MTT REPORT 163

Landrace *in situ* Conservation Strategy for Finland

Maarit Heinonen and contributors

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Suomen maatiaiskasvien viljelysuojelun strategia

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Tiivistelmä

Viljelyssä harvinaistuneet maatiaiskasvit nousivat Suomessakin kansallisiksi suojelukohteiksi 2000-luvun alussa, kun Suomi kansainvälisten sopimusten velvoittamana laati maa- ja metsätalouden kasvigeenivaraohjelman. Suomessa viljellään yhä maatiaiskasveja, etenkin viljojen, nurmikasvien, hedelmien, marjojen ja vihannesten paikalliskantoja. Meillä ei ole kuitenkaan kokonaisnäkemystä siitä, kuinka paljon maatiaiskasveja on yhä viljelyssä.

Tässä raportissa kuvataan viime vuosien aikana MTT Maa- ja elintarviketalouden tutkimuskeskuksessa tehtyjä maatiaiskasvien viljelyintentointeja ja kasvikuulutuksissa käytettyjä menetelmiä. Esitämme inventointien tuloksia ja näiden pohjalta suosituksia maatiaiskasvien viljelysuojelun edistämiseksi Suomessa.

Vuosina 2011-2014 teimme viljelyinventointeja paikallisomenalajikkeista, ryvässipulista sekä maatiaisviljoista. Lisäksi listasimme alkuperäiskasvilajikkeet sekä ne paikalliskannat, jotka on hyväksytty kasvilajikeluetteloon.

Inventointien ensi sijaisena tavoitteena oli löytää viljelyssä olevia maatiaislajikkeita, mutta myös täydentää kansallisia kasvigeenivarakokoelmia uusilla lajikeaidoiksi todennetuilla näytteillä. Lisäksi tavoiteena oli kehittää maatiaiskasvien lajiketunnisteita (sekä ilmiasun että genotyypin tunnisteita) myös tulevien inventointien ja lajikeaitouden todentamisen tarpeisiin. Inventoinneissa koottiin myös viljelijätietoja maatiaislajikkeista. Intenvointitietoja voi hyödyntää maatiaiskasvien viljelyn edistämistarkoituksissa.

Kehitimme ja sovelsimme erilaisia maatiaiskasvien kuulutuskeinoja eri kasviryhmille. Kaikki kasvikuulutukset julkistettiin eri medioissa ja tapahtumissa tavoittaaksemme mahdollisimman laajalti viljelijöitä ja puutarhureita, joilla on mahdollisia maatiaiskasveja. Näitä kasvikuulutuksen kautta saatuja kasvinäytteitä tutkittiin tarkemmin erilaisin arviointimenetelmin. Tavoiteena oli saada lajikeaitoja näytteitä.

Maatiaiskasvien viljelyinventointien tuloksena saimme lajikeaidoiksi tunnistettua 117 eri kantaa.Näiden lisäksi Suomessa on viljelyssä 29 maatiaislajiketta, jotka ovat kasvilajikeluettelossa.

Tämä raportti on ensimmäinen maatiaiskasvien viljelysuojelun kansallinen strategia. Strategia on koottu osana EU-rahoitteista PGR Secure projektia ja yhteistyössä Suomen kansallisen kasvigeenivaraohjelman kanssa. PGR Secure hankkeessa laadittiin kansalliset maatiaiskasvien suojelustrategiat kolmelle esimerkkimaalle: Suomeen, Italiaan ja Iso-Britanniaan. Näiden kansallisten strategioiden pohjalta koottiin ehdotus yleiseruooppalaiseksi maatiaiskasvien viljelysuojelun strategiaksi, joka ilmestyi vuonna 2014.

Avainsanat:
maatiaiskasvit, kasvigeenivarat, kansallinen suojelustrategia, in situ suojelu, Suomi

Landrace *in situ* conservation strategy for Finland

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Abstract

In Finland landraces and local strains are still cultivated to some extent, especially landraces of cereals, forages, fruits, berries and some vegetables. However, there are no comprehensive statistics on landrace cultivation.

This report provides the description of the latest Finnish landrace inventory process applied. We present the general inventory results as well as discuss recommendations for the national landrace *in situ* conservation drawn from the inventory experience.

During 2011-2014 landrace *in situ* cultivation inventories were carried out by MTT Agrifood Research Finland. The target taxa were apple (*Malus domestica*), potato onion (*Allium cepa* Aggregatum-group) and cereals (winter and spring rye (*Secale cereale*); spring barley (*Hordeum vulgare*); winter and spring wheat (*Triticum aestivum)*; oats (*Avena sativa*)). The data of conservation varieties and landraces accepted to the National List of Plant Varieties were also collated.

The aims of the inventories were to identify landraces in cultivation but also complete the national *ex situ* collections with variety-proved new accessions, to improve the quality of reference material (both genotype and phenotype identifiers) for the future use of variety verification, to collect farmer knowledge and to promote the continuity of landrace growing.

Different inventory methods were developed depending on the target taxa and facilities for variety identification. The shared method with all inventories was to prepare and release public calls or announcements to find farmers and gardeners with potential landraces to get the plant material for further evaluation.

The landrace *in situ* cultivation inventories produced results of 144 landraces, of which 117 were variety verified by the inventory projects. Some of them especially local apple variety clones and landrace strains of grass plant crops are rather commonly cultivated throughout Finland, in particular in the Central and Eastern part.

This report is the national strategy for landrace *in situ* conservation for Finland. The strategy has been compiled as part of the PGR Secure project and activities within the Finnish National Plant Genetic Resources Programme during 2011-2014. The national landrace conservation strategies prepared during the PGR Secure project in Finland, The Great Britain and Italy formed the basis for the Generic European landrace *in situ* conservation strategy published in 2014.

Keywords:

landraces, plant genetic resources, national strategy, in situ *cultivation,* in situ *conservation, Finland*

Contents

Foreword

This strategy has been compiled as part of PGR Secure project - Novel characterization of crop wild relative and landrace resources as a basis for improved crop breeding - which is funded by the EU Seventh Framework Programme, THEME KBBE.2010.1.1-03, 'Characterization of biodiversity resources for wild crop relatives to improve crops by breeding', Grant agreement no. 266394 to MTT Agrifood Research Finland. One of the elements of the project was to create national landrace conservation strategies. The Finnish strategy was prepared as the part of the activities within the Finnish National Plant Genetic Resource Programme. The set of landrace *in situ* cultivation inventories and variety verifications have been co-funded by Finnish Cultural Foundation, Uusimaa Regional Fund, MTT Agrifood Research Finland, and the Finnish National PGR Programme.

The aim of PGR Secure project was to research novel characterization techniques and conservation strategies for European crop wild relative and landrace diversity, and further, to enhance crop improvement by breeders, as a means of underpinning European food security in the face of climate change. To achieve these goals, PGR Secure had four research themes:

1. Investigation of novel characterization techniques, including: (1a) Genomics, phenotyping and metabolomics, (1b) Transcriptomics, (1c) Focused Identification of Germplasm Strategy.
2. Crop wild relative and landrace conservation, including: (2a) Europe-wide crop wild relative inventory, (2b) Exemplar national crop wild relative inventories, (2c) European crop wild relative strategy, (2d) Europe-wide landrace inventory, (2e) Exemplar national landrace inventories, (2f) European landrace strategy.
3. Facilitating breeders' crop wild relative and landrace use, including: (3a) Identifying breeders' needs, (3b) Meeting breeders' needs, (3c) Integration of conservation and user communities, (3d) Pre-breeding – channelling potential interesting germplasm into commercial breeding programmes.
4. Informatics development, including: (4a) Crop wild relative and landrace inventory information web availability, (4b) Novel characterization information web availability, (4c) Inter-information system operability.

The PGR Secure project partners were: (1) University of Birmingham (UOB), Unisted Kingdom (co-ordinator), (2) Stichting Dienst Landbouwkundig Onderzoek (DLO), The Netherlands, (3) Bioversity International (BIOVER), Italy, (4) Universita Degli Studi Di Perugia (UNIPG), Italy, (5) Julius Kühn Institut Bundesforschungsinstitut für Kulturpflanzen (JKI), Germany, (6) Nordiskt Genresurscenter (NordGen), Sweden, (7) Maa- ja elintarviketalouden tutkimuskeskus (MTT), Finland, (8) Universidad Rey Juan Carlos (URJC), Spain, (9) ServiceXS BV (SXS), The Netherlands, (University of Nottingham (UNOTT), United Kingdom, (11) European Association for Research on Plant Breeding (EUCARPIA), Switzerland (Associate Partner). The External Advisory Board members were: Carl Bulich (German Plant Breeders Association), Véronique Chable (French National Institute for Agricultural Research), Norman Ellstrand (University of California), Anton Güntsch (Berlin Botanic Garden and Botanical Museum), Anke van den Hurk (Plantum NL), Merja Veteläinen (Boreal Plant Breeding Ltd.) and John Wiersema (USDA Agricultural Research Service). The Breeders Committee members were: Steffen Beuch (Nordstaat Satzucht GmbH), Jan Leendert Herrewijn (Nickerson-Zwaan), Andreas Loock (KWS SAAT AG), Axel Schechert (Strube Research) and Fabio Veronesi (University of Perugia).

The research required the integration and collaboration of European policy, conservation and breeding sectors and the products will be disseminated Europe-wide to all appropriate stakeholders. The project, initiated by the European Cooperative Programme for Plant Genetic Resources (ECPGR) *In Situ* and On-Farm Conservation Network involves 42 European countries, as well as both large and smaller European plant breeding companies.

MTT Agrifood Research Finland was involved in preparing national in situ conservation strategies for both landraces and crop wild relatives as well as preparing both European conservation strategies for landraces and crop wild relatives.

The landrace *in situ* cultivation inventories in Finland have involved many experts providing practical work, advice and contacts. Particular gratitude for advice to **Merja Veteläinen** (Boreal Plant Breeding Ltd.), **Kaarina Paavilainen** (Finnish Food Safety Authority Evira), **Elina Kiviharju** (Finnish National PGR Programme) and for practical work to colleagues at MTT Agrifood Research Finland: **Hilma Kinnanen** (apple inventory, apple *ex situ* field collection), **Kristiina Antonius** (DNA analyses of potato onions and apples), **Pirjo Tanhuanpää** (apple DNA analyses), **Ritva Valo** (apple inventory, GIS), **Jaana Ala-Kaarre** (DNA extraction), **Leena Lohermaa** (DNA extraction), **Sirpa Moisander** (DNA extraction), **Mika Raivonen** (maps, ITC), **Merja Hartikainen** (Sesto and other databases, distribution of call material), **Outi Kasari** (print outs of call material) , the media team for the active assistance for distributing calls as well as the chairs of national PGR working groups **Terhi Suojala-Ahlfors** (vegetables, herbs and medicinal crops), **Jaana Laamanen** (fruits and berries) and **Sirkka Juhanoja** (landscape gardening plants). Many compliments also to **Krista Kettunen** for editing the manuscript to the publication of the MTT Report series.

The colleagues of the PGR Secure project have all provided discussions of great importance on landrace *in situ* conservation strategies, particular gratitude to **Valeria Negri** (University of Perugia, IT), **Renzo Torricelli** (University of Perugia, IT), **Nigel Maxted** (University of Birmingham, UK) and **Shelagh Kell** (University of Birmingham, UK).

The very special compliments go to the numerous private persons growing landraces, because without the knowledge and plant samples provided by them inventories had been impossible to carry through.

At Jokioinen 24th October 2014

Maarit Heinonen

MTT Agrifood Research Finland

1 Introduction

1.1 Need for landrace *in situ* cultivation inventories

Genetic resources of cultivated plants comprise the genepool which is available for human utilization: different species and variation within species. Plant genetic resources are important for agriculture, forestry, and also for the cultural heritage of each country and region. These plants have been adapting for centuries to local climate, soil, landscape and culture and this makes them unique. Conservation of genetic resources ensures that diversity is available also to the future needs of growers, breeders, researchers and of the entire community.

Only a few crops are used in modern agriculture and these often have a narrow genetic base. This contrasts with the large number of landraces with a substantial genetic variation used by earlier generations. The increasing genetic impoverishment may have serious consequences, especially when facing a changed climate. It has been shown that crop varieties with a narrow genetic base can be destroyed by diseases. Hence the organized preservation of genetic resources is a prerequisite for future generations to be able to face new challenges.

In cultivation or in the original growing place conserved material is subject to the varying conditions of the growing environment, and plant individuals which are better adapted to changing surroundings are continuously being selected. This may in future add new and unexpected values into those old cultivars.

Cultivation of landraces enables also wider re-use of the traditional selection of cultivated plants. New ways of utilization can be found for old cultivated varieties, the history continues in the present time. Also modern cultivars, which have the traits of producing for example health promoting substances transferred from landraces, increase the selection of the available products.

The international policies and strategies for a sustainable use of plant genetic resources for food and agriculture have emphasized also the need for *in situ* conservation. Many papers specifically referring to Europe (e.g. Veteläinen et al., 2009) have stressed the need for landrace *in situ* cultivation inventory to enable the *in situ* conservation and enhancing broad, active and sustainable use of landraces.

