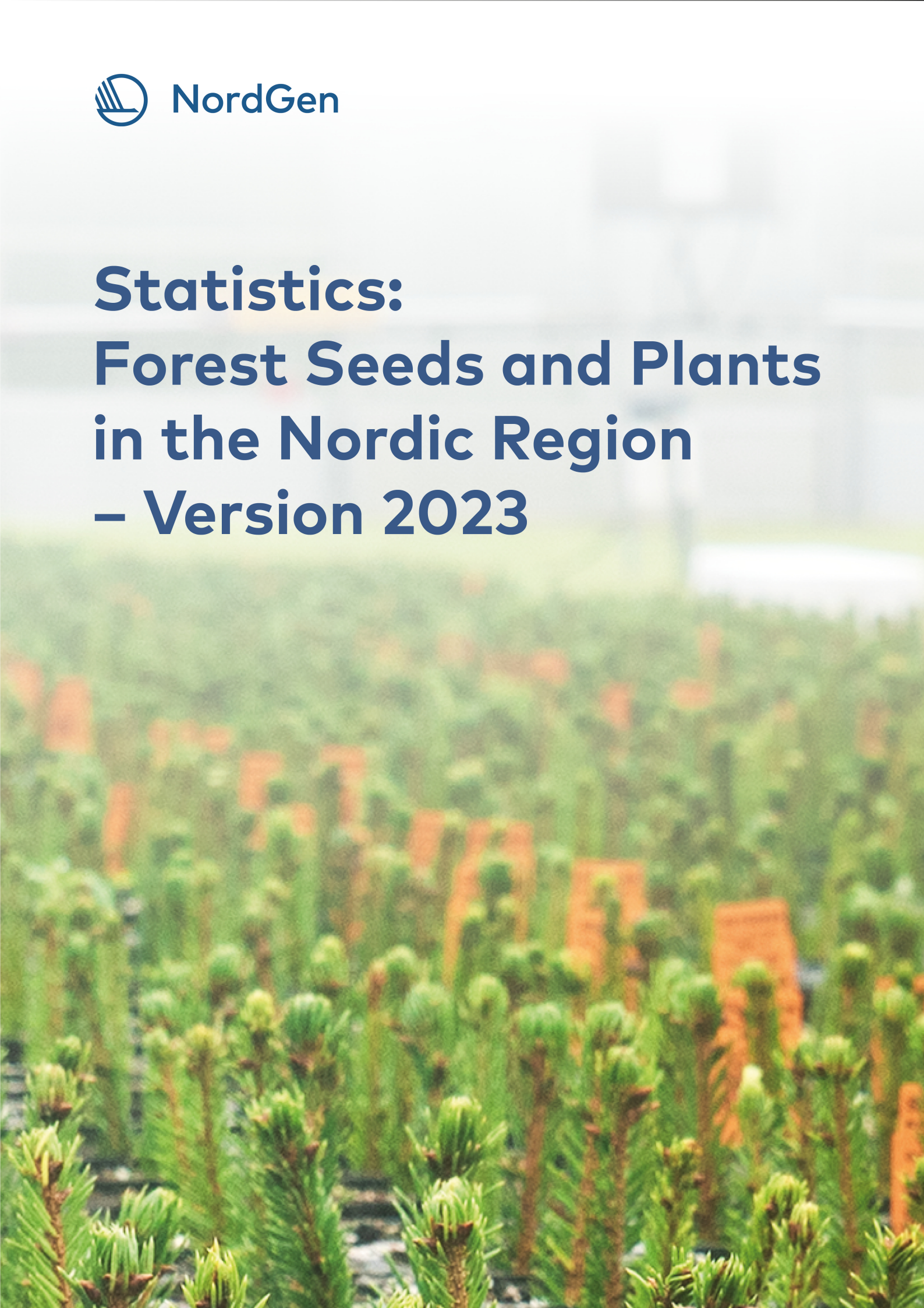
NordGen

Statistics: Forest Seeds and Plants in the Nordic Region – Version 2023



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Preface

Top photo: Lars Sandved Dalen/NIBIO.

This is the second edition in a biennial statistics report on forest seed and plant material in the Nordic countries. The first edition was published in 2021. This edition has been expanded by including more statistics and more species than the first report, as well as including more recent data from the years 2020 and 2021. The report compiles statistics and reports contributed by representatives of each country in the NordGen Forest Regeneration Council.

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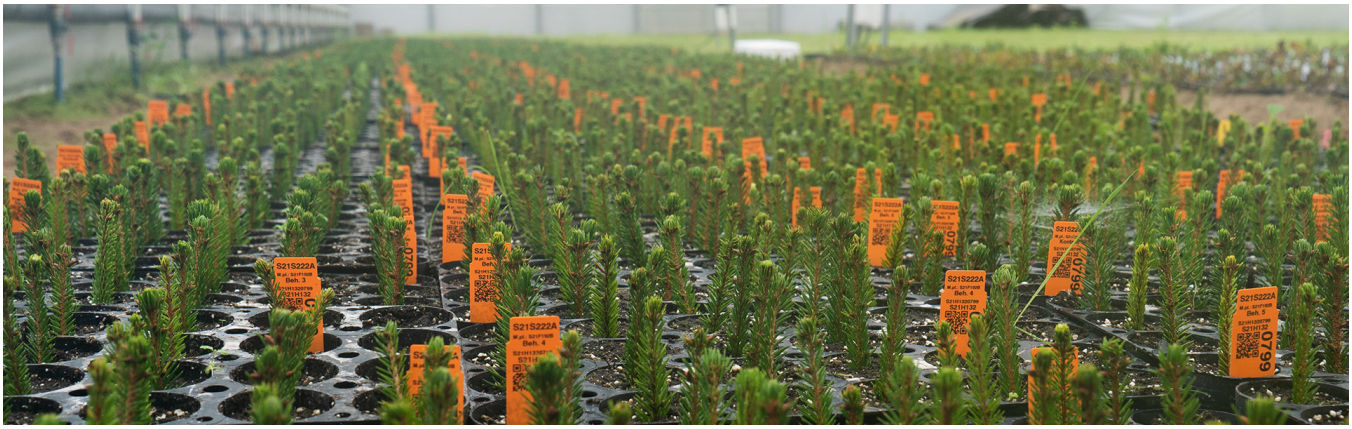
Please contact NordGen Forest if you are interested in further statistics, see "About This Publication" for contact information. How to cite this publication: Solvin et al. 2023. Statistics: Forest Seeds and Plants in the Nordic Region 2023. NordGen Publication Series: 2023:02.



Seeds and Seedlings for Forest Regeneration in the Nordic Forestry

In the Nordic countries, forests have always played an important role. Forests provide wood and bioenergy, protection against wind and erosion, support biodiversity and act as carbon dioxide sinks, as well as important areas for outdoor recreation and human health. When it comes to climate change, the forest is especially important because it binds carbon dioxide throughout its lifetime. In addition, timber can replace other materials that give large emissions when produced.

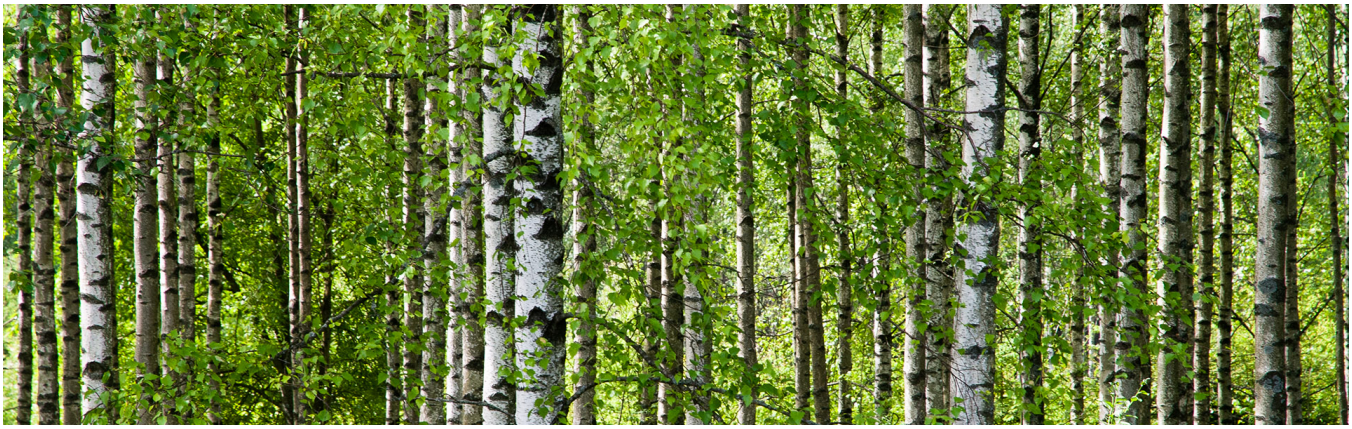
For all these purposes, it is important to keep a healthy and resilient forest, with sufficient genetic diversity for adaptation to climate change. Sufficient regeneration with the proper seed and plant material is crucial. Forest regeneration after harvest may be executed differently in the Nordic countries, and for the various species, either by natural regeneration using seed-trees, by direct sowing or by planting of seedlings. For the main commercial species, planting of seedlings based on genetically improved seeds are used when such seeds are available. This report aims at giving an overview of the use of seeds and seedlings in the Nordic countries, with key statistics from Denmark, Finland, Iceland, Norway and Sweden.

For all these purposes, it is important to keep a healthy and resilient forest, with sufficient genetic diversity for adaptation to climate change.

NordGen Forest

NordGen Forest is a Nordic body dedicated to forest regeneration, plants, seeds and genetic resources. Our main goal is to contribute to the establishment of the best possible Nordic forests for the future, through knowledge exchange and dialogue. NordGen Forest is supported by two networks, the NordGen Forest Regeneration Council and the NordGen Forest Working Group on Genetic Resources, each with members from all the Nordic countries.

NordGen – the Nordic Genetic Resource Center – is a Nordic organization dedicated to safeguarding and sustainable use of cultivated plants, farm animals and forest trees.



Overview of the Most Important Species in Each Country

Top photo: Michael Angeloff/NIBIO.

Choice of species for forest production varies across the Nordic region based on which tree species are naturally occurring and which thrive and produce under different climatic conditions. This, and the fact that available statistics vary among the countries, makes comparisons challenging across countries. Therefore, not all statistics are presented for all countries and species.

Seedlings in Sweden, Finland, and Norway

As an overview of the most important species in the production chain for the different countries the amount of seedlings delivered to the forestry in 2021 is shown below (Figure 1-4). In Finland, Sweden and Norway the two conifers Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*) make up most of the plant production for forestry. Norway spruce makes the biggest share for commercial production of these two due to the large extent of natural regeneration and direct seeding of pine. Sweden has the largest forest area while Norway has the smallest among these three countries.

Photo: Spruce shoots, John Yngvar Larsson/NIBIO.

Sweden

452.000.000 seedlings in total

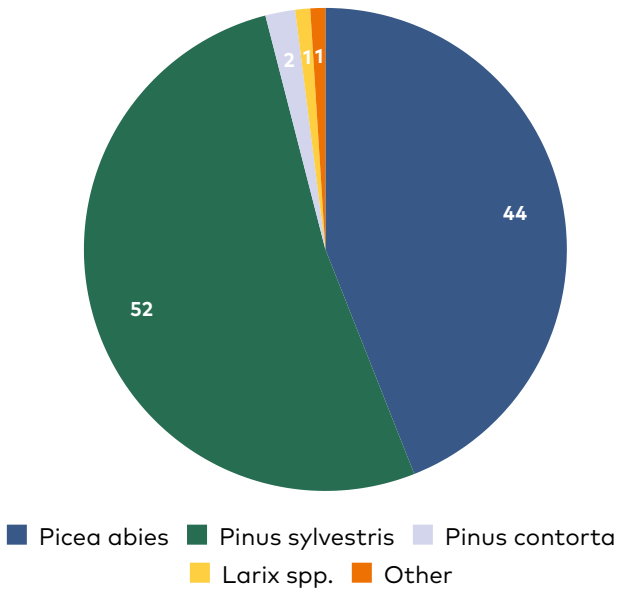


Figure 1

Figure 1-3 shows rounded percentage of seedlings delivered to Swedish, Finnish and Norwegian forestry in different species categories in 2021. The total amount is rounded to thousand seedlings.

