planting value was studied (quantity and quality of seed) while the genetic diversity of the different stocks, to be studied in detail in a later phase of the project, was approached by questions about how (many) local stocks were maintained and how their agronomic performance was valued.

Seed supply was seen as sufficient. However, as one crofter remarked, it is unclear what will happen in a wet summer when drying seed after combine harvesting in a favourable season becomes an issue. None of the growers kept a seed reserve.

Most seed was produced as mixtures of small oat and rye, with or without bere. Pure stock seed growers formed a minority of seed producers, and of these, only very few maintained pure stocks of bere and rye. These pure stocks form a mechanism to control mixture ratios. Accessibility to rare stocks may be a problem as some crofters were trying to source mainland barley or rye for mixing in (see also Colin MacPhail, this volume). The variability of mixture composition observed in 2006 and 2008 could become a problem with changing, more variable summer weather.

Given the hazardous nature of cropping and harvesting on the islands, the dynamic nature of local seed production with fair amounts of seed sharing and swapping, is not surprising. The risk of damage to seed crops by geese was a dominant concern, making crofters bale up their seed stock instead of risking loss, and even the choice of a seed patch in the field was determined not by good seed heads but where the threat of geese was least. Seed drying problems after harvesting and during storage, and seed treatment against smut can be added to the list of challenges facing seed growers.

Five out of 22 Uists growers in this study did not produce their own seed. This is likely an underestimation because the trend in seed production seems to be more seed produced by fewer crofters. The number of seed stocks is likely to decrease further: eaten by geese; baled in order to safeguard a crop; and seed production given up by older crofters. Sixteen of the 22 Uist crofters provided up to a third of their seed crop to other crofters and at least two crofters were mainly growing corn for seed. Espinosa and Fauré (2004) who interviewed 34 crofters on South Uist about developments in crofting styles found a similar pattern of specialisation. Amongst their six types of machair crofting, only three involved seed production and only one type involved seed supply to others.

Local and scientific names	Area	Number of growers
Bere (*Hordeum vulgare* L.)	Orkney, Shetland	5-20
Bere or barley or Uist barley *Eorna* (pure)	Uists and Barra	A dozen
Bere *Eorna*	Tiree	1
Small oat / *Coirce béag* (*A. strigosa* Schreb.), rye (*Secale cereale* L.) and bere *Eorna*	Uists and Barra	100 – 250
Black oat / *coirce dubh* (*A. strigosa* Schreb.)	Lewis	2
Tiree oat / *coirce béag* (*A. strigosa* Schreb.)	Tiree	1
Shetland oat/ Shetland ait (*A. strigosa* Schreb.)	Shetland	Less than 10
Orkney traditional black oat (Murkle) (*Avena sativa* L.)	Orkney	2
Orkney traditional black oat (*A. strigosa* Schreb.)	Orkney	1

Table 1. Overview of Scottish cereal landraces names and estimated number of growers 2008.

Island	Species	Own seed	Seed supplier	Seed swap	Most recent swap and extent
Benbecula	small oat + some rye	0	0		
Benbecula	small oat + some rye	0	0	1	2-3 years ago 100%
Benbecula	small oat + some rye	1	1	1	3 yrs
Benbecula	rye	1			
Benbecula	small oat + rye	1	1	1	few years ago 75% from 2 sources
Benbecula	bere + bit oats	1	1	0	
Berneray	small oat + bit rye	1	0	1	some years ago - some
Lewis	small oat + rye + bit bere	1	shared	1	some years ago
North Uist	bere	1	1	0	
North Uist	small oat + some rye	1	1	0	
North Uist	rye	1	0	0	
North Uist	small oat	shared	shared		
North Uist	small oat	1	1	0	
North Uist	smal oat + rye + barley	shared	shared		not on a regular basis
North Uist	small oat + some rye	1	1	0	
North Uist	small oat + rye	1	1	1	a little every 4-5 years
North Uist	bere	1	1	1	a little every 4-5 years
North Uist	small oat + some rye	1	1	1	few years ago
South Uist	small oat + rye + barley	1	0	0	
South Uist	small oat + rye	1		1	2 yrs ago, a couple of bags
South Uist	small oat + rye	1	1	1	2 years ago 100%
South Uist	small oat + some rye	1	1	1	3 years ago 100%
South Uist	small oat + rye + Triticale + bere	1	1	1	4 years ago, partially
South Uist	small oat + rye + Uist barley	1	1	1	3-4 years ago
South Uist	small oat + rye + bit bere	1		0	
South Uist	small oat + rye	0		n/a	
Tiree	small oat + rye + bit bere	1	0	1	some years ago, few bushels

Table 2. Overview seed samples from 22 growers, species ratio, source, supply and seed exchange (1 = yes)

If the (few) younger crofters in this study represent the future of Uist seed production, there will be corn mixtures of three landraces, with extra bere mixed in from own stock or sourced elsewhere; left-over seed will be used on barren dune pits to prevent erosion; alternative (mainland) varieties will be sourced to improve silage yields; a patch in the field with 'good seed heads' will be harvested by a combine (which is owned); seed will be shared, supplied to or sourced from others; and all of this done as an extra shift to full-time jobs.

Almekinders, Louwaars, and de Bruijn (1994) summarised the limitations of local seed systems with: sub-optimal performance of local varieties, seed storage problems and accessibility problems impeding seed exchange. They recommended improving storage as well as the physical and genetic quality of seed of the local genepool. Darling - more than fifty years ago and glaringly topical – noted for the Hebrides a lack of storage facilities, the need for community-level seed sourcing and the need for better yielding varieties (Darling, 1955). Of the three elements of seed security listed by Sperling (2008), lack of availability of better yielding stocks, lack of access to individual components of corn mixtures as well as high disease loads of seeds can be seen as the weak sides of Uist local seed production.

In the short term, the action point in the Western Isles' LBAP to include seed production of local varieties into agro-environmental schemes should be followed up. This would acknowledge the practical work and expertise of local seed growers who by supplying seed to others, provide a community service, and by maintaining a variety of local seed stocks and guaranteeing the survival of local varieties, a public service of *in situ* conservation.

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