In Finland landraces and local strains are still cultivated to some extent, especially landraces of cereals, forages, fruits, berries and some vegetables. However, there are no comprehensive statistics on landrace cultivation.

The aims of the current Finnish landrace inventories were to identify landraces in cultivation but also complete the national *ex situ* collections with variety-proved new accessions, to improve the quality of reference material (both genotype and phenotype identifiers) for the future use of variety verification, to collect farmer knowledge and to promote the continuity of landrace growing.

This report provides the description of the latest Finnish landrace inventory process applied. We present the general inventory results as well as discuss recommendations for the national landrace *in situ* conservation drawn from the inventory experience.

1.2 Finnish National Programme for Plant Genetic Resources

The Finnish National Programme for Plant Genetic Resources was founded at 2003 to enhance conservation of genetic resources in agriculture and forestry. The programme covers plant genetic resources (PGR) both for agriculture and horticulture; and forestry. MTT Agrifood Research Finland is responsible for the coordination of agricultural and horticultural PGR and for preservation of vegetative propagated crops and some other crops at the *ex situ* field and cryo collections. The Finnish Forest

Research Institute is responsible for the conservation of genetic resources of forest trees.[1] Conservation consist not only taking care of PGR collections but enhancing sustainable use and public awareness of the national PGR. According to the Finnish constitution, all citizens and organizations are responsible for nature, its diversity, the environment and Finnish cultural heritage, and thus all contribute to the realization of the programme. (This chapter: see for more detailsVeteläinen et al. 2008; Kiviharju 2014; MTT 2014a, MMM 2001.)

The most important international agreement relevant to plant genetic resources for food and agriculture is the International Treaty on Plant Genetic Resources for Food and Agriculture. It entered into force in 2004 and Finland ratifies the Treaty during the same year. Finland is fully committed to the provisions of the Treaty and the implementing is under way on the Nordic and national level. Finland is also a member of the European Cooperative Programme for Plant Genetic Resources (ECPGR). For Finland the most important ECPGR working groups had been the ones dealing with cereals; fruits and berries; potato; forages; medicinal and aromatic plants; and on-farm and *in situ* conservation. The Nordic collaboration is very close, since the *ex situ* conservation of seed propagated crops and potato of Finnish origin is organized in the Nordic Center for Genetic Resources (NordGen) jointly with all five Nordic countries. NordGen working groups (of cereals, forage crops, fruit, berries and ornamentals, vegetables and potato, industrial crops) have been composed by experts of plant breeding and research from Nordic countries.

The National Advisory Board for Genetic Resources advises and monitors the Finnish National PGR Programme. The board has broad representation from diverse ministries, universities, research institutes, stakeholders and NGOs. The Ministry of Agriculture and Forestry in Finland appoints the board for four years period of time. The chairman of the board is a representative of the Ministry of Agriculture and Forestry. At the moment there is one full-time programme coordinator who is in charge of the agricultural and horticultural crops under the programme and also acts as the secretary of the board. One programme coordinator is in charge of the forest trees.

The PGR working groups at MTT Agrifood Research Finland have organizational responsibility for managing the *ex situ* field collections. Decisions of the long term preservation and organization of the collections are made in the national working groups established for different plant groups. There are working groups for (1) fruits and berries; (2) vegetables, herbs and medicinal crops; (3) field crops; and (4) landscape gardening. In addition there is a group working with demonstration of the PGR at the MTT headquarter at Jokioinen. The members of the working groups are recognized national experts on the respective crops and genetic resources.

One of the tasks of the Finnish National PGR Programme is to promote the possibility of landraces and old commercial cultivars to remain in active cultivation. Traditionally used plants and their old cultivated forms are part of valuable Finnish cultural heritage, which is threatened to disappear from the cultivation use. It is important to have an extensive view of what the present situation is in farming of these old plants, to enable the programme to support and enhance these activities. Finnish PGR researchers are gathering information with questionnaires, interviews and calls. Researchers are looking for growers and enthusiasts who grow and cultivate landraces and old cultivars. Researchers are also surveying old plants kept in the old yards and gardens as well as of different types of museums, for example local museums, outdoors museums and manor house museums.

As evaluated in the ten year jubilee seminar of the Finnish National PGR Programme (Kiviharju 2014, 4): During the first ten years of the programme the focus of the activities has been more in the vegetatively propagated plants. The e*x situ* field collections of MTT have been evaluated, and plant inventories are continuously made to find landraces still in cultivation but missing from the collections. Much of this work is done in the different research projects, such as the recent calls for fruit trees, potato onions, hops and cereals. Diversity of the collected material is analyzed by DNA markers when possible, to select genetically wide material and discard duplicates. Fingerprinting is developed especially for fruit and berry species. Cryopreservation provides a cost efficient way to ensure safety duplicates of vegetatively propagated plants in long term storage, and these protocols have so far developed especially for berry species. Information of vegetative collections is managed nationally, and the accession data is currently

[1] From 2015 on the National Resources Institute will be responsible for the coordination of all national programmes of genetic resources in agriculture and forestry in Finland. MTT Agrifood Research Finland, the Finnish Forest Research Institute (Metla), the Finnish Game and Fisheries Research Institute (RKTL) and the statistical services of the Information Centre of the Ministry of Agriculture and Forestry (Tike) are to be merged under a new entity called Natural Resources Institute Finland as of 1 January 2015.

being transferred to Sesto data management system of NordGen. The accumulating knowledge on the cultural history aspects of plants may serve e.g. as an attraction for increasing tourists' interest in local gardens and parks. It may also enhance the interest of home-gardeners in growing ornamentals originating from the locally adapted genetic resources. In general, well growing and healthy plants in the collections, with appropriate double collections, form a base for conservation of valuable plants, as well as for their uses. More detailed evaluation of the key traits would enhance their use. It is also important to increasingly develop cryopreservation techniques to ensure preservation, and apply DNA-markers as an identification tools.

The Finnish PGR programme of the field of agricultural and horticultural crops is responsible for conserving landraces, old bred cultivars, valuable breeding material and crop wild relatives. The national strategy for the *ex situ* field and cryo conservation is planned to be updated by 2016. The national crop wild relative conservation strategy have been prepared as part of the PGR Secure project and the activities within the Finnish National PGR Programme in 2013 (Fitzgerald 2013). Furthermore the national conservation strategy for ornamental plants has been compiled with the finance of the Ministry of Agriculture and Forestry in Finland in 2013 (Juhanoja et al. 2013).

This report is the national strategy for landrace *in situ* conservation for Finland. The strategy has been compiled as part of the PGR Secure project and activities within the Finnish National PGR Programme during 2011-2014. The national landrace conservation strategies prepared during the PGR Secure project in Finland, The Great Britain (Maxted et al. 2014) and Italy (Negri et al. 2014a) formed the basis for the Generic European landrace *in situ* conservation strategy (Negri et al. 2014b) and for the European specific landrace conservation strategy for target crops (*Avena*, *Beta*, *Brassica* and *Medicago*) (Negri et al. 2014c) published in 2014.

1.3 Definitions of landrace and *in situ* conservation

Landrace is not easily defined because of differences in crop reproduction and adaptation time required. A seed propagated landrace is a variable population, which is identifiable and usually has a local name, (generally) lacks formal crop improvement, is characterized by a specific adaptation to the environmental conditions of the cultivation area (tolerant to the biotic and abiotic stresses of that area) and is closely associated with the uses, knowledge, habits, dialects and celebrations of the people who have developed and continue to grow it (Negri et al. 2009). They are structured populations made up of several subpopulations. Also clonally-propagated crops (e.g. vines, olive trees and other crops) can be constituted of multiple genotypes (see Negri et al. 2014b-c).

In the PGR Secure project the definition of the landrace *in situ* was developed on the continuity or discontinuity of their growing history as follows (Negri et al. 2014b-c):

i. *sensu stricto* landraces are extant landraces, which have been continuously cultivated in the area which they have adapted to for decades of cultivation. They continuously maintain their link with the territory of adaptation at minimum 50 years of time. *Sensu stricto* landraces *in situ* are often under threat of extinction and thus deserve the highest attention.

ii. re-introduced landraces, are *sensu stricto* landraces that were once cultivated in a certain area, later *ex situ* preserved to genebanks, field collection or cryo collections and then reintroduced in cultivation from *ex situ* collections in the same area of previous cultivation after a certain period of time. After some period of time re-adaptation may occur.

iii. introduced landraces are landraces that originated in an area different from that where they are presently grown.

It is widely agreed across Europe (e.g. Veteläinen et al. 2009) that landraces are important components of the plant genetic resources for food and agriculture. When they are maintained *in situ* on farms and gardens they allow (Negri et al. 2014b-c):

- to maintain and develop diversity for local communities and breeding (including participatory plant breeding), as a pre-requisite to ensure food security, productivity as well as resilience to biotic and abiotic stresses in a scenario of climate change and unpredictability,

- to develop new environmentally friendly farming systems that are based on diverse varieties and answer the needs of farmers (like organic farmers) and the consumer demand for a sustainable production systems,
- to develop farming systems that rely on landraces to produce high value typical products,
- to maintain and develop different traditions and uses of a crop while extending crop and varietal uses,
- to maintain viable agro-ecosystems and useful agro-ecosystem services,
- to increase farmer capacities that are related to selection and conservation methods, improving yield and quality.

Due to the loss of landraces in modern agriculture there is a pressing need to actively conserve extant landraces *ex situ* and *in situ*.

The Convention on Biological Diversity (CBD 1992) defines *in situ* conservation as *"the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties"*.

Similarly, the Commission Directives (2008/62/EC 20 June 2008 and 2009/145/EC 26 November 2009) states that *"conservation in situ means the conservation of genetic material in its natural surroundings and, in the case of cultivated plant species, in the farmed environment where they have developed their distinctive properties"*. (Negri et al 2014b-c.)

In the Finnish landrace *in situ* conservation strategy as well as the generic European one, the term '*in situ* (on-farm)' are used for conservation activities that are carried out on-farm by farmers, but also in home and community gardens by gardeners.

1.4 Ecogeography of Finland

Lying approximately between latitudes 60° and 70° N, and longitudes 20° and 32° E, Finland is one of the world's northernmost countries. Of world capitals, only Reykjavík lies more to the north than Helsinki. The distance from the southernmost to the northernmost point in the country is 1 160 kilometer.

Finland is a Northern European country with a total area of 338,145 km^2. The land coverage consists of 230 000 km² forests, 33 000 km² water, 23 000 km² agricultural land, 9300 km² built-up area and 33 000 km² other areas. Finland's population is around 5,5 million, the majority concentrated in southern regions. Finland is the eighth largest country in Europe and the most sparsely populated country in the European Union.

Finland's climate is warmed up by the Gulf Stream causing the temperatures to be slightly higher than averages across the boreal coniferous forest zone.

In southern Finland, the growing season is 170 days, in north only 100 days. There are also large differences in the effective temperature sum: in the south it is 1 300 and in the north 500 degree days. Frost in the middle of the summer may occure in all parts of the country.

Winters of southern Finland (mean daily temperature remains below 0 °C) are usually about 100 days long, and the snow typically covers the land from about late November to mid-April. Even in the most temperate regions of the south, the harshest winter nights can see the temperatures fall to −30 °C. Climatic summers (mean daily temperature remains above 10 °C) in southern Finland last from about late May to mid-September, and in the inland, the warmest days of July can reach 35 °C.

In northern Finland, particularly in Lapland, the winters are long and cold, while the summers are relatively warm but short. The most severe winter days in Lapland can see the temperature fall down to −45 °C. The winter of the north lasts for about 200 days with permanent snow generally covers from about mid-October to early May. Summers in the north are quite short, only two to three months, but can still see maximum daily temperatures above 25 °C during heat waves.

The amount of the light in summer reduces the differences in the growing conditions to some extent since nights are short especially in central and northern parts of Finland. A quarter of Finland's territory lies within the Arctic Circle and the midnight sun can be experienced for more days the farther north one travels. At Finland's northernmost point, the sun does not set for 73 consecutive days during summer, and does not rise at all for 51 days during winter.

Climatic conditions are a decisive factor in crop production. Cultivation of wheat, oilseed and pear is restricted to southern Finland, where as rye, barley, oats, grass, onions and potato can be cultivated in most parts of the country. Cultivars that are adapted to the Finnish conditions are needed.

2 Methodology

During 2011-2014 landrace *in situ* cultivation inventories were carried out by MTT Agrifood Research Finland. The target taxa were apple (*Malus domestica*), potato onion (*Allium cepa* Aggregatum-group) and cereals (winter and spring rye (*Secale cereale*); spring barley (*Hordeum vulgare*); winter and spring wheat (*Triticum aestivum)*; oats (*Avena sativa*)). The data of conservation varieties and landraces accepted to the National List of Plant Varieties were also collated from the Finnish Food Safety Authority register (Evira 2014).