Finland

152.088.000 seedlings in total

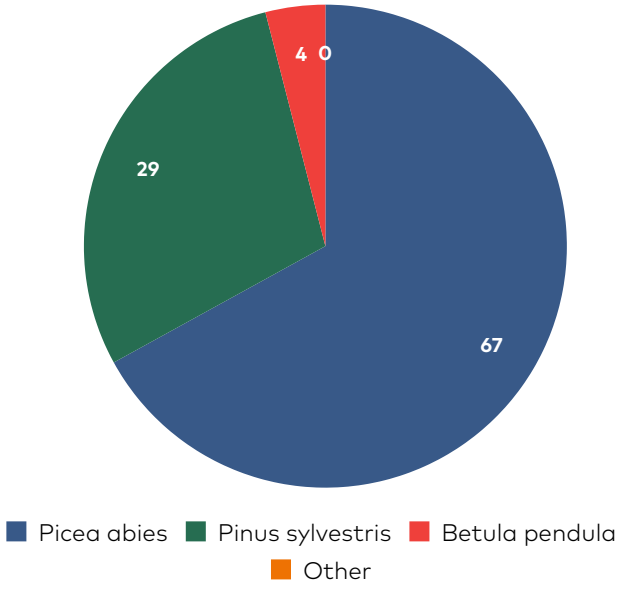


Figure 2

In the category "Other" the percentage is 0,2 percent.

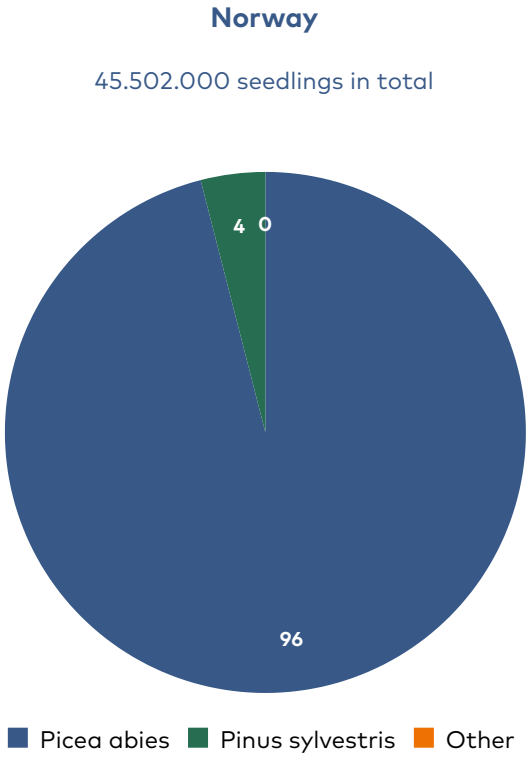


Figure 3

In the category "Other" the percentage is 0,5 percent.

Flowering spruce (*Picea abies*). Photo: Arne Steffenrem Skogfröverket/NIBIO.

Seedlings in Iceland

The main species used for afforestation in Iceland is the native birch (*Betula pubescens*). Silver birch (*Betula pendula*) may be an alternative in lowland areas with increasing temperatures. Seeds are collected in the wild or from planted trees. Other important species in Iceland include *Larix sibirica*, *Larix decidua* and the hybrid *Larix sibirica x Larix decidua*, *Populus trichocarpa*, *Pinus contorta*, *Picea sitchensis*, *Picea glauca* and *Abies lasiocarpa* (Christmas trees).

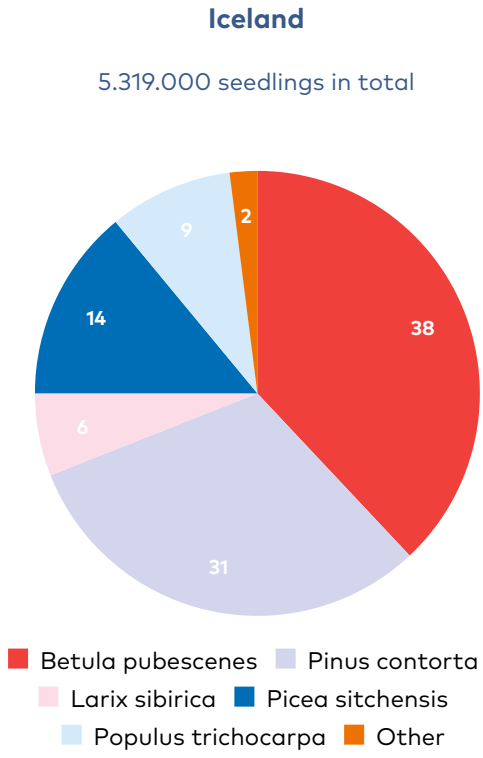


Figure 4

Percentage of seedlings delivered to Icelandic forestry in different species categories in 2021.

Afforestation in Iceland

The first official National Forest Plan for Iceland was published in August 2022 by the Ministry of Food, Agriculture and Fisheries. After years of cutbacks due to the economic recession from 2008, the afforestation budget in Iceland has started to increase again, especially due to the efforts to reach the goals of the Paris Agreement on Climate change and the system of carbon credits causing an increased interest from the private sector and foreign companies to invest in afforestation in Iceland. In the next ten years about 15.000 hectares will be planted and 350.000 hectares of land will be restored by birch forest with natural methods. In 2022 Iceland reached 2 percent cover of forest and woodland. Another milestone this year was that the tallest tree in Iceland, a sitka spruce planted in 1949 at Kirkjubæjarklaustur, reached 30 meters height.

Seedlings in Denmark

Seedling statistics for Denmark is not available. As an overview of the most important species in the Danish forestry, the proportions of the total forest area covered by each species are presented in the pie chart below. It is important to note that the conifers are planted and introduced species, whereas for instance beech (*Fagus sylvatica*) and sycamore (*Acer pseudoplatanus*) often are regenerated naturally. Furthermore, the yearly use of seedlings is higher for short-rotation Christmas trees (e.g. *Abies* species) than for typical long-rotation species such as oak (*Quercus* spp).

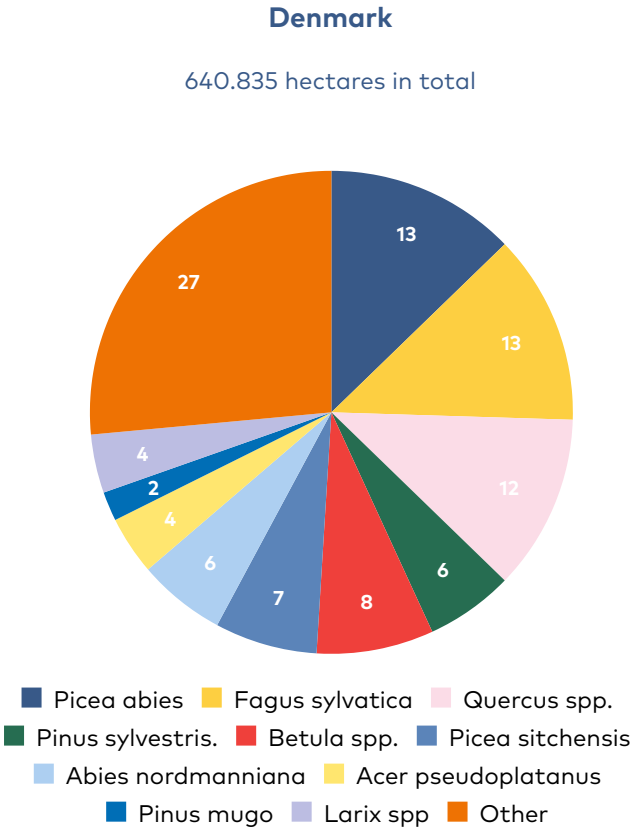


Figure 5

Area of the 10 most common tree species in Denmark. References: Nord-Larsen, T., Johannsen, V. K., Riis-Nielsen, T., Thomsen, I. M., Bentsen, N. S., & Jørgensen, B. B. (2023). *Skovstatistik 2021.*

Forest Areas Are Set Aside for the Benefit of Nature

With the goal of a total of 75,000 hectares of untouched forest, approximately 12 percent of the forest area in Denmark would be left untouched. The majority of the forests becoming untouched are state-owned.

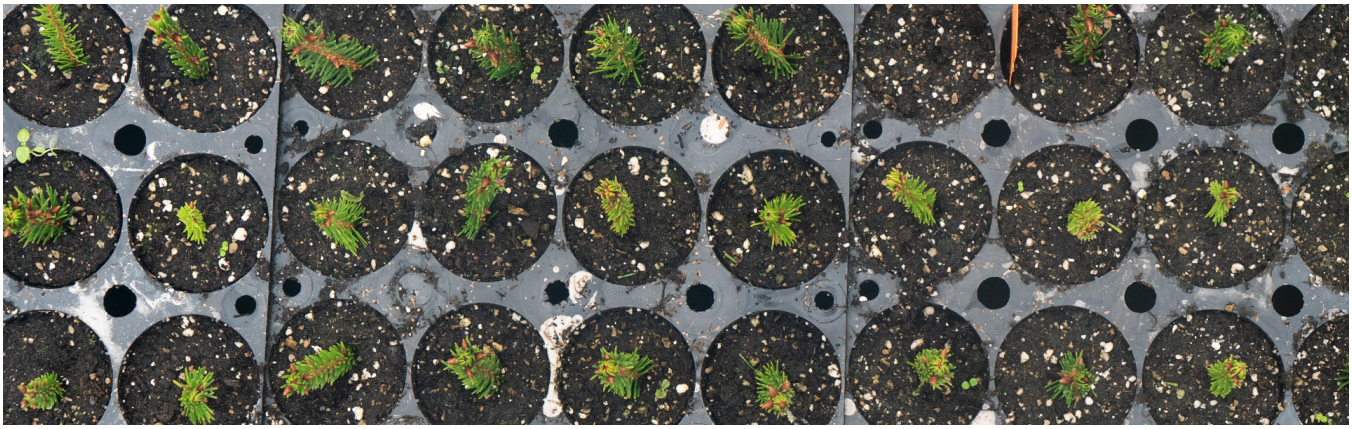
In 2022 an important milestone in the work of setting aside areas was reached as 28.000 hectares of state-owned forest was selected for this purpose. With this latest setting a side of areas the goal of a total of 75.000 ha of untouched forest is almost reached.

A common thing for the untouched forests – regardless of where they are located – is the stop of commercial forestry, and that dead trees and fallen trunks are left in the forests for the benefit of biodiversity.

In the implementation of the untouched forests there will be a restoration period, where different processes are initiated through a number of restoration activities. These restoration activities include for instance felling of mainly non-native conifer species. Also, the hydrology of the areas is restored by closing of ditches and drains, so small lakes, bogs and mires again become an integrated part of the forests. Veteranization of trees will assure higher levels of standing and laying dead wood in the untouched forests.

Cutting of hardwood tree species will gradually be phased out, in order to ensure the accessibility of certified wood during a transitional period to the Danish sawmills.

Approximately 12 percent of the forest area in Denmark would be left untouched.



Time Series for Plant Deliverance

The deliverance of seedlings to forestry is presented below for the years 2006-2021 for Norway, Sweden, Iceland and Finland.