Different inventory methods[2] were developed depending on the target taxa and facilities for variety identification. The shared method with all inventories was to prepare and release public calls or announcements to find farmers and gardeners with potential landraces to get the plant material for further evaluation. This was an essential starting point for all target taxa because there is only one and limited register of landrace growers: the register of conservation varieties. Landrace call materials were prepared for both the national wide and the local or territorial search missions. The latter approach of restricted geographical location turned out especially workable because it succeeded to attract the media for spreading calls that saved costs and time. The media was especially active informing about local apple varieties and according to the media follow-up in MTT Agrifood Research Finland, there have been well over 100 news items and articles in the Finnish media. We had the unique possibility to collaborate also with national audiovisual media especially with the calls of potato onions and cereal landraces and to plan and execute two short (10-30 minutes) episodes to one magazine programme and one cooking programme. Call materials consisted of press releases for the media, short articles offered to be published in local print and digital media and trade magazines, and posters offered to public events and websites.

Call materials contained landrace descriptions as detailed as possible in order to receive only relevant information from the public. We succeeded in potato onion calls and received, indeed, only contacts and plant material of potato onions, not of other type of onions. Instead local apple variety calls produced a massive amount of contacts (near to 500) about old apple trees which informants had no or very little knowledge on their origin (of seed planted, foreign variety or local variety). Neither MTT Agrifood Research Finland nor any other expert organization in Finland had resources or valid methods to evaluate all of them.

The very important repository for landraces turned out to be the earlier studies on them dating them the early 20th century. In Finland the first collecting missions of landraces were organized by professional plant breeders who collected and studied an extensive amount of landrace samples for breeding material. Especially cereal and apple breeders collected landraces to use them in breeding programs to get winter hardiness and early maturing genetic material. (Heinonen 2009; Heinonen et. al. 2014.) These old literature offered phenotype description, sometimes also with photos or drawings, their origin and cultivation sites. This information was useful both in planning and preparing the calls and in analysing the received samples (the variety verification).

Local history data (especially family, village) printed in newspaper articles or books and old photos were also very useful if available. Problematic in using the latter source material is that collecting and analyzing is especially time consuming. During the inventory projects a web-based announcement form for all PGRFA important taxa was designed and released at the public website of the Finnish National PGR Programme (MTT 2014b).

All sorts of call material fallen upon farmer or gardener knowledge on the origin, cultivation history and description of the potential landrace. Every call material also included the contact details of whom to send information via e-mail or telephone.

[2] The detailed description of the inventory methods developed and applied will be available later after published in a scientific journal.

This preliminary data offered by the calls formed the basis for further studies. The most potential landraces were evaluated against the old literature and other knowledge available on that landrace strain and, as the most important, against farmer information about his/her landrace (see the descriptors for *in situ* inventories Negri et al. 2012). After that the potential landrace sample entered to phenotype and DNA analyses. All inventories aimed to identify single landraces and distinguishing them from other landrace strains as well as bred and foreign cultivars. As the final stage the farmer on-farm data was completed of variety verified samples.

Picture 1. The family portraits were also taken in the garden. This photo from the 1910s reveals that potato onions were grown in the kitchen garden in the south part of Finland. (Photo: Anselm Laakso/Archive of the Yläne local heritage association.)

3 Landraces *ex situ* maintained

3.1 *Ex situ* seed collections

The Nordic Genetic Resource Center (NordGen) situated in Alnarp, Sweden, is responsible for maintaining the seed collections for all five Nordic countries: Finland, Sweden, Norway, Denmark and Iceland. According to the agreement, the countries have a joint ownership to the stored material. This regional gene bank is responsible for seed storage, documentation, evaluation, characterization and regeneration of the gene bank material. The Sesto information system includes accession passport data, seed storage data, taxonomic references and checklists, cultivar information, material requests, distribution, characterization and evaluation results, simple GIS and data analysis utilities, photo archive, project and activity information, person and organization details, correspondence and library references. Sesto is also applied to the accessions of national *ex situ* field and cryo collections. (This chapter: see for more details Veteläinen et al. 2008.)

The storage conditions for material for which the countries take long and medium term responsibility are identical. Medium-term material is not monitored for viability and not regenerated. The main criterion for accepting long-term storage responsibility is that the material should be Nordic in origin. The ordinary collection contains material gathered as a result of the normal activities of the NordGen staff and the Nordic crop working groups. The special collections are larger sets of material donated to NordGen by other institutions, which normally comprise genetic stock collections or other breeding and research material. The seed store fulfils the gene bank standard for long-term storage.

The safety duplicates of the Nordic seed material has after year 2008 deposited to the new global safety storage 'Global Seed Vault' in the Svalbard Islands, Norway.

Picture 2. Long-term collections are stored in aluminum bags in deep freezers.
(Photo: Simon Jeppson/NordGen.)

There are in total 1 211 seed accessions originating from Finland in the long term *ex situ* storage at the NordGen (updated in 2008 for FAO report). Compared to the total number of stored landraces (537 accessions), the share of cereal landraces is 28 percent (154 accessions), forage grasses 59 percent (317), pulses 11 percent (40) and root plants 3 percent (12). Considerably high number of landrace accessions is in rye (81), barley (51), timothy (132) and red clover (85). Also Finnish landrace horse bean material is rather broad (24 accessions). (Table 1.) Among the Nordic countries the Finnish cereal landrace material is largest in number at the NordGen (Sesto 2014).

Table 1. The Finnish long term ex situ seed material at the NordGen (updated in 2008).

Crop vernicular name (taxon)	Cultivar	Breeding material	Landrace	Wild	Other	TOTAL
Cereals in total	**127**	**51**	**154**	**0**	**1**	**333**
Oat (*Avena sativa*)	26	5	13	0	0	44
Barley (*Hordeum vulgare* spp. *vulgare*)	39	38	51	0	1	129
Rye (*Secale cereale*)	29	0	82	0	0	111
Wheat (*Triticum aestivum* ssp. *aestivum*)	33	6	7	0	0	46
Bristle oat (*Avena strigosa*)	0	0	1	0	0	1
Hordeum vulgare ssp. *spontaneum*	0	2	0	0	0	2
(Forage) grasses in total	**29**	**12**	**317**	**339**	**11**	**713**
Common bent (*Agrostis capillaris*)	1	2	2	32	0	42
Redtop (*Agrostis gigantean*)	0	1	0	0	0	1
Creeping bent (*Agrostis stolonifera*)	0	0	2	2	0	4
Meadow foxtail (*Alopecurus pratensis*)	0	1	13	24		38
Sweet vernalgrass (*Anthoxanthum odoratum* ssp. *odoratum*)	0	0	2	7	0	9
Smooth brome (*Bromus inermis*)	1	0	0	0	0	1
Cock´s foot (*Dactylis glomerata*)	2	1	8	11	1	23
Turfy hairgrass (*Deschampsia cespitosa* ssp. *cespitosa)*	0	0	14	14	0	28
Wavy hair-grass (*Deschampsia flexuosa*)	0	0	4	11	0	15
Awned wheat grass (*Elymus caninus*)	0	0	0	7	0	7
Elymus fibrosus	0	0	0	4	0	4
Elymus mutabilis	0	0	0	3	0	3
Fescue (*Festuca*)	0	0	0	1	0	1
Sheep fescue (*Festuca ovina*)	0	0	3	10	0	13
Meadow fescue (*Festuca pratensis*)	6	1	6	5	3	21
Red fescue (*Festuca rubra*)	3	2	8	37	0	50
English ryegrass (*Lolium perenne*)	1	2	0	0	0	3
Alfalfa (*Medicago sativa*)	1	0	0	0	0	1
Reed canarygrass (*Phalaris arundinacea*)	0	1	3	68	0	72
Alpine timothy (*Phelum alpinum*)	0	0	1	2	0	3
Turf timothy (*Phelum pratense* ssp. *bertolonii*)	0	0	0	1	0	1
Timothy (*Phelum pratense* ssp. *pretense*)	7	1	132	48	3	191
Northern meadow grass (*Poa pratensis* spp. *alpigena*)	0	0	0	6	0	6
Common meadowgrass (*Poa pratensis)*	1	0	18	17	0	36
Bluegrass (*Poa trivialis)*	0	0	5	4	0	9
Alsike clover (*Trifolium hypridum*)	1	0	5	3	1	10
Red clover (*Trifolium pratense* ssp. *pratense*)	4	0	85	17	3	109
White clover (*Trifolium repense* ssp. *repense*)	1	0	6	5	0	12
Pulses in total	**36**	**24**	**40**	**3**	**2**	**105**
Garden pea (*Pisum sativum*)	16	20	2	0	1	39
Field pea (*Pisum sativum* ssp. *sativum*)	9	2	0	0	0	11
Field pea (*Pisum sativum* ssp. *arvense*)	9	0	3	0	0	12
Bird vetch (*Vicia cracca*)	0	0	4	1	0	5
Horse bean (*Vicia faba*)	2	2	24	0	1	29
Broad bean (*Vicia faba* var. *equina*)	0	0	2	0	0	2
Bush vetch (*Vicia sepium*)	0	0	5	2	0	7
Root plants in total	**3**	**0**	**12**	**0**	**5**	**19**
Sugarbeet (*Beta vulgaris* var. *altissima*)	1	0	0	0	0	1
Swede (*Brassica napus* ssp. *napobrassica*)	1	0	5	0	4	10
Turnip for flash-and-burn cultivation (*Brassica rapa* ssp. *rapa*)	0	0	7	0	1	8
Other in total	**12**	**5**	**7**	**1**	**0**	**25**
Buckwheat (*Fagopyrum esculentum*)	0	0	7	0	0	7
Spring turnip rape (*Brassica rapa* ssp. *oleifera*)	6	1	0	0	0	7
Canola (*Brassica napus* ssp. *oleifera*)	4	4	0	0	0	8
Arctic raspberry (*Rubus arcticus* ssp. *arcticus*)	0	0	0	1	0	1
Flax (*Linum usitatissimum*)	2	0	0	0	0	2
Species in total	**206**	**92**	**537**	**357**	**19**	**1211**

The column 'Other' contains accessions of unknown origin. Source: Veteläinen et al., 2008.

3.2 Ex situ field collections

According to the national strategy for conservation of plant genetic resources (MMM 2001), MTT Agrifood Research Finland is the main responsible organization for the conservation of *ex situ* field collections of vegetatively propagated crops in Finland. MTT has a network of research stations located in different parts of the country. The inventory of MTT plant collections was initiated on 2003 and most stations had collections of horticultural crops which included material that fulfilled the criteria for long-term conservation set out by the National PGR Programme. (This chapter: for more details Veteläinen et al. 2008.)

There are about two thousand accessions stored in field collections (field genebanks) at five MTT research stations; the most north collection is situated in the Arctic Circle and the most south one in the coastline in the very south of Finland (latitude 60˚ N).

MTT Jokioinen (N 6746497 E 308760): field collections (Japanese quince, sea-buckthorn), temporary collections and demonstration plantations of horticultural crops

MTT Piikkiö (N 6702755 E 254733): main field collections of horticultural crops (groups of *Allium*, *Armoracia*, *Fragaria*, *Malus*, *Prunus*, *Pyrus*, *Rheum*, *Ribes*, *Rubus*) and landscape gardening plants (also managing collections at The College of Land based studies in Tuorla and arboretum Yltöinen)

MTT Laukaa (N 6910906 E 448055): cryopreservation of horticultural crops (esp. groups of *Ribes*), field collections of some horticultural crops and landscape gardening plants

MTT Sotkamo (N 7110171 E 564975): field collection of herbs and medicinal plants.

MTT Rovaniemi (N 7384679 E 456072): field collection of Allium (potato onion) and some landscape gardening plants

The national field hop collection (*Humulus lupulus*) is hosted outside the MTT, at **HAMK University of Applied Sciences in Mustiala** (N 6746922 E 324379) nearby MTT Jokioinen.

Under the Finnish National PGR Programme the guidelines for the long term preservation of fruits and berries (Aaltonen et al. 2006a); vegetables, herbs and medicinal plants (Ahokas et. al 2006); and woody ornamentals (Aaltonen et. al 2006b) have been described for the practical implementations of the genetic resource preservation in the *ex situ* field collections. The guidelines are planned to be updated by 2016.

The guidelines describe the scope of MTT Agrifood Research Finland clone archives, list the necessary measures for the *ex situ* preservation of genetic resources, and present the criteria for selecting material to be conserved. Instructions are included for the establishment and renewal of the clone archives and for selecting alternative *ex situ* preservation methods.

Guidelines are given for those fruit and berry species/genera that are traditionally grown in Finland such as strawberries (*Fragaria*), apples (*Malus*), plum and bullace (*Prunus domestica*), sour cherry (*Prunus ceracus*), pear (*Pyrus*), black currant (*Ribes nigrum*), red raspberry (*Rubus idaeus*), as well as some more

recent and less commonly cultivated species/genera, such as saskatoon (*Amelanchier*), chokeberry (*Aronia*), Japanice quinces (*Chaenomeles*), sea buckthorn (*Hippophae rhamnoides*), blackberry (*Rubus alleghonirnsis*), arctic bramble (*Rubus arcticus*), cloudberry (*Rubus chamaemorus*), sweat rowanberry (*Sorbus*) and blueberries (*Vaccinium*).

Guidelines are given for those vegetable, herb and medicinal plant species/genera that are found in the Finnish collections or those that have potential in the future. The species/genera include onions (*Allium* ssp), *Brassicas* turnip, swede, cabbages and seakale, rhubarb (*Rheum*), horse radish (*Amoracia rusticana*), mints (*Mentha* ssp), mountain-tobacco (*Arnica montana*), sweet-flag (*Acorus calamus*) and hop (*Humulus lupulus*).