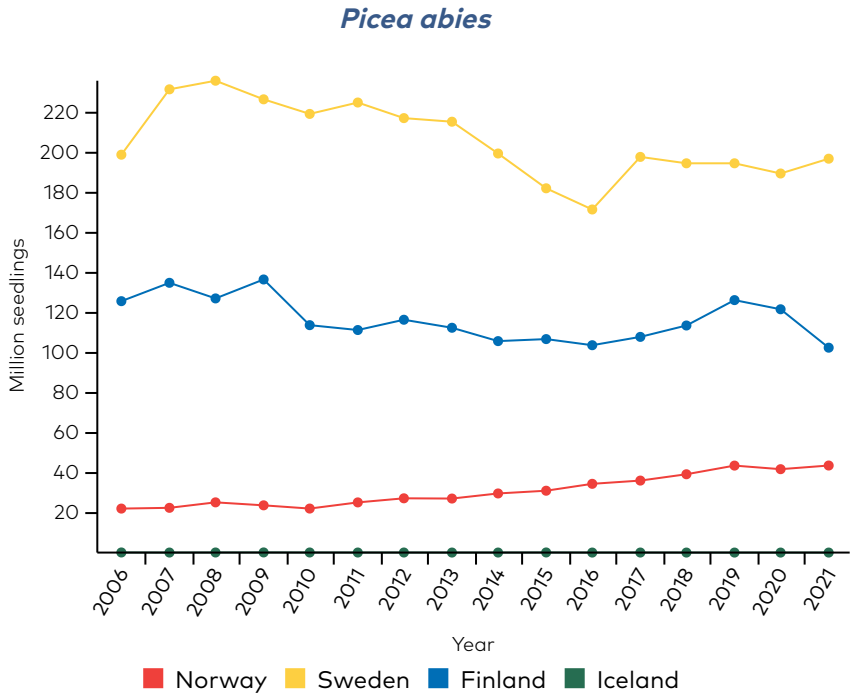


Figure 6

Figure 6-14 shows the number of million seedlings to the forestry planted in each country and year.

Spruce seedlings at Skogforsk's research station Ekebo.

Pinus sylvestris

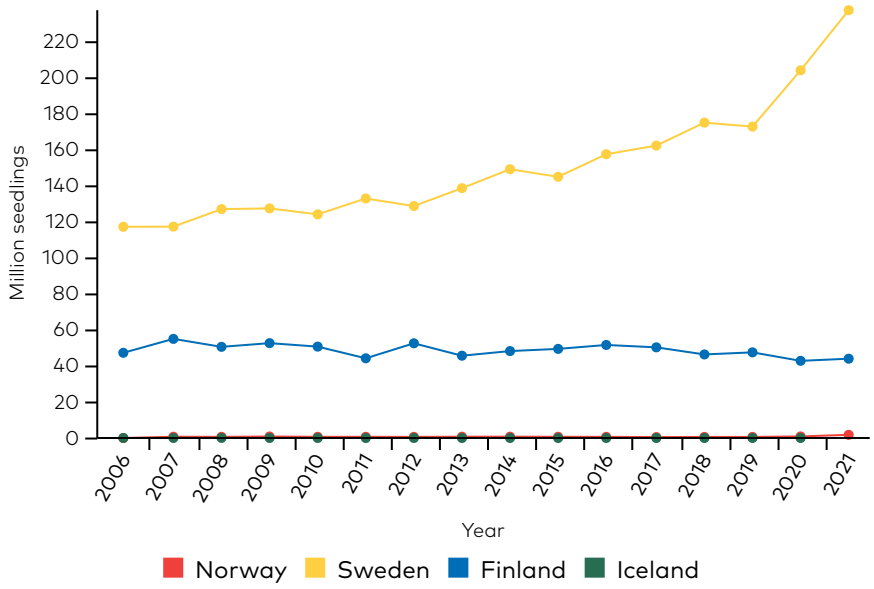


Figure 7

The low numbers of pine seedlings in Norway is due to the fact that pine traditionally has been regenerated naturally.

Abies spp.

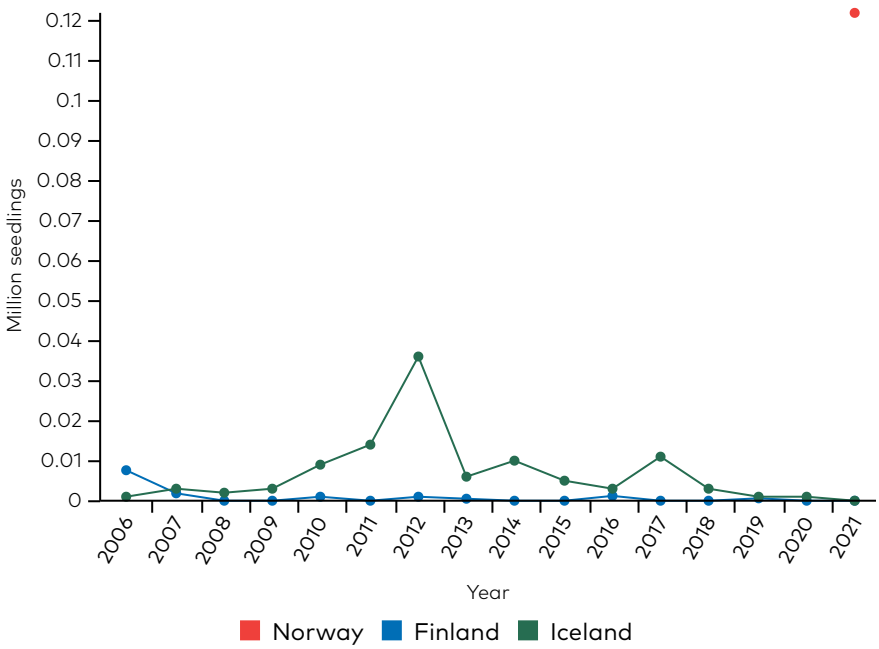


Figure 8

Data for Norway not available for the years before 2021.

Iceland

For the past decades forest seedlings have been stored outside over the winter time in Iceland. There is a growing interest in using freezers to store seedlings during the winter, as this method eases the transportation of seedlings and can better guarantee their quality.

A PhD project, carried out by Rakel J. Jónsdóttir, compares survival, growth and autumn freezing tolerance for seedlings stored in freezers and in an outdoor storage. After planting the seedlings at various dates in early spring and summer. The result will help to deal with increasing production and planting of seedlings.

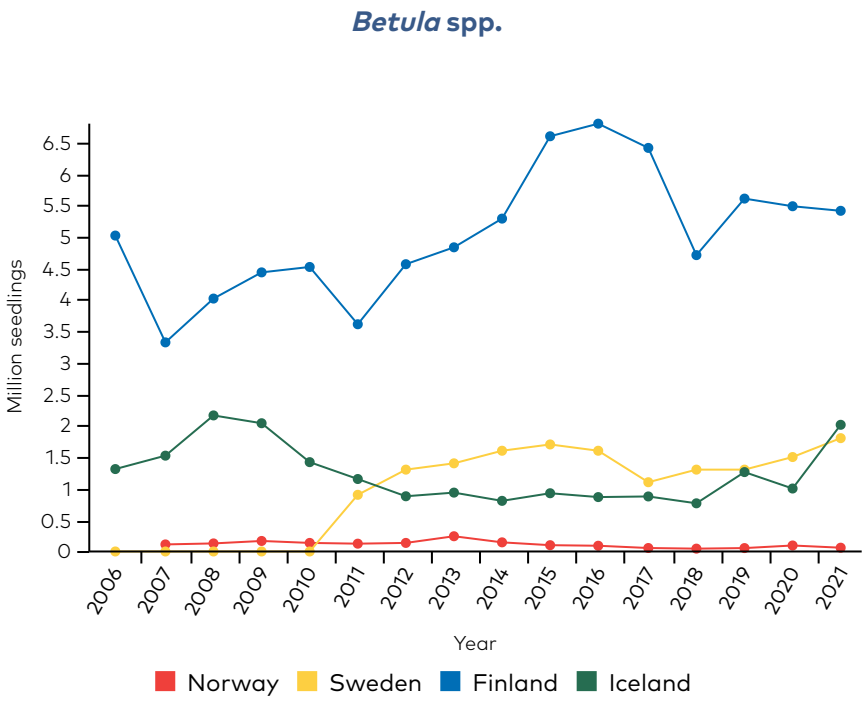


Figure 9

The category *Betula* spp. (birch) contains aggregated numbers for all species of birch where data were available.

Larix spp.

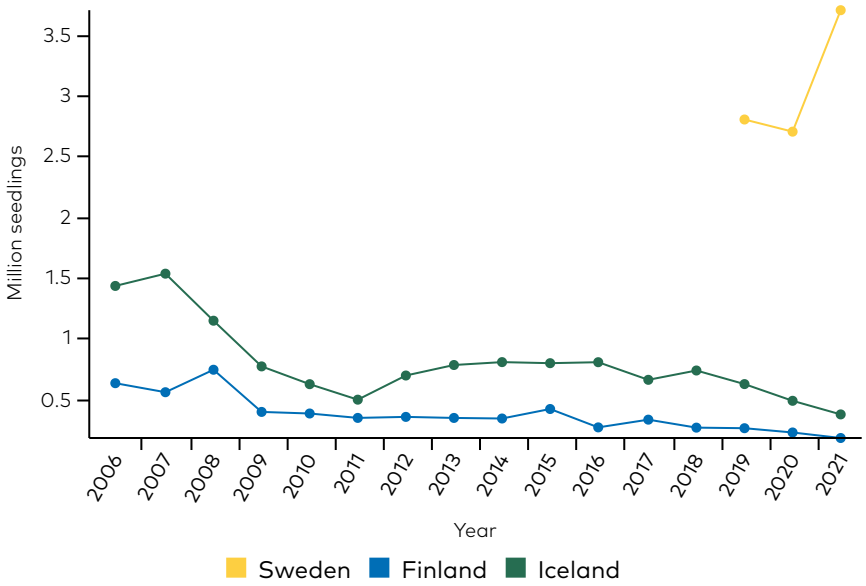


Figure 10

Data for Sweden not available for the years before 2019.

Pinus contorta

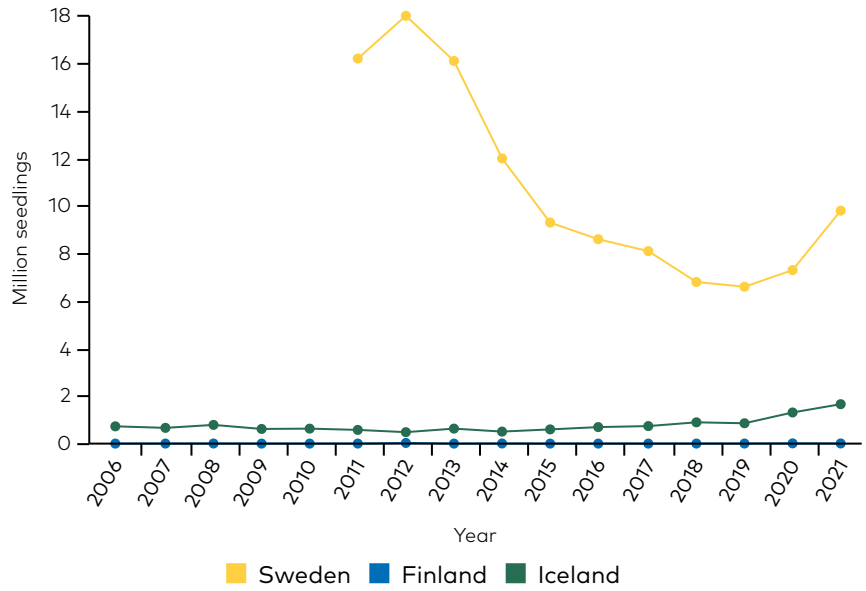


Figure 11

Data for Sweden not available for the years before 2011.

Sweden

In 2021, 452 million seedlings were delivered in Sweden, which is an increase by 11 percent since 2020. Scots pine has increased since 2013 and is now the most common species to be planted in Sweden. Also the amount of spruce seedlings has increased since 2020, but on a lower level than Scots pine. After several years of decrease, Lodgepole pine *(Pinus contorta)* has increased in the two last years, to an annual delivery of 10 million seedlings. The most common broadleaved tree species sold in Sweden is birch, with 1.8 million seedlings delivered in 2021.

Popolus spp.

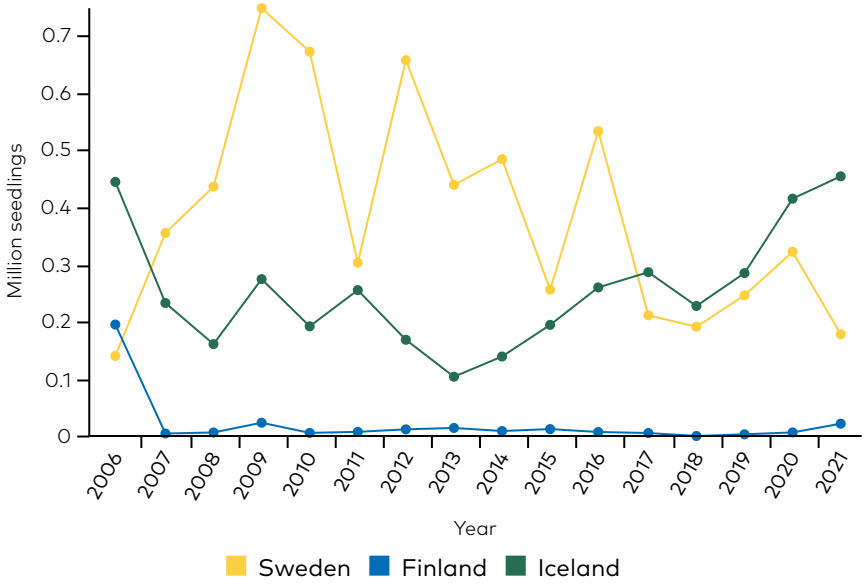


Figure 12

Aspen forest, photo: Lars Sandved Dalen/NIBIO.

Other conifers

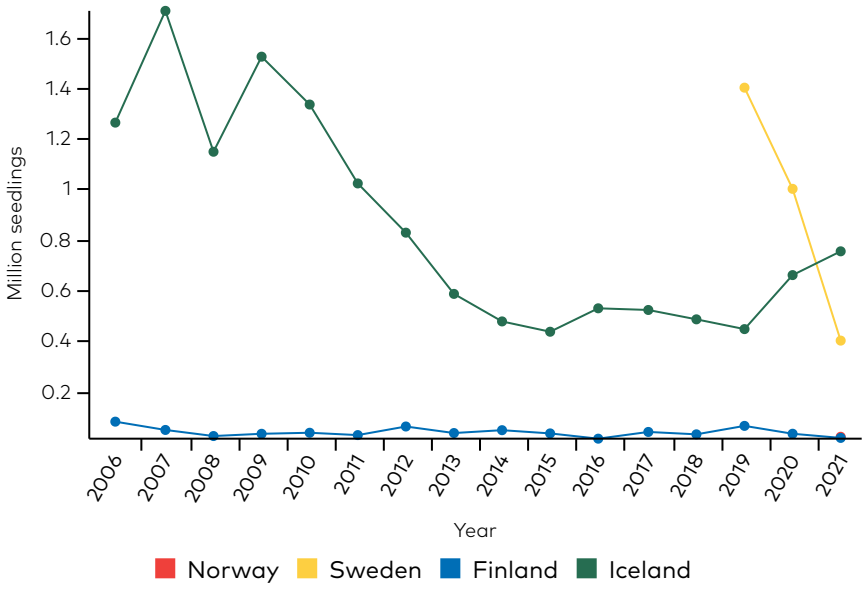


Figure 13

Data for Sweden not available for the years before 2019.

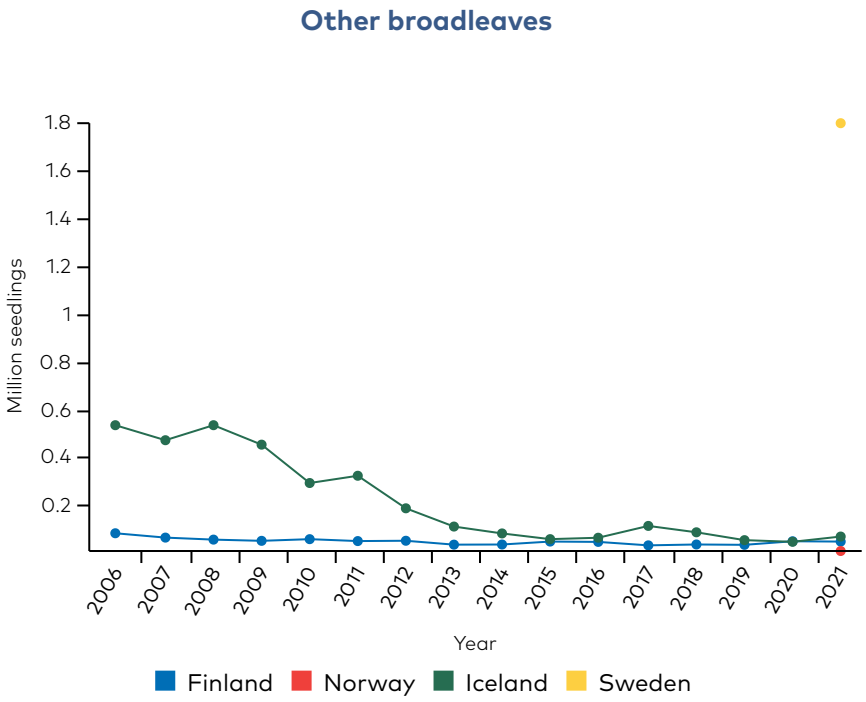


Figure 14

Data for Norway and Sweden not available for the years before 2021.

Forest for Climate Mitigation in Norway

In 2016 NOK 33 mill was allocated to climate mitigation measures within the forest sector in Norway. The funds were divided into three different uses; denser planting of forest, fertilization and breeding. There was a shortage of spruce seedlings in Norway the same year. Political aim and increased funding for climate mitigation measures, including denser planting of forest, caused a growing demand for seedlings.

Photo: Stefano Puliti/NIBIO.

Plant Deliverance in 2020/2021 Categorized as Improved/Unimproved

In the following we present deliverance of plants to the forestry categorized as improved and unimproved material. The purpose of this partition is to compare the use of material that has been genetically improved, typically as part of a forest tree breeding program, with the use of material not subject to genetic improvement. We have defined improved material as plants from seeds classified as "qualified" or "tested" according to the OECD classification (table 1 in the chapter "Seed Production per OECD Category"). Unimproved is here defined as any other material than improved.

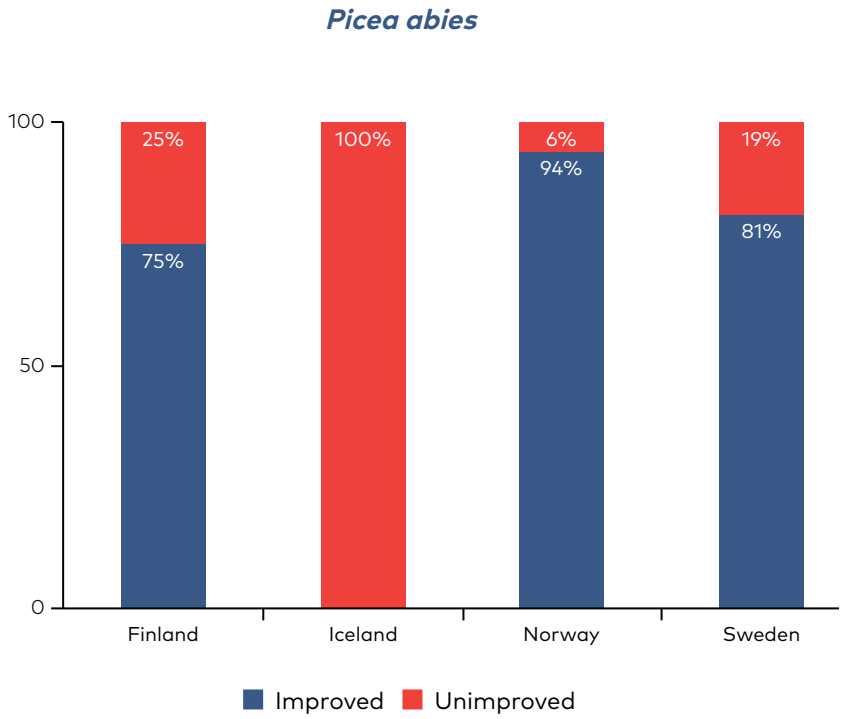


Figure 15

The stacks in this chapter represents rounded percentage of the total amount in thousand seedlings.

Finland: 102.474

Iceland: 1

Norway: 43.540

Sweden: 197.000

Pinus sylvestris

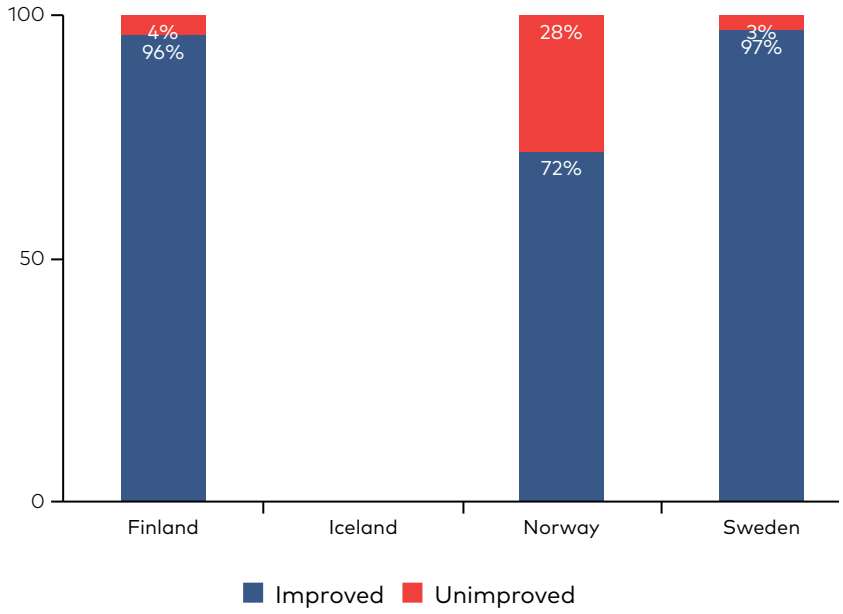


Figure 16

Finland: 43.937

Norway: 1753

Sweden: 237.000

Betula spp.

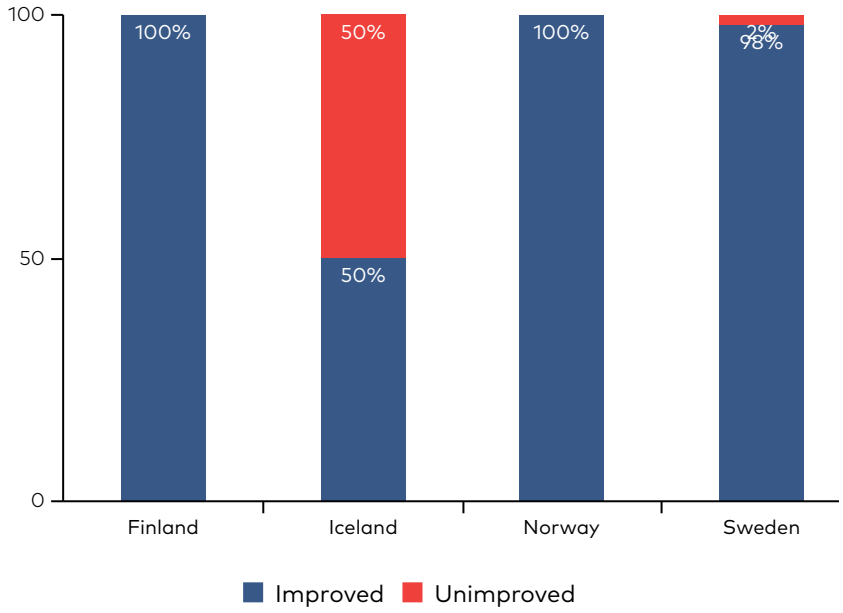


Figure 17

Finland: 5411

Iceland: 2012

Norway: 60

Sweden: 1800

Larix spp.