Guidelines are given for those woody ornamental species/genera that have for decades grown in Finland and proved to be hardy in our climatic conditions. Most of the species are scrubs, but some small trees as well as creeping ground covering species are included. Some species and genera are traditionally and commonly grown, others are specialties, hardy individuals of in Finland rarely grown species. Most species have been field-tested for many years. Among ornamental scrubs there are clematises (*Clematis*), forsythias (*Forsythia*), hydrangeas (*Hydrangea*), honeysuckles (*Lonicera*), mock oranges (*Philadelphus*), cinquefoils (*Potentilla*), bird cherries (*Prunus*), rhododendrons and azaleas (*Rhododendron*), spireas (*Spirea*), lilacs (*Syringa*), snowballs (*Viburnum*) and weigelas (*Weigela*). Roses are in two groups, pimpinella-leaved roses (*Rosa* Pimpinellifolia hybrids) and other roses (*Rosa*). In ground covering shrubs cotoneasters (*Cotoneaster*), bush honeysuckles (*Diervilla*), creeping cherries (*Prunus*), creeping currants (*Ribes*), dewberries and blackberries (*Rubus*) and low species of willows (*Salix*) are included. In specialties there are actinidias (*Actinidia*), serviceberries (*Amelanchier*), pea shrubs (*Caragana*), flowering quinces (*Chaenomeles*), brooms (*Cytisus*), fothergillas (*Fothergilla*), beauty bushes (*Kolkwitzia*), common privets (*Ligustrum*), magnolias (*Magnolia*), pierises (*Pieris*), Chinese magnolia vines (*Schisandra*), sorbarias (*Sorbaria*), rowans (Sorbus), snowberries (*Symphoricarpos*), and common yews (*Taxus*).

The Finnish National PGR Programme has set a principle that each accession approved for long term conservation in field collections should have a safety duplicate. The safety duplicate should be preserved in a different location for security reasons. In addition, a sample should be stored in the cryopreservation security storage. So far about 20 percent of vegetatively propagated material have a duplicate in another site, or is stored using different methods. Cryopreservation techniques were introduced at MTT Agrifood Research Finland in 2004, as the first unit in the Nordic countries exploiting this method for plant material. Longterm preservation was first started with *Humulus*, *Prunus* and *Rubus* materials.

The field *ex situ* collection material has been grouped into ligneous ornamentals; perennial ornamentals; herbs and spices; fruits and berries; and vegetables. Decisions on long-term storage responsibility have so far been taken for 359 accessions of vegetables, fruits and berries, herbs and spices (in total 39 species/genera). However, there are a considerable amount of temporary accessions waiting for the variety verification and long term decisions. The share of landraces is 58 percent (209 accessions). For the most part the cultivars are Finnish and the rest are those old foreign cultivars which have had great importance for food production in Finland. The exception is the long term collection of strawberries (*Fragaria* x *ananassa*) which includes foreign cultivars (8 accessions) internationally agreed to conserve (Aaltonen et. al 2006a.). (Table 2.)

Table 2. Accessions of the long term *ex situ* material of vegetables, fruits and berries, herbs and spices in the Finnish field genebanks.

Taxon name	Crop vernacular name	Cultivars	Breeding material	Landraces	Wild	TOTAL
Acorus calamus	Sweet-flag	1	0	1	0	1
Allium cepa Aggregatum group	Potato onion	1	5	16	0	22
Allium cepa Ascalalonicum group	Shallot	0	6	0	0	6
Aronia Prunifolia group		1	0	0	0	1
Artemisia abrotanum	Southernwood	2	0	0	0	2
Bergenia crassifolia	Bergenia	2	0	0	0	2
Chaenomeles japonica	Japanese Quince	3	14	0	0	17
Fragaria vesca	Wild strawberry	1	0	0	0	1
Fragaria x *ananassa*	Strawberry	17	0	0	0	17
Hippophae rhamnoides	Sea-buckthorn	5	0	0	0	5
Humulus lupulus	Hop	0	0	7	0	7
Leonorus officinalis		0	0	1	0	1
Levisticum officinale	Lovage	0	0	1	0	1
Malus domestica	Apple	18	0	50	0	68
Melissa officinalis	Lemon balm	1	0	0	0	1
Mentha ×piperita	Peppermint	3	0	1	0	4
Mentha arvensis ssp. *piperascens*		0	0	1	0	1
Mentha spicata var.crispa		0	0	1	0	1
Myrrhis odorata	Cicely	0	0	1	0	1
Origanum vulgare	Oregano	0	0	0	1	1
Prunus cerasus	Sour cherry	0	0	33	0	33
Prunus domestica ssp. domestica	Plum	0	0	15	0	15
Prunus domestica ssp. insititia	Bullace	0	0	6	0	6
Prunus fruticosa	Dwarf cherry	1	0	0	0	1
Pyrus communis	Pear	2	0	5	0	7
Rheum rhabarbarum	Rhubarb	2		30	0	34
Rhodiola rosea	Rose root	1	0	0	7	8
Ribes Glossularia group	Gooseberry	4	1	9	0	14
Ribes nigrum	Black and green currant	10	0	20	1	31
Ribes Rubrum group	Red and white currant	7	0	11	0	18
Rubus alleghiensis	Allegheny Blackberry	1	0	0	0	1
Rubus arcticus	Arctic bramble	3	0	0	0	3
Rubus arcticus ssp x *stellarcticus*		2	0	0	0	2
Rubus chamaemorus	Cloudberry	0	0	0	1	1
Rubus idaeus	Rasberry	11	0	0	0	11
Rubus idaeus x *allegheniensis*		0	2	0	0	2
Rubus nessensis		0	0	0	1	1
Rubus x *binatus*	Nectar bramble	1	3	0	0	4
Vaccinium Angustifolium group	Lowbush Blueberry	0	0	0	7	7
Species in total		100	31	209	18	359

Sources: Sesto and the databases of the Finnish National PGR Programme. Updated in October 2014. Note: considerable amount of termporary *ex situ* accessions are waiting for the long term decision (e.g. accessions of apple, sea-buckthorn). Furhermore, 126 accessions of woody ornamental species have been accepted for long term *ex situ* preservation (situation in 2013) and 180 termporary accessions of perennials are waiting for the long term decision.

4 Conservation varieties

4.1 Subsidiary system for conservation varieties

Following the obligations of CBD and FAO Global Plan of Action, a landrace project financed by the Government of Finland and implemented by the Finnish Food Safety Authority (Evira) was initiated in 1997. Furthermore in 1998 a new Council Directive (98/95/EC) opened the possibility of establishing specific "*conditions under which seed may be marketed in relation to the conservation* in situ *and the sustainable use of plant genetic resources*". The Parliament of Finland included the idea in the Seed Trade Act of 2000 (728/2000) by allowing the seed of landraces to be marketed uncertified in order to conserve genetic diversity. As a result of this cereal landrace on-farm inventory project, the first European support system for on-farm cultivation of landraces and old cultivars was developed in Finland. (For more details Paavilainen 2009.)

The support has been paid as a special subsidiary within EU agri-environmental scheme. During the first agri-environmental scheme 2000-2006, the cultivation of landraces, old commercial cultivars and strains derived from old commercial cultivars of cereals and forages were subsidized. Later in the scheme for years 2007-2013, the paid support has been extended also to pulses (pea and broad bean).

Of all the conservation varieties only landraces can be marketed as seed: old commercial varieties and old modified commercial varieties cannot. Seed production is also limited to species most commonly and/or traditionally grown in Finland: oats (*Avena sativa* L.), barley (*Hordeum vulgare* L.), rye (*Secale cereale* L.), wheat (*Triticum aestivum* L. emend. Fiori et Paol.), red clover (*Trifolium pratense* L.), white clover (*T.repens* L.), alsike clover (*T. hybridum* L.), timothy (*Phleum pratense* L.), meadow fescue (*Festuca pratensis* Huds.), smooth-stalked meadowgrass (*Poa pratensis* L.), cock's foot (*Dactylis glomerata* L.), red fescue (*Festuca rubra* L.), turnip for slash-and-burn cultivation (*Brassica rapa* L. subsp. *rapa*), swede (*B. napus* L. var. *napobrassica* (L.) Rchb.), broad bean (*Vicia faba* L.) and pea (*Pisum sativum* L.).

The aim of the subsidiary system is to enhance the continuity of cultivation of landraces and old cultivars by offering annual economic support based on the contracted cultivated area (1 ha) to a farmer. Furthermore, the aim is also to enlarge the landrace cultivation: the registration of a landrace not existing on the National List of Plant Varieties gives the right to the farmer to market seed in Finland. For the new agri-environmental scheme for years 2014-2020 it is under negotiation to enlarge economic support also to those horticultural species most commonly and/or traditionally grown in Finland. In addition some reformation actions to ease and lower expenses of the farmer in registration process have been suggested to attract more farmers and also associations.

Registration of conservation varieties (undergoing a modified DUS-test) is a task of the Finnish Food Safety Authority 'Evira', which decides on applications and keeps the register of approved conservation varieties. Evira is also the Designated Authority for seed certification in Finland and it approves the seed lots of landraces for marketing. During the registration process Evira consults experts of the National PGR Programme.

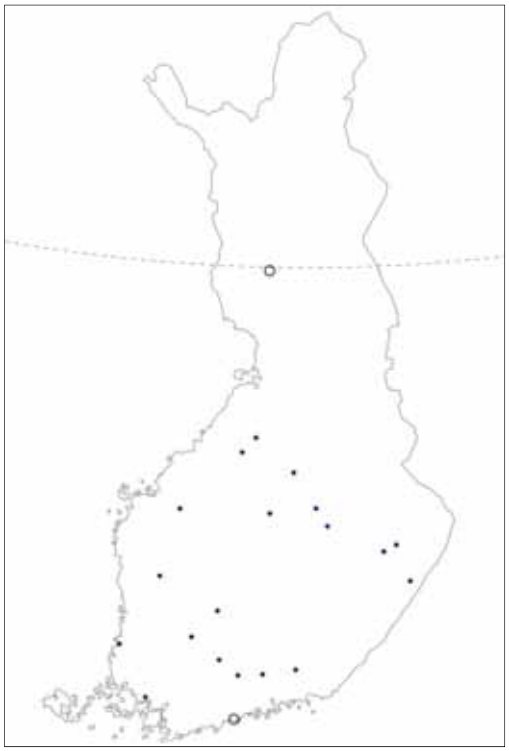
4.2 Current conservation varieties

Today there are 19 registered conservation varieties. Furthermore, eight local strains of forages and one landrace potato have been accepted to the National List of Plant Varieties (Table 3). Among the species, rye is the most common conservation variety (eight diverse landraces) and red and white clovers (in total seven diverse landraces). Among the cereals, traditionally rye landraces remained longest in cultivation in Finland (Heinonen 2009) and are still found in cultivation.

Table 3. Number of conservation varieties and landraces at the National List of Plant Varieties in Finland.

Taxon name	Crop vernacular name	As conservation variety	As cultivar	TOTAL
Brassica rapa var. *napobrassica*	Swede	0	1	1
Brassica rapa subsp. *rapa*	Turnip (in slash-and-burn cultivation)	2	0	2
Avena sativa	Oat	1	0	1
Trifolium spp.	Red and white clover	7	3	10
Hordeum vulgare	Barley	1	0	1
Phleum pratense	Timothy	0	2	2
Secale cereal	Rye	8	1	9
Solanum tuberosum	Potato	0	1	1
In total		19	8	27

Source: Evira 2014. Updated in August 2014.



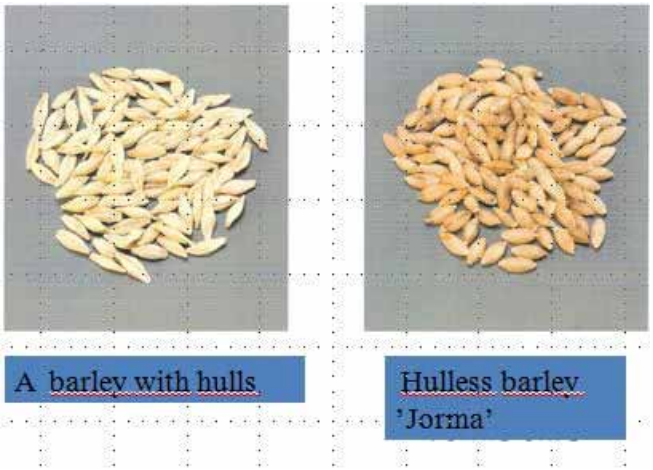
The conservation varieties have been concentrated to central and southern part of Finland (Picture 3). Traditionally in central and eastern parts of the country landraces survived in cultivation longer than in the most southest part (Heinonen 2009). The Northern Finland has scattered settlements and the climate conditions set limits for farming, therefore landrace cultivation must still exist to some extent. However no conservation variety is registered in the North but one northern landrace potato is accepted to the National List of Plant Varieties.