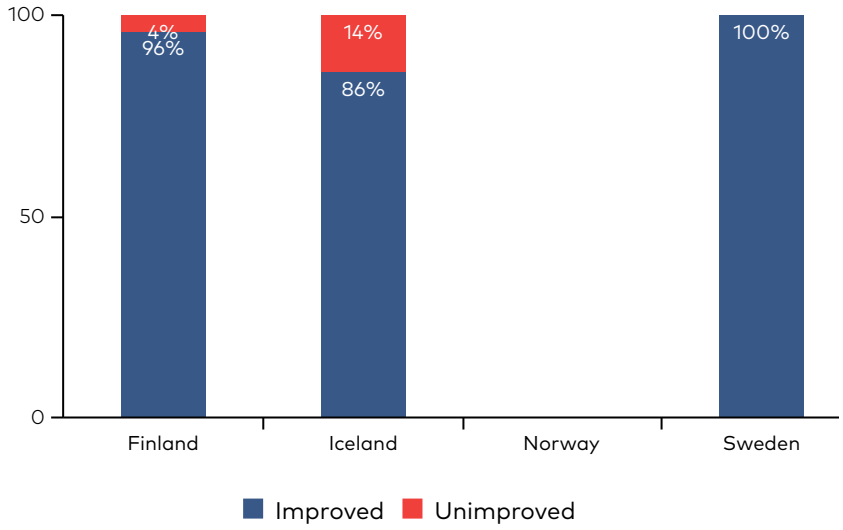


Figure 18

Finland: 178

Iceland: 372

Sweden: 3700

Norway

The demand for plants and seeds from pine is increasing, and Norwegian forestry has a clear preference for improved material. This is mainly imported from Sweden as seeds or plants. Skogfrøverkets (Norwegian Forest Seed Center) sale of pine seeds increased by 223% from 2020 to 2021. 85% of sales are domestic stand seed. Much of the demand for pine seed for plant production is now covered by improved seed from Sweden, which has made it possible to sell more stand seed in Eastern Norway for direct sowing in forest. Skogfrøverket has started a breeding program for pine (*Pinus sylvestris*) that will provide second generation seed materials from Norwegian orchards in approximately 15-20 years.

Abies spp.

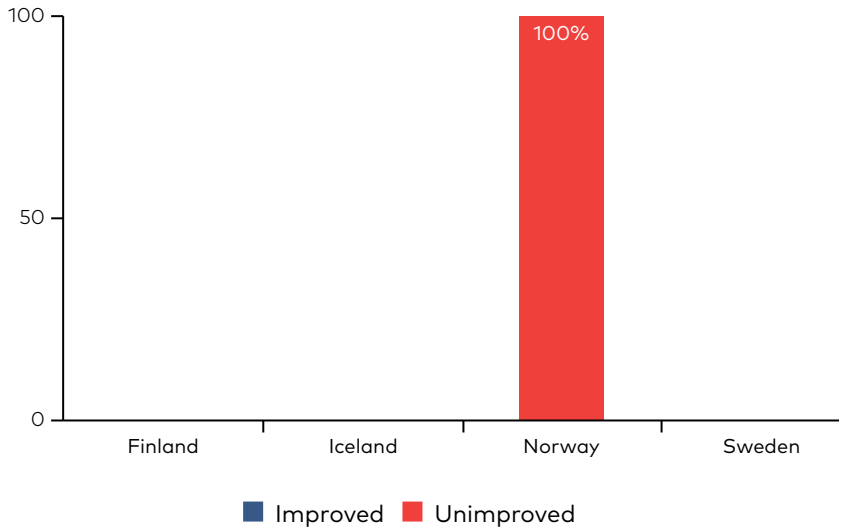


Figure 19

Norway: 122

Pinus contorta

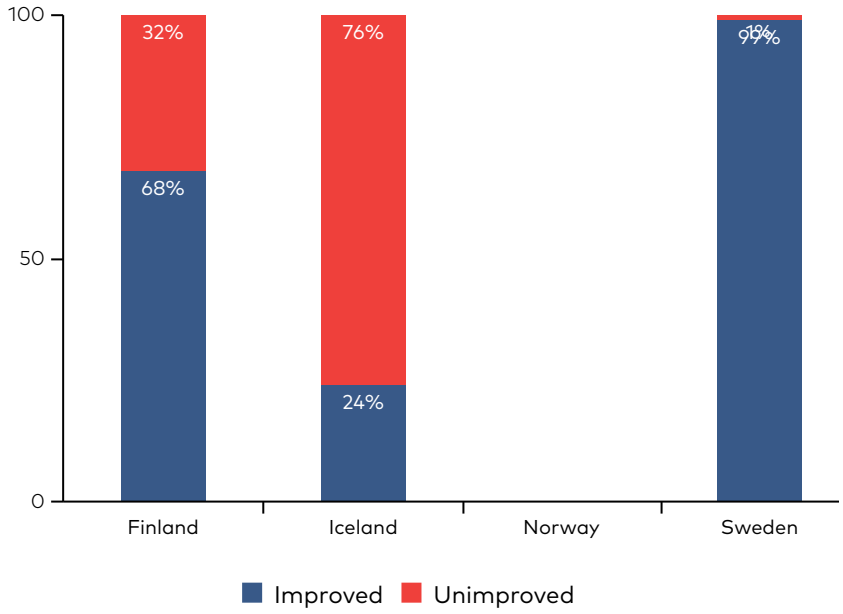


Figure 20

Finland: 6

Iceland: 1659

Sweden: 9800

Fagus sylvatica

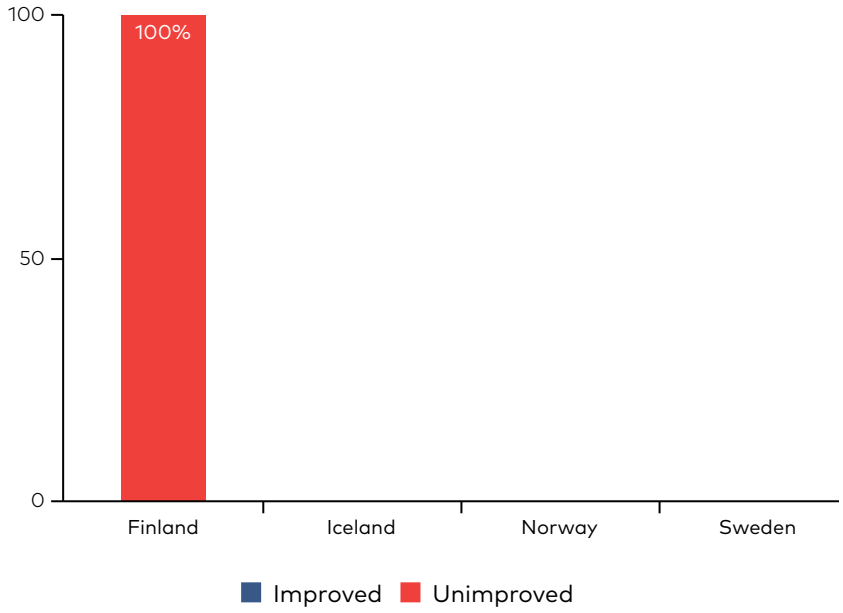


Figure 21

Finland: 0,3

Populus spp.

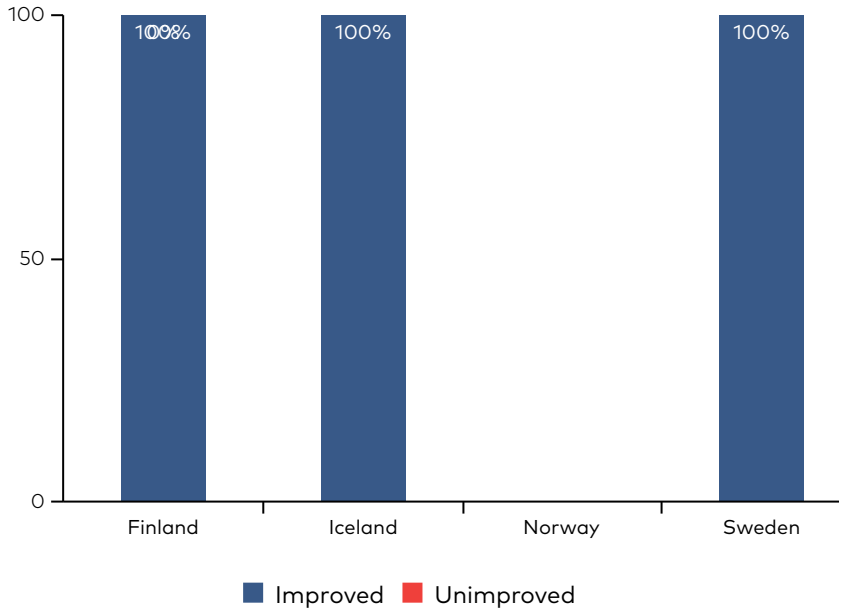


Figure 22

Finland: 21

Iceland: 454

Sweden: 178

Quercus spp.