Picture 3. The distribution of the farmers with registered conservation varieties. (Map: Mika Raivonen/MTT)

One of the conservation varieties is landrace hulless barley 'Jorma' (Heinonen & Timonen 2012). The hulless barley (*Hordeum vulgare* L. var. *nudum* Hook. f.) is a form of domesticated barley with an easier-to-remove hull. Hulless barley is an ancient food crop and the landrace variety 'Jorma' is the only hulless barley variety still in cultivation in Finland. This particular landrace originates from at least the 17th century and research shows that seed samples dating back more than 400 years are the same type as 'Jorma'. It is four-row type hulless barley with a long and weak straw.

'Jorma' is named after the first name of a seed seller who received a small amount of hulless barley, selected seeds, and released it as a commercial variety in the 1970's. Nowadays 'Jorma' barley is registered as a landrace following EU regulations allowing seed production. One organic farm has cultivated it for over 50 years in eastern Finland and nowadays three other farms nearby also cultivate it (location N 62^0 E 30^0).

The amount of flower and other milling output are significantly plentiful compared to barley with hulls. According to the dietary mineral and protein analysis, 'Jorma' contains more protein, starch and beta-glucan than barley with hulls. These nutritional qualities have balancing effects for cholesterol and blood sugar.



Picture 4. Hulless barley seeds compared to a barley with hulls. (Photo: Laitinen family album.)

The farmer family itself has been active with introducing different kinds of 'Jorma' dishes in local groceries and institutional kitchens, such as in hospitals. The regional development project of the niche foodstuff has also arranged meetings with those involved in barley processing and use of the product, such as local mills and bakeries.

These companies and the family farm have designed and developed the 'Jorma' product line which includes different hulled grains, flours, flakes, but also pies (especially the traditional Karelian pie), 'talkkuna' flour[3], unleavened barley bread, cookies and modern vegetarian sausages. 'Jorma' both niche and traditional products are also included in the menu of a local restaurant.

Picture 5. The farmer of the 'Jorma' barley showing seedlings cultivated to assess germination. (Photo: Maarit Heinonen/MTT.)

The old local potato (*Solanum tuberosum*) strain 'Puikula' grown in Lapland was registered as 'Lapland's Puikula, in the European Union under the terms of Protected Designation of Origin (PDO)[4] in 1997. It has been accepted to the National List of Plant Varieties in Finland amongst bred cultivars.

'Puikula' has been grown in the northern part of the Nordic countries since the late 18th century. In the early decades of the 20th century it was the oldest and the most important variety in Lapland. Today the cultivation of 'Puikula' covers about half of the commercial potato growing area in Lapland.

[3] Talkkuna (no English name) is powdered and dried barley flour. Barley flour is first boiled and then left to dry in a sauna. In some parts of Finland, powdered peas, oats, rye or beans have been added to the mixture. Talkkuna is still often eaten in Finland mixed with milk, buttermilk or soured whole milk and sweetened with sugar. In the old days, talkkuna was mixed with buttermilk to form thick dough of which egg-sized lumps could be formed. These were a very handy snack when, for instance, people worked long days on the fields.

[4] The PDO can be assigned to a product which has a fixed association with a geographical region, and whose quality or characteristics are essentially or exclusively sourced from a specific geographical area. The production of the product must also take place in the region to which its name refers.

It is late-maturing, and has long and strong stems and small leaflets. The stems and white flowers contain anthocyanin colour. The long, almost banana-shaped, tubers are white-skinned. The flesh colour is bright yellow and the dry matter and starch contents are high. 'Puikula' is a very late cultivar. Its dormancy mechanism is so strong that it is almost impossible to sprout it during the storage period in winter. This means that it has very good storing before planting. The proper time is 60 to 90 days compared with other varieties, which need two to four weeks sprouting time in the spring. (MTT 2014b, Veteläinen 2001.)

'Puikula' behaves as a typical short-day variety in the long-day environment. On the other hand it can utilize quite well the best growing period at the beginning of August. 'Puikula's' yield potential is high, but the growing season in the north is always too short and therefore the tubers are always harvested immature. Although the yield is low the immature harvesting date gives the tubers their special taste, which is lost if the tubers are fully mature. (Hannukkala 2009.)

The PDO designation has drawn a lot of attention to this local potato strain from the north and allowed it to become a popular landrace product in homes and professional kitchens in Finland.

Photo: Asko Hannukkala/MTT

5 Cereal *in situ* inventory

5.1 Background

Untill the early 20th century, Finnish agriculture was based on cultivating cereal landraces which had during centuries adapted to the northern environment and cultivation methods used by farmers. The modernisation of agriculture with bred cereal cultivars led to the marginalisation of cereal landraces. The cultivation of cereal landraces started to outstandingly decline during 1930's, and they almost disappeared, except landrace winter rye, till 1960's (Table 4).

Table 4. Estimated shares of landraces in cultivation (%) during 1902-1955 in Finland.

Crop vernicular name (Taxon)	1902	1920-21	1930	1935-39	1950	1951	1955
Oat (*Avena sativa*)	~100	33.8	~5-10	7.2	0.9	2,1	0.2
Spring barley (*Hordeum vulgare* spp. *vulgare*)	~100	69.3	~25	23.1	3.9	3.6	1.0
Winter wheat (*Triticum aestivum* ssp. *aestivum*)	~100	100	~60-70	30.1	2.3/‹5.0	‹5.0	0.7
Spring wheat (*Triticum aestivum* ssp. *aestivum*)	~100	94.3	~5	2.9	0.1	~0.1	0.1
Winter rye (*Secale cereale*)	~100	100/81.9	~70-80	23.4/35.9	28.9	34.3	19.0

Note: The shares are based on early plant breeders' estimations on cultivated varieties. The first agricultural statistics of cultivated varieties was collected in 1950. Source: Heinonen 2009.

The winter rye stayed in cultivation since the new bred rye varieties were not winter resistant enough for especially the winter conditions of central, eastern and northern part of Finland. Because of harsh growing conditions for spring wheat, they were rare and cultivated only in the southernmost part of the country and mostly foreign cultivars were used. Instead well adapted landraces of winter wheat were usable for farmers for wheat production. Foreign bred cultivars of oats and spring wheat offered more yield and especially the cultivars bred in Sweden (Svalöf breeding company) were suitable for southern and central parts of Finland where the most of the arable land exists. Gradually also the Finnish cereal breeders (the private Hankkija breeding institute and public breeding institute of former MTT) new cultivars, especially barley, gained more favour among farmers across Finland. (Heinonen 2009.)

Finnish cereal breeders in the early 20th century collected very extensively landraces from all parts of the country. For example during 1910-1920 the director of the private breeding company J. O. Sauli collected 176 landrace samples of winter wheat, almost 200 samples of landrace barley and considerable amount of samples of landrace spring wheat and studied their phenotype and cultivation properties for the use of breeding programmes. The first Finnish bred cereal varieties very based on these materials. Unfortunately these landrace collections had disappeared after they were utilized in the breeding programmes. (Heinonen 2009.)

When the Nordic Gene Bank (currently NordGen) was established in 1979 and it started the collection missions in order to get landrace material, the only small amount of landraces were any more in cultivation. It was only possible to get extensive diverse seed material from landrace rye and thus the landrace rye accessions are the largest today in NordGen (81 accessions). The high value of landrace rye is seen also today, because they consists half of the total number of the conservation varieties (8 from 19).

5.2 Previous inventories

The planned collecting missions and inventories have been essential for conservation of plant genetic resources for food and agriculture. In Finland the starting-signal was made in the late 1970's when the Nordic countries started their joint gene bank activities. Before the Nordic Gene Bank activities, the first

professional plant breeders collected and studied an extensive amount of landrace samples for breeding material during the early 1900s. (This chapter see for more details: Heinonen &Veteläinen 2009.)

The Nordic Gene Bank (currently NordGen) conducted its inaugational landrace collecting missions during the late 1970s and early 1980's in Finland (Table 5). The focus was on the cereals and forages. During 1979-1983 for example samples of barley were collected. The Finnish State Seed Testing Station tested 62 barley samples of which 22 were landraces. Tested samples of the collecting missions were sent to *ex situ* maintenance to gene bank.

Since the first collecting missions only few NordGen collection projects have been launched in Finland and the target species have been other than cereals. In addition to the NordGen collection missions there are a number of *ex situ* accessions that have been collected through national activities and they have been donated to the NordGen.

Table 5. The NordGen organized collecting missions in Finland.

Year	Collection	Species
1979	Collection in North Finland	mainly forages; some cereals
1980	Collections in Finland	mainly rye; also barley, forages, turnip and broad beans
1981	Collection in Ostrobotnia, Finland	mainly rye; also barley, forages, swedes, turnip and broad beans
1982	Collection in Finland	mainly forages and rye; also barley
1983	Collection in Finland	mainly forages and rye; also barley
1994	Conservation of potato onions, Finland (collected before NordGen)	potato onions
2000	Collection in Finland	natural populations of reed canary grass
2007	Collection in Northern Finland	grasses, clovers

Source: Veteläinen *et al.*, 2008.

The landrace inventory for cereals and forage grasses during 1996-1998 carried out by Seed Testing Department at the Plant Production Inspection Center (currently the Finnish Food Safety Authority,'Evira') resulted in total 39 samples from farmers. These along with some other landraces and old commercial cultivars (Table 6) were field-tested under the varietal trials based on the UPOV guidelines for conducting tests for distinctness, uniformity and stability. The DUS-testing method was adapted in order to distinguish them from commercial cultivars.

Table 6. The number of samples in the varietal testing in the landrace inventory 1996-1998.

Source of the samples	Oat		Barley		Spring Rye		Winter Rye		Wheat		Timothy	
	CV	LR	CV	LR	CV	LR	CV	LR	CV	LR	CV	LR
Farmers	2	0	0	1	0	5	0	24	0	0	0	8
NGB	0	0	0	0	0	9	0	2	0	0	0	6
Breeder seed	0	0	0	0	1	0	2	0	0	0	0	0
Foreign seed	0	0	0	0	2	0	0	0	0	0	0	0
Comparison material	4	0	4	0	0	0	0	0	4	0	0	0

CV = old commercial cultivar; LR = landrace; Comparison material = breeder's seed was compared to the sample of the KTTK and/or the NGB of the same cultivar (Source: Heinonen & Veteläinen 2009).

The project also draw a proposal on how varietal research, registration and *on-farm* maintenance of cereal, forage grasses and legume landraces and old commercial cultivars could be organized in Finland.

The landrace inventory for cereals during 2006-2008 realized by MTT Agrifood Research Finland and the Finnish National Plant Genetic Programme for Agricultural and Horticultural Plants resulted in total 46 notifications of cereal landraces or old commercial varieties from farmers (Table 7). The most of landraces were still in cultivation; only in four cases they were stored old seed.

Rye was the most cultivated among cereal landraces in Finland. In the mid 1990's, the landrace project received 29 samples of seed which were informed as rye landrace; and in the mid 2000's the number was 21 (only including landraces in cultivation). Other cereal landraces were very rare in cultivation.

Table 7. The received notifications of landraces and old commercial varieties of cereals.

	Oat	2-row barley	4/6-row barley	Spring rye	Winter rye	Spring wheat	Winter wheat
Landrace	4*	3**	-	1	23***	1	1
Old cultivar	4	2	2	-	3	1	1

* In two cases landrace oats had not been cultivated for a long time.
** The very same old two-row barley was in cultivation in three separate farms.
*** In two cases a rye has not been cultivated for a long time. In three cases the very same landrace winter rye was in cultivation in two separate farms.
Source: Heinonen & Veteläinen 2009.

The seed material received from the farmers was evaluated for phenotype traits by experts on cereal genetic resources. No DNA analyses were available. As the result of the inventory, some new landrace samples were sent to the NordGen to be conserved *ex situ*. We also returned one *ex situ* stored landrace rye back to on-farm cultivation to the family farm where it was collected originally.

5.3 Current *in situ* inventory

During the PGR Secure project the cereal landrace inventory data collected during 2006-2008 was updated and a new call for landrace cereals was launched in 2012.

We had a unique possibility to plan and execute a call for cereal landraces for audiovisual format with a TV producer in January 2012 for Finnish television. The call was part of the cooking programme of a famous Finn chef specialised in local food (Heikin lähiruokaa). One episode of 30 minutes was dedicated to landrace cereals and food prepared from them. The episode was shot in location in a landrace farm which has for decades cultivated the hulless landrace barley 'Jorma'. The episode included the interviews of the farm family, local home baker, the chef of the local restaurant and the researcher (Maarit Heinonen) of the specific landrace and in general the value of landraces and the importance to keep them in cultivation for niche and traditional products. The episode was put out for the first time in March 2012 and had several re-runs. The cooking programme had in average of 30 000 viewers. We produced press releases for the media about the programme and several newspaper articles.

Picture 6. The TV group turned the farmer's kitchen to the recording studio for one episode of the cooking programme. (Photo: Maarit Heinonen.)

During the re-inventory the farmer descriptor data (Negri *et. al.* 2012) was updated and collected of the earlier inventory. The current cereal inventory brought out only few new farmers to the contact list of earlier inventory in 2008. We received the new contacts and three of them were potential landrace growers of rye and the rest growers of old commercial cultivars. The phenotype evaluation has not been finished yet (by August 2014). Despite the TV programme, the call material may have not reached

farmers extensively enough. However the number of landrace cereal cultivating farmers seems to be small and it may be possible that extant landraces are not possible to find any more.

Cultivation and management of landraces on-farm in Finland lean greatly on the silent knowledge and actions of farmers. Only five farmers have registered their landrace cereals or old cereal cultivars to the subsidiary system. In most cases, landraces are for subsistence cultivation and self-evident part of their lifestyle. Many of the farmers have not thought that they are on-farm maintainers but just ordinary farmers who happen to cultivate landraces in small scale.

Compared to modern cultivars, cultivation of low yielding cereal landraces and old cultivars require acquaintance, more work and a special motivation. In most cases the motivation wells from the cultural and symbolic value of a landrace. A typical landrace farmer in Finland cultivates an old winter rye strain which has been grown in the same family or in the home village for several generations. She or he cultivates it approximately if not every year but every second or third year in the area of 1-2 hectares, and uses the yield for own consumption (for e.g. baking rye bread).

The ageing of landrace cultivating farmers and the declining number of farms in general are true challenges for cereal landrace maintenance on-farm. There is need to study the on-farm management also from a broader perspective and to find ways to commit new and different kind of actors in on-farm management. Also the possibilities to develop niche products may stimulate new farmers to landrace cultivation. To encourage this, documentation of landrace knowledge is needed. Different perspectives not forgetting the cultural and historical knowledge of a single landrace is valuable for developing and marketing landrace-based niche and traditional products, services and other uses.

6 Potato onion *in situ* inventory

6.1 Background

Potato onion (*Allium cepa* Aggregatum Group) is close to shallot (Ascalonicum Group), although producing larger bulbs and a stronger aroma (Picture 7 in right. Photo: Maarit Heinonen/MTT).

Potato onion is a northern onion type, supposedly of eastern origin. Potato onions were commonly cultivated in Finland until the mid 20th century, after which time the cultivation declined and has become very limited. In the Europe, the tradition of growing potato onions has been strong in Finland and in the Baltic states. Supposedly the plant material has in the due course arrived from Russia, during 19th century.

Finnish potato onions with long cultivation history are all landraces; no breeding programme has been in Finland. Instead, at the eastern neighbouring country Estonia, there has been a breeding programme for potato onion. During the very recent years some potato onion clones with long cultivation history in Estonia and Estonian cultivar 'Jögeva' have been imported to Finland.

Potato onion needs about 100 days to grow in southern Finland, but in northern Finland only about 70 days because of the longer daylight hours. Because potato onion is especially adapted to the northern environment, when cultivated in the south, usually heat treatment is required to avoid flowering.

MTT Agrifood Research Finland and University of Helsinki collected Finnish potato onions still in cultivation during 1980's. 112 samples were collected nationwide, mainly they were cultivated in the northern Finland and only few samples received from western coastline. The samples were evaluated according to the morphological descriptors. Morphologically rich variation amongst Finnish landrace potato onions were seen in size (from one to several centimetres in diameter); in shape (from round to oval); in colour of the skin (from light yellow to light red); in resistance to virus and other deceases; in division of bulbs (from a couple to 15); and in storage resistance. In the end of 1990's MTT Agrifood Research Finland conducted cultivation tests with some potato onion samples in order to revive their cultivation in the northern Finland. (Ahokas et al. 2006.)

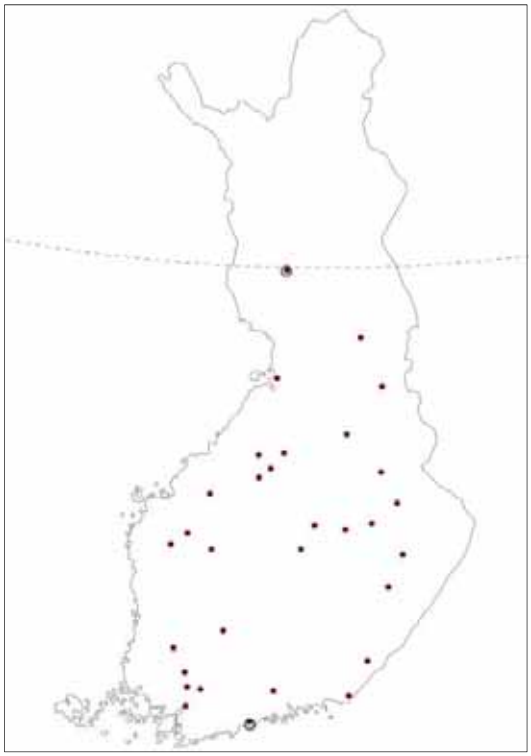
Only small part of this material finally entered to the *ex situ* field collections at MTT Agrifood Research Finland. Later some new samples were included to the field collection. After establishing the Finnish National PGR Programme in 2003 the collection got the official status. Number of 29 accessions of potato onions were accepted for long term storage in field collections at MTT Agrifood Research Finland. The main field collection is situated in the Article Circle and the duplicate collection in the very south of Finland (latitude 60^{0} N).

6.2 Current *in situ* inventory

During the PGR Secure project with an additional finance from the Finnish National PGR Programme an inventory of *in situ* maintained potato onions in Finland was carried out during 2011-2013. In order to contact growers calls for potato onions still in cultivation was widely released via both local and national media (print and audiovisual), public events (e.g., garden fairs), website of the Finnish National PGR Programme with short announcements, articles and posters (see e.g. the poster below).

The first call for landrace potato onions was announced via a national TV show. The call (document of 10 minutes) broadcasted in October 2011 on the national TV channel in prime time. The TV show had about 50 000 viewers.

After releasing the calls for potato onions that were known to grow at least 50 years, we received 45 contacts of potato onion growers from throughout Finland (see the map of the sample distribution below). They were asked to send a couple of bulbs as a sample for DNA analysis and 41 samples were received. The bulbs were planted in pots and grown in a glasshouse in order to produce 1-2 centimetres long green shoot for DNA extraction.



Pictures 8. and 9. In the left: The poster of the call for potato onions. (Poster: Maarit Heinonen/MTT.) In the right: The potato onions in cultivation in Finland. (Map: Mika Raivonen/MTT.)

At the same time the 29 accessions of potato onions and six accessions of shallots (*A. cepa* Ascalonium-group) in the national collection were also analysed. No identification of accession genotypes has previously been carried out. Two bulb onions (*A. cepa* Cepa-group) (one yellow and one red) were used as standards. Altogether, 72 samples were analysed with nine microsatellite DNA markers developed for the *Allium cepa* group (Fisher & Bauhmann 2000).

In total, 22 different genotypes (clones) were found by DNA analysis[5]. Sixteen of them are already preserved in the national field collections. About half of the accessions of the national collection are overlapping clones (duplicates). Among the *in situ* cultivated samples there were six genotypes that did not exist in the national field collection yet, but which have been included as the result of the PGR Secure project. The DNA analyses provide a basis to structure the collection, which in turn can be useful information for phenotype analyses and for the use of the material for commercial purposes. As the result of the DNA analyses the genetically overlapping clones have been rejected from the national field

[5] The detailed results of DNA analysis (by K. Antonius) will be available later after published in a scientific journal.

collection. One shallot accession which turned out to be same as one of the potato onion accessions is also rejected.

By tradition potato onion clones have been handed out to other home gardeners. *In situ* collected material includes two particularly widespread potato onion landraces: the northern and eastern types. Additionally, four other landrace potato onion types have been cultivated in at least three different localities (municipalities). In most cases landrace potato onions are kept for several decades in the family. Many maintainers have also taken the potato onion bulbs along when moving to another locality. Today only one grows potato onions for local markets, while all other maintainers grow them for home consumption. In Finland potato onions are traditionally cultivated from the bulbs, not from the seeds.

After the active inventory we have received several (ten) new contacts of potato onion growers. The inventory process needs to be continued and the new clones DNA studied in the case if they contain new genotype not identified yet.

During the inventory project some preliminary tests of nutrition content (quercetin) of potato onions were carried out. In average all the four potato onion clones tested contained twice as much quercetin compared to *Allium cepa* red bulbs. Different potato onion clones were also tested in three top chef restaurants in Finland. The chefs valued the intensive and strong aroma of potato onions. (Suojala-Ahlfors et al. 2014.)

Potato onions are very potential to niche landrace products. Recently they have raised interest abroad, namely among British suppliers of supermarkets (see Kell et al. 2014).

Pictures 10. and 11. In the left: Finnish potato onion collection at MTT Agrifood Research Finland. (Photo: MTT Archive.) In the right: The very robustly grown Finnish potato onion samples at NIAB Innovation Farm (Cambridge, UK) raised interest among visitors during and after the joint PGR Secure/EUCARPIA conference. (Photo: Maarit Heinonen/MTT.)

7 Apple *in situ* inventory

7.1 Background

The first apples (*Malus domestica*) known to be grown already in the 16th century in some rare gardens in southern parts of Finland. The saplings were imported from Baltic countries, Russia, Denmark, Germany and south of Sweden. However regular cold winters destroyed the first apple orchards time after time. Gradually enthusiasts in manors and farms planted seeds of the foreign apples in order to achieve winter resistant local apple varieties for local growing conditions. During the centuries of trails, some valuable local apple varieties were born and spread to local cultivation and were named, such as 'Huvitus', 'Lavia' and 'Grenman' by their birth place (garden, village or the planter of the seed). (Kinnanen & Antonius 2006; Heinonen et al. 2014.)

Fifty accessions of local apple varieties have been accepted for long-term storage in the Finnish national *ex situ* field collection, and the identification these of accession genotypes had been carried out. It was known that about 30 local apple varieties described in old Finnish pomological literature were still missing from the collection. Furthermore, it was unclear whether all the varieties in the apple collection were genuine since name confusions are known to be common. The data of origin and morphological descriptions of the collection of apples were in many cases limited and scattered.

7.2 Current apple *in situ* inventory

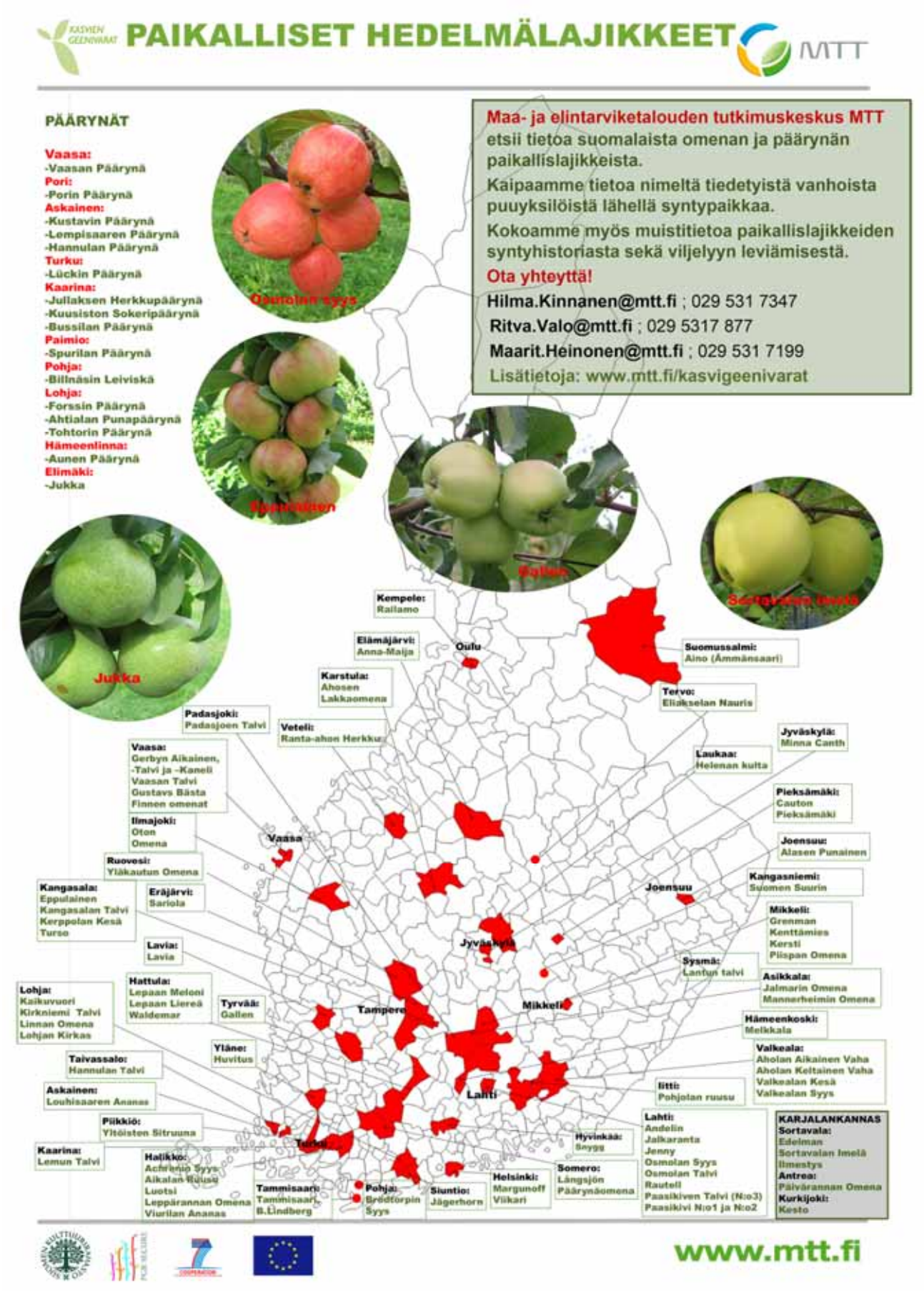
During the PGR Secure project with co-finance from the Finnish Cultural Foundation, the Uusimaa Regional Fund, MTT Agrifood Research Finland and the Finnish National PGR Programme an inventory of *in situ* maintained local apple varieties (landrace apples) was carried out during 2011-2014.