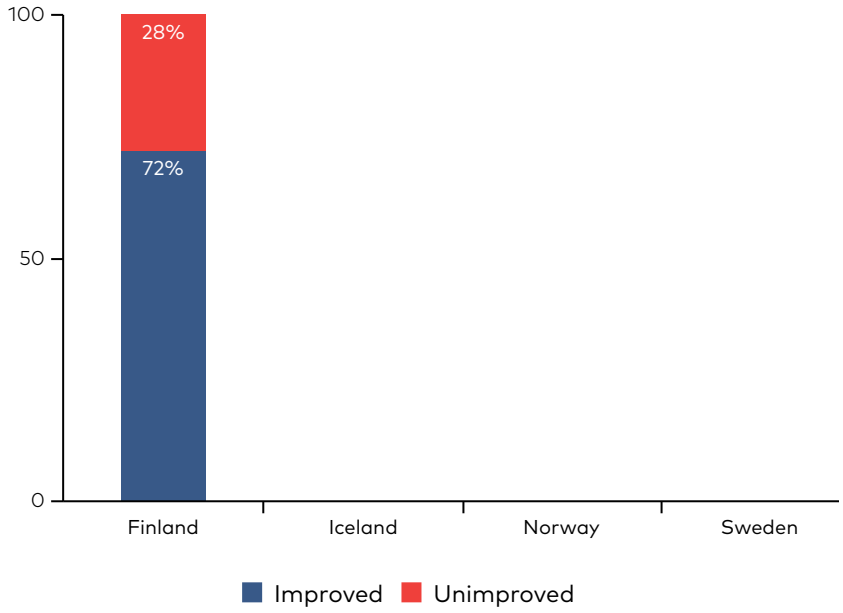


Figure 23

Finland: 11

Other conifers

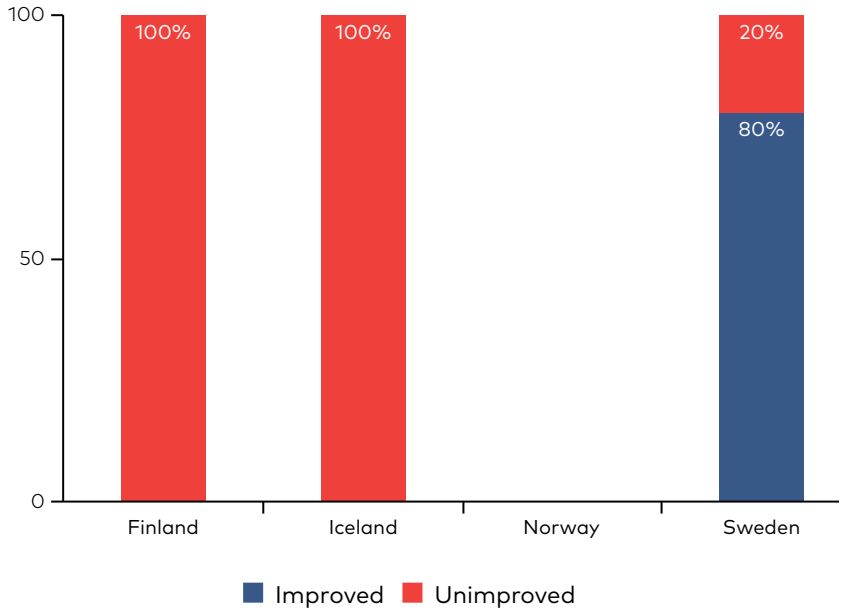


Figure 24

Finland: 15

Iceland: 753

Sweden: 400

Other broadleaves

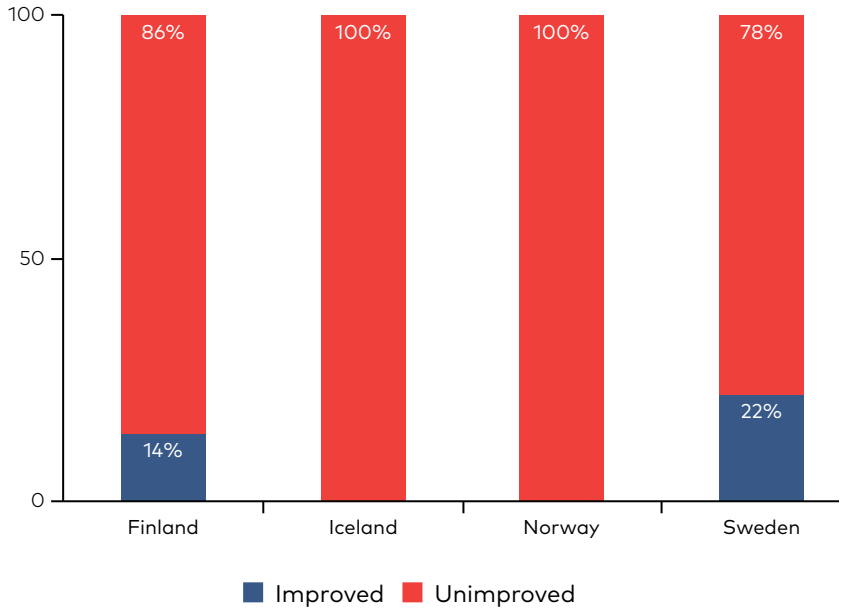


Figure 25

Finland: 36

Iceland: 68

Norway: 8

Sweden: 1800

Top: Seeds of ash (*Fraxinus excelisor*), photo by Lars Sandved Dalen/NIBIO.

Seed Production in the Nordic Countries

The seed production is presented below (Figure 26-29) for the years 2009-2021. The following categories are included in the figures: Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*), birch (*Betula* spp.), firs (*Abies* spp.), larch (*Larix* spp.), contorta pine (*Pinus contorta*), European beech (*Fagus sylvatica*), oak (*Quercus* spp.), other conifers and other broadleaves.

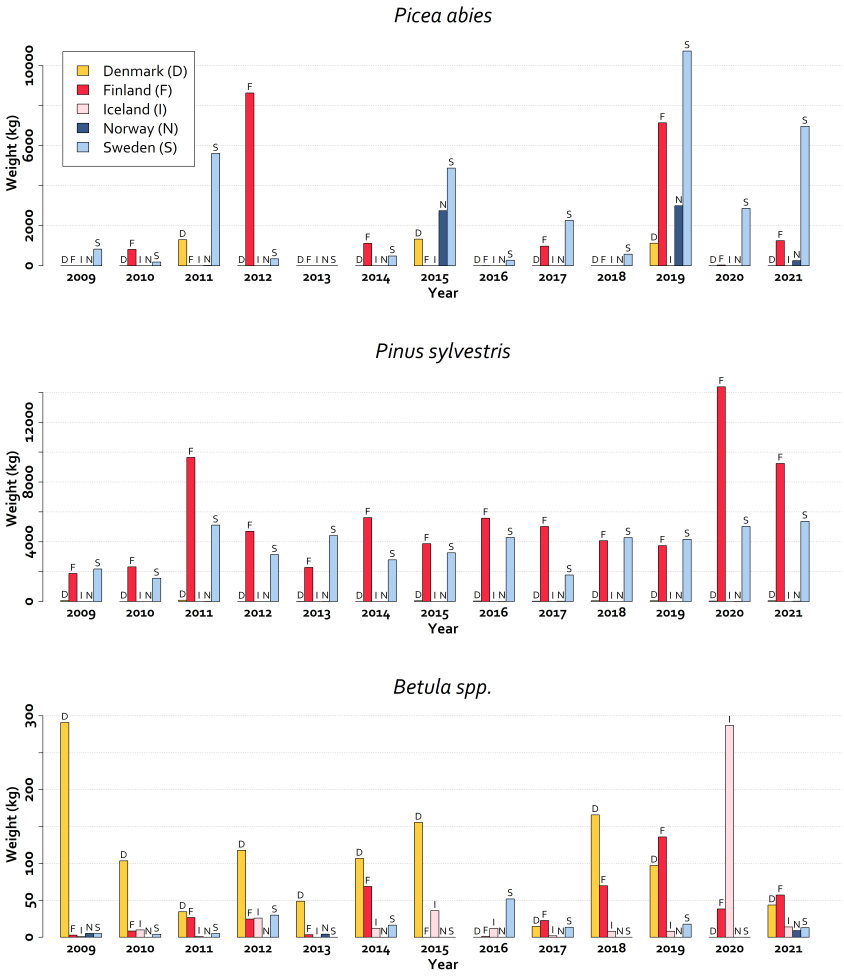


Figure 26

Figure 26-29 shows seed production for species in countries and years (year of ripening/harvest). Data were not available for Finland in 2019 and before 2013, and for Iceland before 2014.

When comparing seed production in kg among species it is worth noting that seeds of different species can have very different weights.

Norway

Norway spruce had a lot of cones in most parts of the country in 2021. Particularly high expectations were to the possibilities for cone harvest in Northern Norway since the seed available for this region is old and of a lower quality. There were plans to harvest cones for 15–25 years of seed supply for the region, but the yield did not turn out to be as high as hoped. This was mainly due to less cones available for harvest in this region and a high proportion of empty seeds due to poor pollination. The seed crop will supply seedling production for the next 15 years in northern Norway. It was also collected seed from *Pinus sylvestris*, *Abies lasiocarpa*, *Alnus glutinosa* and *Betula pendula* in 2021.

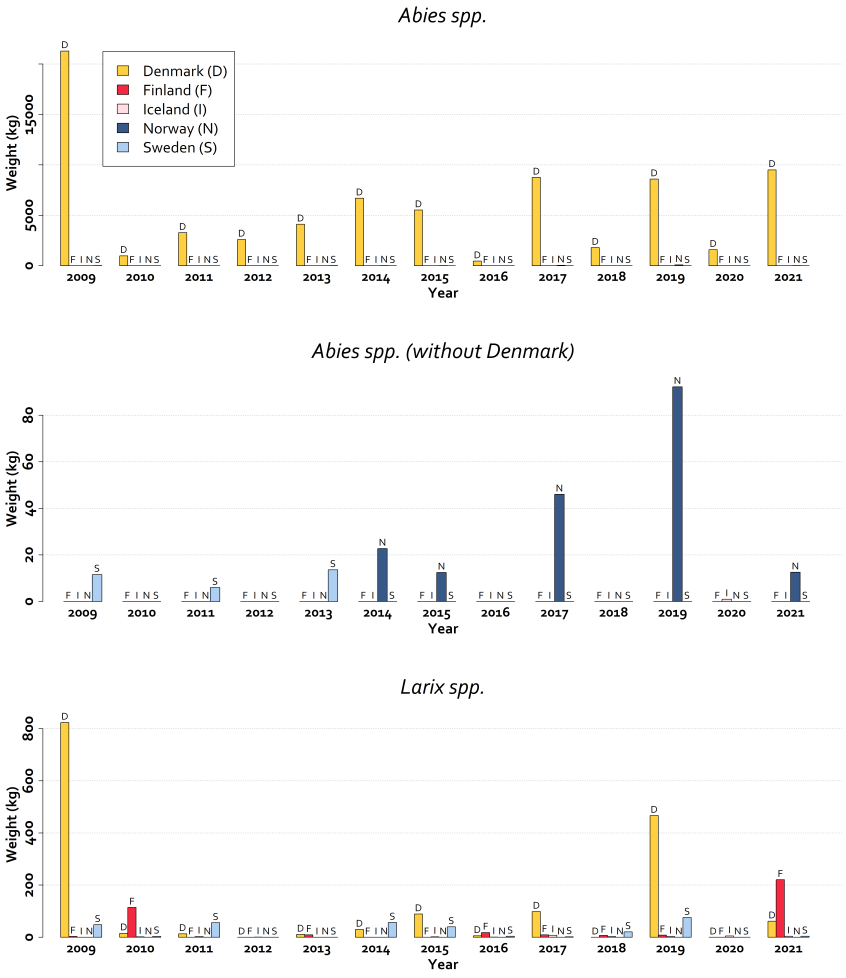
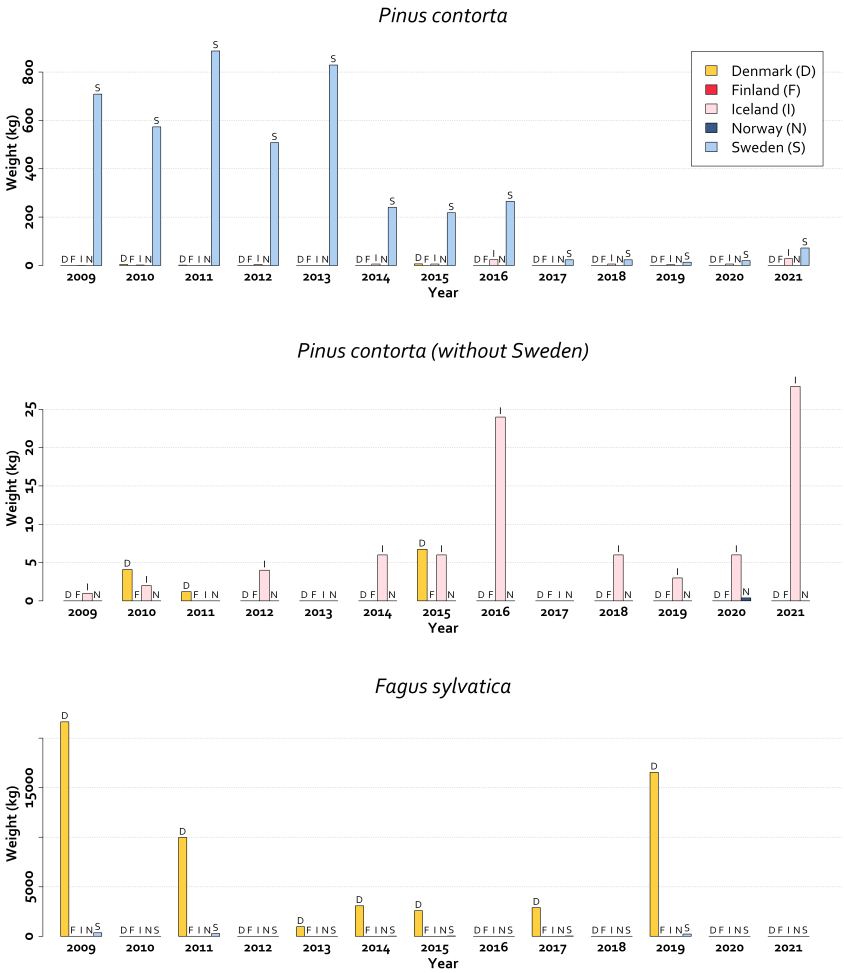


Figure 27

Figure 28



Seed Quality

All seeds produced in the EU must come from officially approved and registered basic material, such as seed orchards or seed stands. A Master Certificate is issued to each seed lot after collection and is required for marketing forest reproductive material. It assures that seeds are collected from an approved basic material and include information on the type of basic material, phenotypic and genetic quality and origin of the material.

Forest reproductive material coming from countries outside the EU may be imported to and marketed in the EU if it affords the same assurances as the material produced in the EU, based on the OECD Certificate of Identity or Certificate of Provenance.

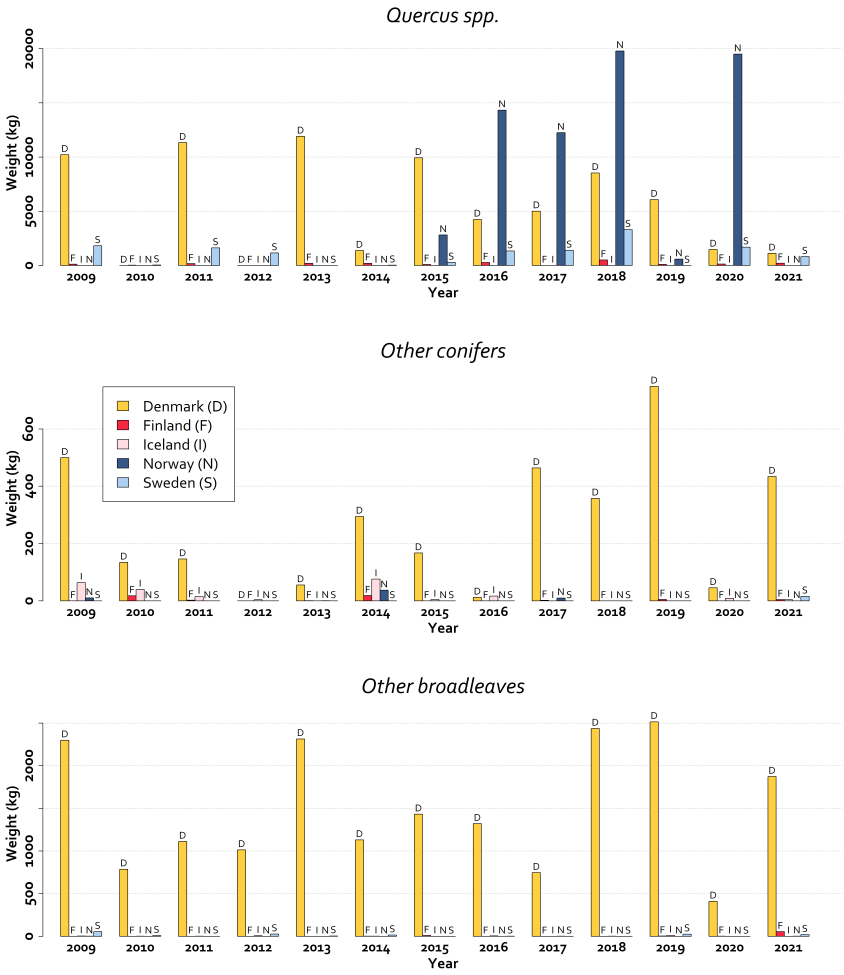


Figure 29

Data *for Quercus* spp. for Norway were not available before 2014.

Seed Production per OECD Category

Top photo: Spruce seed, Dan Aamlid/NIBIO.

The object of the OECD Forest Seed and Plant Scheme is to "*encourage the production and use of seeds, parts of plants and plants that have been collected, processed and marketed in a manner that ensures their trueness to name*" (www.oecd.org/agriculture/forest). Reproductive material can be certified under four categories as in table 1:

Table 1

Classification by the OECD.

Category	Definition
Source-identified	This is the minimum standard permitted in which the location and altitude of the place(s) from which reproductive material is collected must be recorded; little or no phenotypic selection has taken place.
Selected	The basic material must be phenotypically selected at the population level.
Qualified	The components of the basic material have been selected at the individual level; however, evaluation may not have been undertaken or completed.
Tested	The superiority of the reproductive material must have been demonstrated by comparative testing or an estimate of its superiority calculated from the genetic evaluation of the components of the basic material.

Picea abies

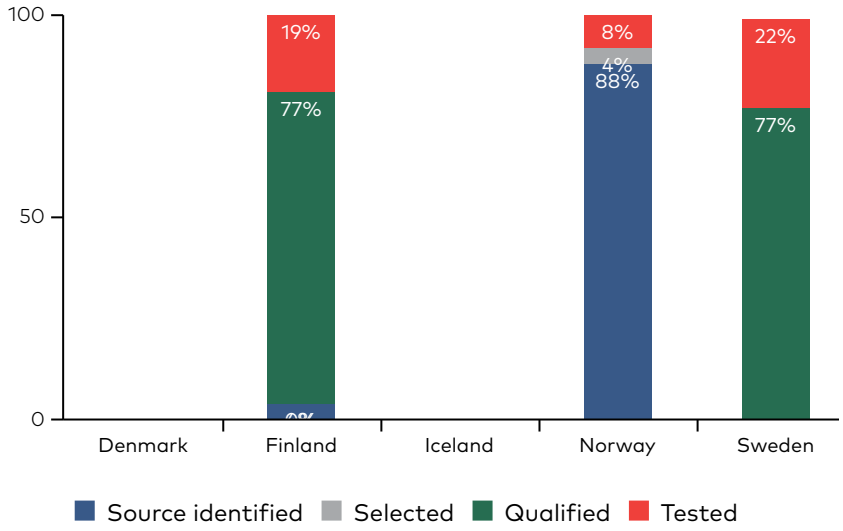


Figure 30

The stacks in this chapter represent rounded percentage of the total amount of kilos of seeds produced in 2021.

Finland: 1251,6 kg.

Norway: 255,4 kg.

Sweden: 6963 kg.

Pinus sylvestris

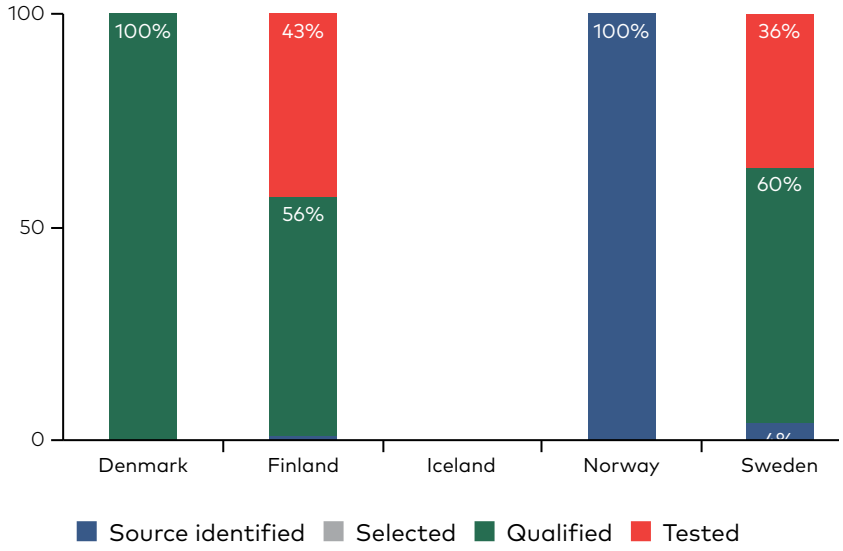


Figure 31

Denmark: 52,2 kg.

Finland: 9245,2 kg.

Norway: 17 kg.

Sweden: 5375 kg.

Betula spp.

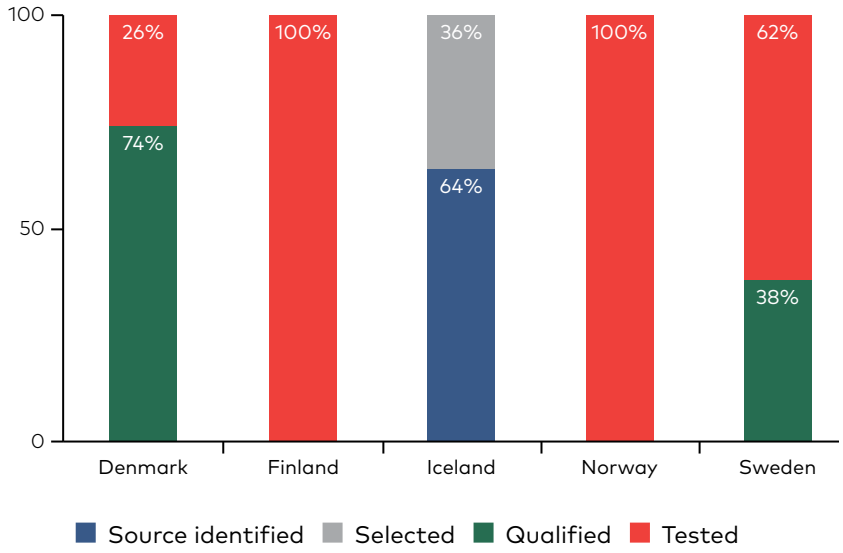


Figure 32

Denmark: 43,7 kg.

Finland: 57,2 kg.

Iceland: 14 kg.

Norway: 9 kg.

Sweden: 13 kg.

Larix spp.

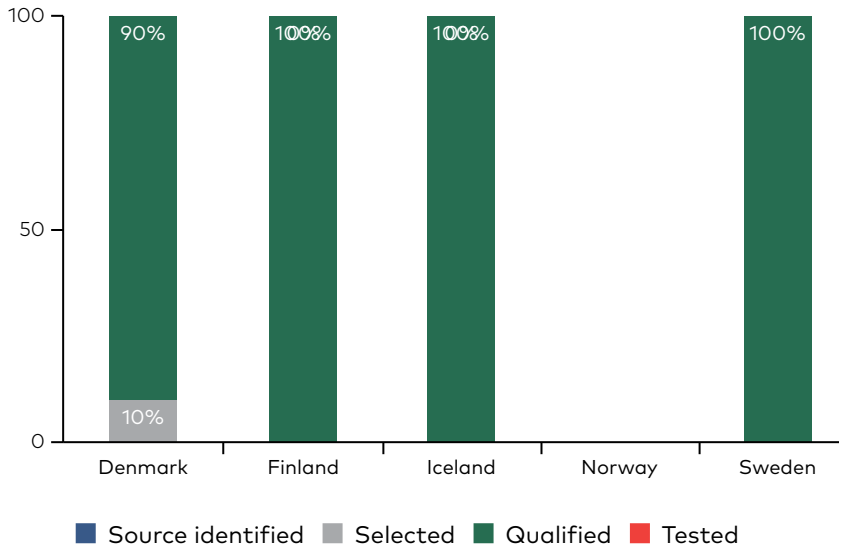


Figure 33

Denmark: 61,5 kg.

Finland: 220,8 kg.

Iceland: 4 kg.

Sweden: 4 kg.

Quercus spp.

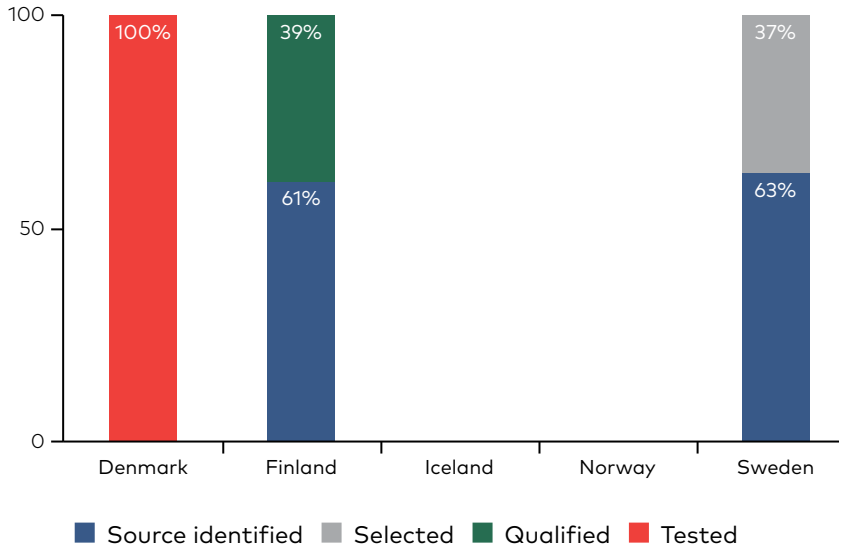


Figure 34

Denmark: 1116 kg.

Finland: 213,8 kg.

Sweden: 822 kg.

Abies spp.