Because the collection of apple material had originally been collected mainly from the nurseries the collection holder had received very limited grower contacts and information. Hence the current call materials needed to be based on the list of local apple varieties gathered from a range of Finnish pomological literature of the late 19th and early 20th centuries.

While we searched for potato onions *in situ* on taxa level, we needed to approach the landrace *in situ* inventory of apples differently on the local variety level. We listed 80 local apple varieties with their given names and their origin municipality. We searched only for original mother trees and/or old trees crafted from the mother tree of those varieties.

During the inventory we became aware of about the additional 20 local apple varieties originating from the northern Finland and that have not been described in the old pomological literature but met the criteria of the local variety (spread to local cultivation). We included those local varieties in the *in situ* cultivation inventory.

In order to contact growers calls were widely released via local and national print and audiovisual media and public events (e.g., garden fairs) with short announcements, articles and posters.



Picture 12. The poster of the national call for landrace apples and pears in Finland. (Poster: Maarit Heinonen, Hilma Kinnanen and Mika Raivonen/MTT).

Picture 13. We also produced an annual calendar of local apple varieties with collaboration of the Finnish home economics organisation (called the Martha organisation). For each month one local apple variety was presented with apple drawing. The website of the Martha organisation also offered every month an apple recipe. The calendar was used both as call material and as for public awareness. (Local apple calendar 2013: Kirsi Mäkinen /Martha organisation and Hilma Kinnanen/MTT)

In addition, we produced regional call materials for regional targeted search for eastern, southern and south-western parts of Finland for those local apple varieties which originate from these areas (see posters above. Posters: Maarit Heinonen and Hilma Kinnanen/MTT).

In total, leaf samples from 268 single apple trees were selected for DNA genotype analysis. In average, leaf and apple samples from 2-5 separate trees per the one studied variety were needed in order to compare and to establish which one is the original one in the case when mother tree was already dead. For the most of the trees we received leaf samples for DNA analysis and apple samples for phenotypic analysis from the growers via mail posted. The growers were instructed for sample handling very detailed in order to avoid incorrect samples.

Picture 14. MTT researchers collecting leaf samples from the mother tree of local apple variety 'Huvitus' from the original old and vanished garden, with the guidance of the local informant (in right). The news of the DNA results and this picture travelled fast in whole Finland to via the Finland's leading news and picture agency STT-lehtikuva in 2011. (Photo: Maarit Heinonen/MTT.)

We visited 75 old gardens where the local apple varieties were known to originate or where an old tree of a potential genuine variety exists in order to interview growers as well as to gather leaf and apple samples and visual material (photos, observation).

Leaf samples were used for DNA extraction and were analyzed with eight microsatellite DNA markers (Liebhard et. al. 2002)[6]. The *in situ* cultivated samples were compared with those accessions preserved in the national collection and also morphological descriptors were included in the analyses.

Picture 15. A potential genuine local apple variety (in left) was compared to the apple sample of the same name in the national *ex situ* field collection. (Photo: Hilma Kinnanen/MTT.)

During the inventory project we identified a hundred local apple varieties with valuable genetic resources. Due to the laborious identification process, for now (situation in October 2014) the apple inventory has produced results of variety verification for 57 local apple varieties and the phenotypic and DNA-fingerprinting analyses are still ongoing with 40-44 candidates. Nine local apple varieties listed have not been able to locate, because we have received any grower information of them.

The local apple variety *in situ* cultivation inventory revealed several missing accessions at the national *ex situ* field collection and also some accessions that were not variety verified and were incorrectly named. The inventory yielded also phenotype and genotype identifiers of every local apple variety for the needs of both conservation and sustainable use. The farmer knowledge and historic origin data have also been added as essential background data to these identifiers. The list of home gardeners (over one hundred) and the locations of the variety verified old apple trees will serve also as a backup resource for the national collection. The completed DNA reference data of local apple varieties enables future inventories which are aimed to yield information on number of trees found still *in situ*. The inventory data also enables the development an identification service for citizens who wish to know more about the varieties in their old gardens. The inventory showed the large interest of citizens on old apple trees but also weak and limited knowledge of their origin.[7]

In addition to apple calls we prepared also a call for local pear varieties with same methods as apple calls. We received some potential mother trees or old trees crafted from them but had technical problems in DNA extraction and also the lack of financial and personal resources to continue the inventory. The inventory of local pear varieties need to be accomplished in the near future before the mother trees and old trees of pears as well as that generation who still remembers the origin of the old trees in their gardens will vanish.

[6]The detailed results of DNA analyses (by K. Antonius and P. Tanhuanpää) will be available later after published in a scientific journal. Some results are presented in Garkava-Gustavssona et al. 2013.

[7] The results of the local apple inventory will be utilized in writing the book of Finnish local apple varieties in 2015. This book will offer the morphologic descriptions of one hundred varieties as well as the description of their origin and birthplaces.

8 Conclusions and recommendations

8.1 Recommendations for landrace *in situ* conservation in Finland

On the basis of the information gathered during the inventory projects the following recommendations for a future Finnish *in situ* conservation strategy for landraces are drawn. Recommendations are as follows:

i. to complete the national *in situ* inventory with all crops and ornamental plant species

Extensive information of landraces in cultivation is essential for the implementation of the Finnish National PGR Programme in order to enable support and encouragement for *in situ* management and use. Landrace *in situ* inventories need to be continued and more crops should be involved. The more effort should be put on collecting farmer/gardener based knowledge on their landraces. For example, information on cultivation practices and use is needed. There is also a need for DNA identification for the variety verification, especially for vegetatively propagated crops. DNA marker profiles and reference data need to be broadened in two levels: (1) among already studied crops (potato onion, fruits, berries, potato) both for reliable incorporation of new genotype samples in the *ex situ* collections and for verifying landraces in cultivation; (2) DNA identification of crops not yet analysed (esp. some vegetables, ornamental plants). DNA reference data is useful in the evaluation of later collected *in situ* cultivation material and reveals if the material is *ex situ* preserved. In order to collect the required information and landraces local and territorial NGOs (e.g. associations of local heritage, rural and home economics, youth and museums) are potential collaborators. They have also an important role in preserving landraces locally in living plant collections and on the farms and gardens.

ii. to promote safe landrace conservation

More efforts are needed to encourage farmers, especially young ones, for active landrace *in situ* management. For thus, it is important to further develop the existing conservation *in situ* support programme towards less bureaucratic and costly form. Also, informal support tools (farmer networks etc.) are needed. Even support tools also for horticultural on-garden management need to be established. On-garden conservation network would serve also as an essential backup reserve for field collections of horticultural crops which are increasingly under the threat of plant pests, viruses and bacteria (e.g. apple proliferation fytoplasma and *Erwinia amylovora*).

iii. to promote the sustainable and active use of landraces

In order to promote landrace use more research on their characteristics are required. In addition, research on resistance traits both for abiotic and biotic stresses are needed. More emphasis on characterization of nutrition and other quality properties of landraces is needed. In order to develop market opportunities for landrace niche products, promoting local food chains is required. We are also lacking knowledge on consumer desirable landrace products. Actions are needed to broaden landrace user community and to attract alongside breeders and farmers/gardeners also other users such as schools, local museums, public and private historic garden owners, local heritage associations, rural and home economics association, youth associations.

iv. to promote landrace re-introduction from *ex situ* collections back to on-farm management

Landrace re-introduction back to on-farm management will diversify the genetic base of landraces on farms. Continued evolution on crops may provide new gene combinations for plant breeding and other use.

v. to intensify promotion of landrace awareness among stakeholders and the public

Further awareness of the significance and value of landraces is needed. Both local and nation wide promoting events, e.g. seminars, public events ("ask and show landraces"), provide a forum for exchanging knowledge between scientists and local people serving the aims of both identifying new landrace accessions and of promoting their cultivation and use. Teaching and lecturing activities at universities and agricultural and horticultural schools educate the new generation to value landraces and use them actively. An example comes from the Finnish National PGR Programme where experts are currently preparing learning materials for elementary, high and technical school levels with the project funding of the Ministry of Education and Culture in Finland. The aim is to include landrace knowledge into the official syllabuses of Finnish education system. Web-based Finnish landrace information site need also be improved and detailed information on more taxa should be provided (MTT 2014c). Since 2013 the joint newsletter 'Geenivarat' of the Finnish national genetic resources programmes have provided news in the field of conservation, sustainable use and research on the topic (Geenivarat 2013 and 2014). The active awareness building aims also to gain more national support for research on landraces and for development work on their sustainable use.

Picture 16. Local heritage associations maintain their local cultural heritage and usually uphold local museums with traditional buildings and tools (e.g. for farming and housekeeping). Maintaining local landraces and other heritage plants can easily be involved to their activities. The local development project by MTT studied the possibilities for collecting and maintaining local plant heritage by local museum actors and heritage associations (Heinonen et. al. 2014). (Photo: Maarit Heinonen/MTT.)

8.2 Conclusion

The resent landrace *in situ* cultivation inventories produced results of 144 landraces, of which 117 were variety verified by the inventory projects (Table 8). Some of them especially local apple variety clones and landrace strains of grass plant crops are rather commonly cultivated throughout Finland, in particular in the Central and Eastern part.

Table 8. Number of identified and variety verified landraces in on-farms/in gardens in Finland.

Crop vernacular name	Scientific name	Total no. of *in situ* accessions	Registered as conservation variety	Accepted to the Finnish Plant Variety List
Potato onion	*Allium cepa* Aggregatum Group	41[1]	0	0
Swede	*Brassica rapa* var. *napobrassica*	2	0	1
Turnip (in slash-and-burn cultivation)	*Brassica rapa* subsp. *rapa*	2	2	0
Oat	*Avena sativa*	4	1	0
Red and white clover	*Trifolium* spp.	10	7	3
Barley	*Hordeum vulgare*	3	1	0
Timothy	*Phleum pratense*	2	0	2
Rye	*Secale cereal*	21[2]	8	1
Apple	*Malus domestica*	57[3]	0	0
Potato	*Solanum tuberosum*	2	0	1[4]

[1]Includes several same clones. In total 22 different clones identified.
[2] Includes some duplicates (i.e. same landrace is cultivated in two or three farms).
[3] Mother trees or old clones; one accession per local variety. In total identified about 100 LR apple varieties. 40-44 samples are still under variety verification (phenotype and DNA-fingerprinting).
[4] Landrace 'Puikula' cultivated and packed in Lappland has been awarded by the EU quality mark 'Protected desination of origin (PDO)' since 1997.
Note: Except of some potato onions and rye *in situ*, all inventoried landraces are extant in their original area and no duplicated accessions are included to the table.

For promotion of use and appreciation of landrace value we need more verified and diverse scientific, farmer and consumer knowledge on national landraces found *in situ* and preserved *ex situ*. Furthermore, these goals support to meet the current EU genetic resources policy which is shifting from conservation to sustainable use of agricultural genetic resources (European Commission 2013).

Currently landraces are grown mainly for home consumption and only few landrace based products are available for consumers, with three exceptions. One potato landrace registered under the terms of Protected Designation of Origin (PDO) and the traditional turnip for slash-and-burn cultivation which are retail traded nationwide. One conservation variety of barley has regional markets to its niche products. Although 19 seed propagated landraces are registered as conservation varieties mainly there are cultivated in one single farm. Eight seed propagated landrace varieties are accepted in the National List of Plant Varieties and these have larger cultivating area with many farmers. Twelve old local varieties have gained the trademark FinE© (Finnish Elite) for the horticultural plant varieties as proof that they are also valuable and well-adabted for cultivation in the northern conditions of Finland. In addition, one third of the landrace apple varieties are widely marketed by nurseries. Consequently, they are now common in home gardens in Finland. The total cultivation area of each landrace apple variety ranges from a handful of gardens to hundred or in some cases to thousands of gardens. A handful of horticultural farms have commercial apple production with landrace varieties.

Typically landrace products are occasionally sold in local market places, events, small bakeries and agritourism farms as typical or niche products. However, Finns are more and more interested on landrace products. According to the recent national study (Tienhaara et. al. 2013) consumers are willing to buy regularly or occasionally landrace plant products: apples, bread and potatoes.

National PGR are not only the basis of the food security, but they also carry along the information of the biological cultural heritage. Finnish landrace plants have been selected into cultivation due to their culinary, esthetical and cultural properties. Therefore the spectrum of their variation can be wide, and thus they are well suited in displaying diversity in the different times of history.

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10 Annex

Table 9. The variety verified landraces in situ cultivation.

GENUS	SPECIES	SUBTAXA	CROPNAME	Local variety name	Municipality	Coordinates
Allium	*cepa*	Aggregatum	potato onion		Seinäjoki	N 6969472 E 289403
Allium	*cepa*	Aggregatum	potato onion		Kajaani	N 7122366 E 535415
Allium	*cepa*	Aggregatum	potato onion		Suomussalmi	N 7196846 E 590345
Allium	*cepa*	Aggregatum	potato onion		Suomussalmi	N 7196846 E 590345
Allium	*cepa*	Aggregatum	potato onion		Tervo	N 6980546 E 485945
Allium	*cepa*	Aggregatum	potato onion		Koski TL	N 6730246 E 288645
Allium	*cepa*	Aggregatum	potato onion		Virolahti	N 6716548 E 538583
Allium	*cepa*	Aggregatum	potato onion		Valtimo	N 7063668 E 588847
Allium	*cepa*	Aggregatum	potato onion		Kangasala	N 6817818 E 344597
Allium	*cepa*	Aggregatum	potato onion		Helsinki	N 6676428 E 385311
Allium	*cepa*	Aggregatum	potato onion		Helsinki	N 6676428 E 385311
Allium	*cepa*	Aggregatum	potato onion		Konnevesi	N 6944178 E 464711
Allium	*cepa*	Aggregatum	potato onion		Kontiolahti	N 6935618 E 622209
Allium	*cepa*	Aggregatum	potato onion		Kurikka	N 6952328 E 263461
Allium	*cepa*	Aggregatum	potato onion		Kaavi	N 6984278 E 574231
Allium	*cepa*	Aggregatum	potato onion		Kuopio	N 6974418 E 533451
Allium	*cepa*	Aggregatum	potato onion		Haapajärvi	N 7069768 E 417823
Allium	*cepa*	Aggregatum	potato onion		Salo	N 6700928 E 286667
Allium	*cepa*	Aggregatum	potato onion		Lappeenranta	N 6771148 E 567535
Allium	*cepa*	Aggregatum	potato onion		Alavus	N 6944408 E 326355
Allium	*cepa*	Aggregatum	potato onion		Juuka	N 7015848 E 613295
Allium	*cepa*	Aggregatum	potato onion		Reisjärvi	N 7055458 E 399973
Allium	*cepa*	Aggregatum	potato onion		Enonkoski	N 6885718 E 599931
Allium	*cepa*	Aggregatum	potato onion		Kärkölä	N 7093948 E 438619
Allium	*cepa*	Aggregatum	potato onion		Evijärvi	N 7030948 E 324169
Allium	*cepa*	Aggregatum	potato onion		Rovaniemi	N 7376938 E 443221
Allium	*cepa*	Aggregatum	potato onion		Nivala	N 7090338 E 399577
Allium	*cepa*	Aggregatum	potato onion		Taivalkoski	N 7272628 E 557083
Allium	*cepa*	Aggregatum	potato onion		Ylistaro	N 6969472 E 289403
Allium	*cepa*	Aggregatum	potato onion		Loimaa	N 6752968 E 285331
Allium	*cepa*	Aggregatum	potato onion		Oulu	N 7210018 E 428107
Allium	*cepa*	Aggregatum	potato onion		Huittinen	N 6790868 E 267767
Allium	*cepa*	Aggregatum	potato onion		Liperi	N 6935618 E 622209
Allium	*cepa*	Aggregatum	potato onion		Pukkila	N 6724508 E 422155
Allium	*cepa*	Aggregatum	potato onion		Somero	N 6726858 E 309549
Allium	*cepa*	Aggregatum	potato onion		Somero	N 6726858 E 309549
Allium	*cepa*	Aggregatum	potato onion		Pöytyä	N 6757938 E 251229
Avena	*sativa*		oats	Heljä	Kouvola	N 6749528 E 483271
Avena	*sativa*		oats		Virolahti	N 6716348 E 538663

Avena	*sativa*		oats		Sastamala	N 6807018 E 287947
Avena	*sativa*		oats		Savitaipale	N 6785038 E 536751
Brassica	*rapa*	*rapa*	turnip	Eno	Joensuu	N 6945848 E 642395
Brassica	*rapa*	*rapa*	turnip	Remes	Kärsämäki	N 7095788 E 439223
Brassica	*napus*	*napobrassica*	swede	Simo	Kaarina	N 6706868 E 245991
Hordeum	*vulgare*		barley	Jorma	Kitee	N 6889048 E 664223
Hordeum	*vulgare*		barley		Virolahti	N 6716348 E 538663
Hordeum	*vulgare*		barley		Nokia	N 6822998 E 316925
Malus	*domestica*		apple	Huvitus	Pöytyä	N 6757938 E 251229
Malus	*domestica*		apple	Ranta-ahon herkku	Veteli	N 7032213 E 341165
Malus	*domestica*		apple	Ranta-ahon kultainen	Veteli	N 7032213 E 341165
Malus	*domestica*		apple	Valkealan syys	Kouvola	N 6748378 E 483461
Malus	*domestica*		apple	Gerbyn aikainen	Pietarsaari	N 7067368 E 297120
Malus	*domestica*		apple	Gerbyn Kaneli	Pietarsaari	N 7067368 E 297120
Malus	*domestica*		apple	Gerbyn Astrakaani	Pietarsaari	N 7067368 E 297120
Malus	*domestica*		apple	Vaasan talvi	Pietarsaari	N 7067368 E 297120
Malus	*domestica*		apple	Gallen	Kaarina	N 6702755 E 254733
Malus	*domestica*		apple	Eliakselan Nauris	Tervo	N 6970731 E 486437
Malus	*domestica*		apple	Aino	Suomussalmi	N 7195422 E 595046
Malus	*domestica*		apple	Sortavalan imelä	Kuopio	N 6973672 E 534723
Malus	*domestica*		apple	Edelman	Liperi	N 6936471 E 628413
Malus	*domestica*		apple	Ilmestys	Lohja	N 6686082 E 329992
Malus	*domestica*		apple	Jägerhorn	Raasepori	N 6648326 E 305635
Malus	*domestica*		apple	Yläkautun omena	Ruovesi	N 6874028 E 348052
Malus	*domestica*		apple	Yltöisten sitruunaomena	Kaarina	N 6702755 E 254733
Malus	*domestica*		apple	Pieksämäki	Pöytyä	N 6757938 E 251229
Malus	*domestica*		apple	Padasjoen talvi	Padasjoki	N 6796618 E 395929
Malus	*domestica*		apple	Grenman	Mikkeli	N 6837758 E 510042
Malus	*domestica*		apple	Kersti	Mikkeli	N 6837758 E 510042
Malus	*domestica*		apple	Inkilä	Mikkeli	N 6837758 E 510042
Malus	*domestica*		apple	Piispan omena	Mikkeli	N 6837758 E 510042
Malus	*domestica*		apple	Peltolan omena	Mikkeli	N 6837758 E 510042
Malus	*domestica*		apple	Kaikuvuori	Lohja	N 6686082 E 329992
Malus	*domestica*		apple	Linnan omena	Lohja	N 6686082 E 329992
Malus	*domestica*		apple	Björn Lindberg	Lohja	N 6686082 E 329992
Malus	*domestica*		apple	Kirkniemen talvi	Lohja	N 6686082 E 329992
Malus	*domestica*		apple	Päivärannan omena	Lohja	N 6686082 E 329992
Malus	*domestica*		apple	Helenan kulta	Laukaa	N 6910202 E 446531
Malus	*domestica*		apple	Kustaan paras	Laihia	N 6988220 E 249530
Malus	*domestica*		apple	Jalkaranta	Orimattila	N 6749388 E 436270
Malus	*domestica*		apple	Ahosen lakkaomena	Karstula	N 6973772 E 388103
Malus	*domestica*		apple	Suomen Suurin	Kangasniemi	N 6863558 E 484439
Malus	*domestica*		apple	Kerppolan Kesä	Kangasala	N 6817254 E 348601
Malus	*domestica*		apple	Eppulainen	Kangasala	N 6817254 E 348601
Malus	*domestica*		apple	Alasen Punainen	Joensuu	N 6943512 E 641303
Malus	*domestica*		apple	Pohjolan Ruusu	Iitti	N 6761063 E 452928

Malus	*domestica*		apple	Snygg	Hattula	N 6778769 E 355923
Malus	*domestica*		apple	Margunoff	Espoo	N 6665740 E 371385
Malus	*domestica*		apple	Viikari	Kemiönsaari	N 6677916 E 263997
Malus	*domestica*		apple	Lepaan Liereä	Hattula	N 6778769 E 355923
Malus	*domestica*		apple	Lepaan Meloni	Hattula	N 6778769 E 355923
Malus	*domestica*		apple	Achrenin syys	Salo	N 6695264 E 280350
Malus	*domestica*		apple	Luotsi	Salo	N 6695264 E 280350
Malus	*domestica*		apple	Aikalan Ruusu	Salo	N 6695264 E 280350
Malus	*domestica*		apple	Leppärannan omena	Salo	N 6695264 E 280350
Malus	*domestica*		apple	Viurilan Ananas	Salo	N 6695264 E 280350
Malus	*domestica*		apple	Sariola	Nousiainen	N 6732341 E 227317
Malus	*domestica*		apple	Anna-Maija	Pihtipudas	N 7027572 E 428443
Malus	*domestica*		apple	Louhisaaren ananas	Mietoinen	N 6732156 E 222397
Malus	*domestica*		apple	Brödtorpin syys	Karjaa	N 6648326 E 305635
Malus	*domestica*		apple	Lohjan kirkas	Lohja	N 6686082 E 329992
Malus	*domestica*		apple	Rautell	Asikkala	N 6783188 E 421383
Malus	*domestica*		apple	Viki	Oulu	N 7213738 E 427123
Malus	*domestica*		apple	Elina	Tyrnävä	N 7182688 E 436273
Malus	*domestica*		apple	Jukarainen	Simpele	N 6814750 E 624666
Phleum	*pratense*		timothy	Nokka	Rauma	N 6790328 E 205085
Phleum	*pratense*		timothy	Vähäsöyrinki	Nivala	N 7091078 E 399079
Secale	*cereale*		spring rye	Juuso	Hämeenlinna	N 6765144 E 362513
Secale	*cereale*		winter rye	Eelis-Antti	Kiuruvesi	N 7059068 E 480367
Secale	*cereale*		winter rye	Haukipuro	Haapavesi	N 7114038 E 420793
Secale	*cereale*		winter rye	Iivo	Liperi	N 6935228 E 622627
Secale	*cereale*		winter rye	Joppe	Orimattila	N 6742438 E 431157
Secale	*cereale*		winter rye	Leivonen	Viitasaari	N 6994968 E 442521
Secale	*cereale*		winter rye	Mansikka-ahon Vihtori	Kuopio	N 6974758 E 533617
Secale	*cereale*		winter rye	Pääkkölä	Haapavesi	N 7114038 E 420793
Secale	*cereale*		winter rye	Taavetti	Liperi	N 6935228 E 622627
Secale	*cereale*		winter rye		Tervo	N 6980768 E 487843
Secale	*cereale*		winter rye		Kaavi	N 6983988 E 575195
Secale	*cereale*		winter rye		Ulvila	N 6824598 E 242415
Secale	*cereale*		winter rye		Riistavesi	N 6976628 E 558485
Secale	*cereale*		winter rye		Keuruu	N 6905198 E 381425
Secale	*cereale*		winter rye		Hirvensalmi	N 6834558 E 488403
Secale	*cereale*		winter rye		Utajärvi	N 7181748 E 472311
Secale	*cereale*		winter rye		Alavieska	N 7118318 E 368883
Secale	*cereale*		winter rye		Lieksa	N 7040436 E 631633
Secale	*cereale*		winter rye		Sastamala	N 6826448 E 287679
Secale	*cereale*		winter rye		Joensuu	N 6940578 E 663125
Secale	*cereale*		winter rye		Kuopio	N 6959718 E 552149
Solanium	*tuberosum*		potato	Lemin punanen	Lemi	N 6769878 E 543493
Solanium	*tuberosum*		potato	Puikula	Lapland (Rovaniemi)	N 7376284 E 442783
Trifolium	*pratense*		white clover	Isomäki	Kauhava	N 7002828 E 300715
Trifolium	*repens*		red clover	Isokallio	Hausjärvi	N 6740878 E 392315

Trifolium	*repens*		red clover	Lahtua	Orivesi	N 6842378 E 359879
Trifolium	*repens*		red clover	Lyydia	Karvia	N 6897218 E 268989
Trifolium	*repens*		red clover	Perttuli	Maaninka	N 7002908 E 515467
Trifolium	*repens*		red clover	Sirppilahden Johanna	Kuopio	N 6974758 E 533617
Trifolium	*repens*		red clover	Tarimaalainen	Vesilahti	N 6801247 E 318974
Trifolium	*repens*		red clover	Turunen	Kuopio	N 6974758 E 533617
Trifolium	*repens*		red clover	Vesilahtelainen	Vesilahti	N 6801247 E 318974

Coordinates ETRS-TM35FIN. Coordinates are not precise points of the landrace in situ cultivation because of privacy protecting reasons of private persons.

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