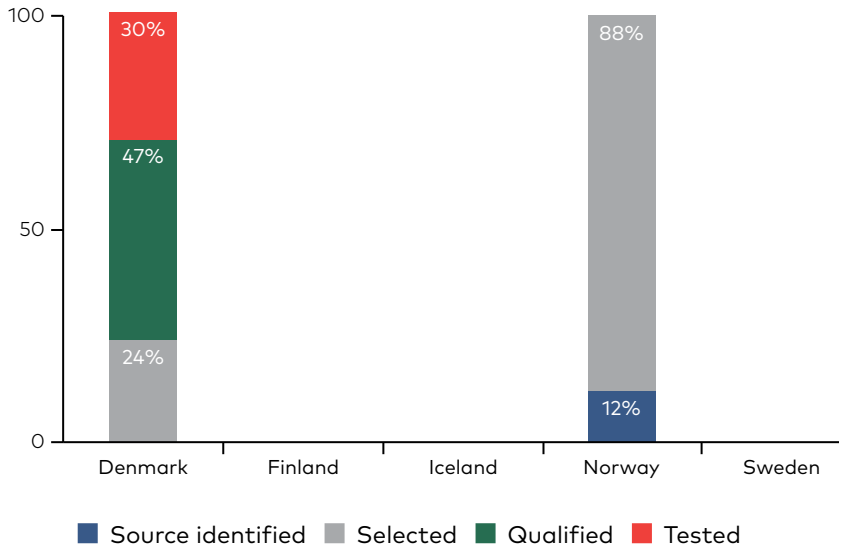


Figure 35

Denmark: 9504,2 kg.

Norway: 12,6 kg.

Pinus contorta

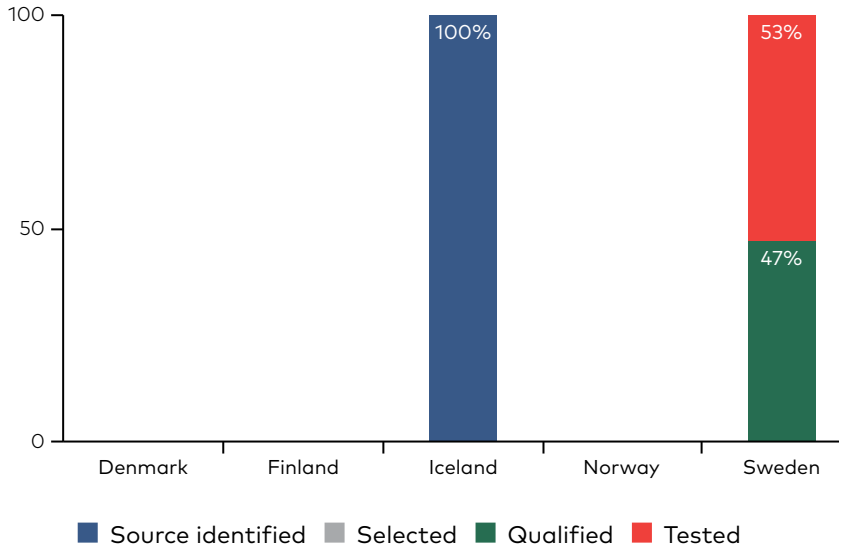


Figure 36

Iceland: 28 kg.

Sweden: 72 kg.

Fagus sylvatica

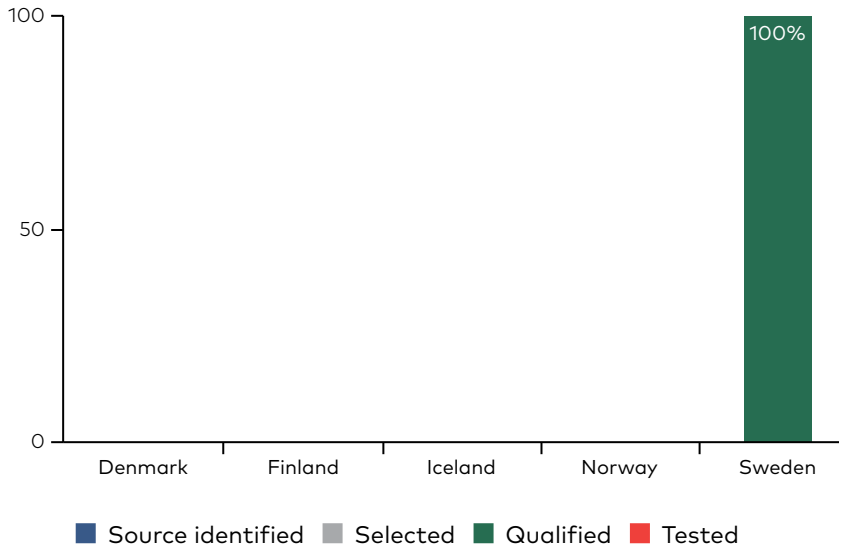


Figure 37

Sweden: 10 kg.

Other conifers

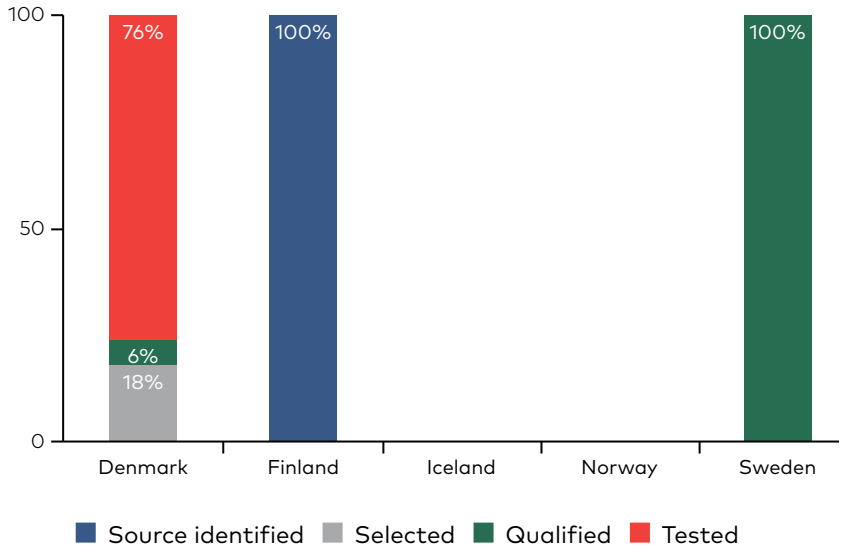


Figure 38

Denmark: 434,1 kg.

Finland: 4,8 kg.

Sweden: 16 kg.

Other broadleaves

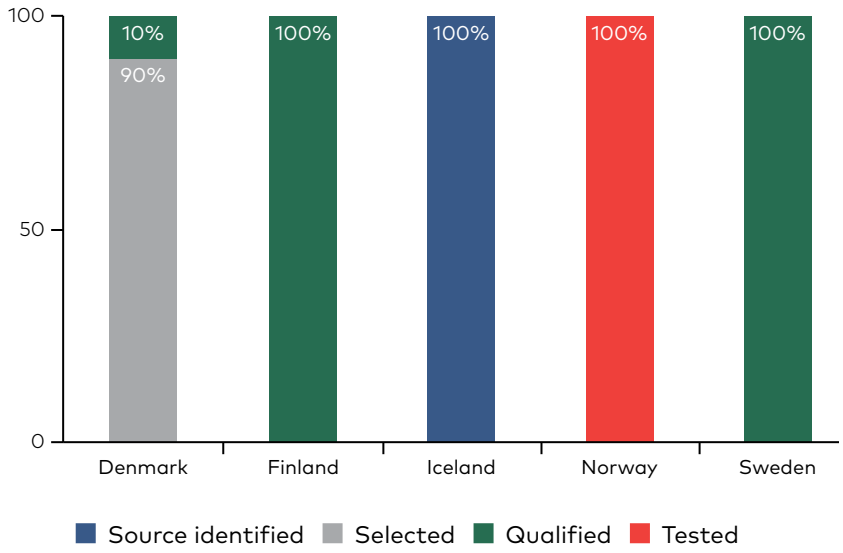


Figure 39

Denmark: 1874 kg.

Finland: 54,2 kg.

Iceland: 1 kg.

Norway: 2,4 kg.

Sweden: 20 kg.

Seeds and Plants Crossing Boarders

Top photo: Erling Fløistad/NIBIO.

A complete account of import of plants and seeds could not be acquired, but available numbers are in the following presented in table form. Additional details, such as country of origin, are described in the text were such information was available.

Plant Import

Apart from the national production of seedlings, there has also been a market for imported material, mainly of Norway spruce *(Picea abies*), between the Nordic countries as well as from Germany and the Baltics (Figure 40). The amount of imported plants varies among years and countries and may constitute a significant proportion of the total number of planted seedlings.

For instance, in Sweden the import of plants varied between 35 and 53 million plants per year in the period 2009-2015, which is roughly 10 to 15 percent of the annual number of plants used. Imported plants are sometimes produced with seeds from the country which receive the plants. In those cases, there is no import of foreign genetic material. For example, out of the 2 350 000 plants of *Picea abies* imported in Norway in 2021, 750 000 were of Norwegian origin produced in Sweden. Iceland does not import seedlings due to plant health risk issues.

Species /Country	Denmark	Finland	Iceland	Norway	Sweden
Abies spp.		0	0	51	
Larix spp.		0	0		2870
Picea abies		0	0	2350	39100
Pinus contorta		0	0		
Pinus sylvestris		0	0	800	8904
Other conifers		0	0		280
Betula spp.		0	0		
Fagus sylvatica		0	0		
Populus spp.		0	0		
Quercus spp.		0	0		
Other broad-leaves		0	0		1137

Table 2

Plant import in 2021. Empty cells means that data were not available. Numbers in 1000 plants.

Growing of pine (*Pinus sylvestris*) seedlings.

Seed Import

Seeds on the other hand are subject to some import in all the Nordic countries, and Iceland imports, or has imported, seed of many exotic tree species, the most important of which are *Pinus contorta*, *Larix* spp., *Picea glauca*, *Picea sitchensis*, *Picea abies, Pinus sylvestris*, *Alnus* spp., *Betula pendula* and *Abies lasiocarpa*. *Picea abies* and *Pinus sylvestris* are important species whose seeds are subject to import/export among Nordic countries, but also species of for instance *Larix* and *Quercus* have been traded. Denmark does not keep statistics of import from EU-countries, but has in 2021 imported seeds from Georgia (*Abies* spp.), USA (other conifers and other broadleaves) and Turkey (other conifers). In 2021 Finland imported seeds mainly from Sweden (*Picea abies, Pinus sylvestris, Betula* spp.), but also from Denmark (*Larix* spp.) and Estonia (*Picea abies*). The Icelandic import in 2021 came from Finland (*Larix* spp.) and Sweden (*Pinus contorta*).

Species /Country	Denmark	Finland	Iceland	Norway	Sweden
Abies spp.	7985	0		6,5	
Larix spp.		0,32	5		
Picea abies		73,62		10	
Pinus contorta		0	4		
Pinus sylvestris		27,25		74,58	
Other conifers	275,5	0,35			
Betula spp.		2,09			
Fagus sylvatica		0			
Populus spp.		0			
Quercus spp.		0			
Other broad-leaves	5,8	0			

Table 3

Seed import in 2021. Empty cells means that data were not available. Numbers in kg seed. Number for Denmark does not include import from EU member states. Numbers for Finland include only import from EU member states.

Seed of birch (*Betula verrucosa masurica*). Photo: Dan Aamlid/NIBIO.

Figure 40

FRM trade illustration by Claes Uggla at the Swedish Forest Agency. The illustration gives an idea of the trade to and within the Nordic countries during the last decade.

Statistics: Forest Seeds and Plants in the Nordic Region

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NordGen

The Nordic Genetic Resource Centre (NordGen) is the Nordic countries' genebank and knowledge center for genetic resources. NordGen is an organisation under the Nordic Council of Minister and works with the mission of conserving and facilitating the sustainable use of genetic resources linked to food, agriculture and forestry.

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