National Poplar Commission of Sweden

Country Report 2012–2015

Lars Rytter[1], Ioannis Dimitriou[2], Gabriele Engqvist[3], Karin Hjerpe[4], Bo Nilsson[5] and Mauritz Ramstedt[6]

[1]The Forestry Research Institute of Sweden (Skogforsk), Ekebo 2250, SE-26890 Svalöv, Sweden, email: Lars.Rytter@skogforsk.se

[2]Swedish University of Agricultural Sciences (SLU), Dept. Crop Production Ecology, P.O. Box 7043, SE-75007 Uppsala, Sweden, e-mail: Jannis.Dimitriou@slu.se

[3]Skårtaryd Postgård 2, SE-36042 Braås, email: Gabriele.Engqvist@gmail.com

[4]Swedish Board of Agriculture, Vallgatan 8, SE-55182 Jönköping, Sweden, email: Karin.Hjerpe@jordbruksverket.se

[5]Häckeberga Säteri AB, Häckeberga Gård 977, SE-24798 Genarp, Sweden, email: Bo.Nilsson@hackeberga.se

[6]Bryttbyn Stensberg 81, SE-74892 Österbybruk, Sweden, email: Mauritz.Ramstedt@mail.com

I. POLICY AND LEGAL FRAMEWORK

IPC aims to promote the cultivation, conservation and utilization of members of the family *Salicaceae*, which includes poplars and willows. In this context we see that the major interest for *Populus* and *Salix* species in Sweden lies in developing new cultivars, cultivation and utilization of them, and environmental effects of cultivation. The values of old sallow and aspen are well known and they constitute valuable objects in nature reserves and landscape planning.

From now on other fast-growing deciduous trees species will also be included in IPCs activities. Other hardwood species of interest for high productivity include the genera *Alnus* and *Betula*. Grey alder (*A. incana*) has recently been included among species where genetic improved plant material will be available in the future (Rytter & Stener 2015).

Europe and Sweden are implementing strategies for greenhouse gas emission objectives, including ambitious targets for renewable energy. In Sweden, biomass production with willows, aspens and poplars on agricultural land will probably play a key role in this development. During recent years, Sweden has been rather successful in introducing biomass as fuel for heat and is now the single largest energy source in the country representing 34 % of the energy consumption. To date this source is dominated by biofuels from forest residues and black liquors, but new sources like fast-growing tree species are also of great interest and have a large potential.

The success of bioenergy was initially the result of a combination of exogenous success factors such as high levels of available forestry resources, a strong forest products industry, and the existence of an established network of district heating systems. However, even in this context, policy instruments were required to support and guide the development of biomass as an energy source for heat and electricity. The most important regulations and visions supporting this development were:

- 1970- present, (rising) energy taxes
- 1991 Carbon Tax & Energy Tax, focus on heat
- 1997–2002 Investment subsidies
- 2000 Carbon tax increases
- 2003 Technology-independent Green Electricity Certificate system introduced
- 2004 Tax on electricity for Households and Services
- 2004 Reduced Combined Heat and Power Plant (CHP) Tax
- 2008 EU Commission – Targets for renewable energy to 2020, Sweden should increase from 40% to 49%

• 2009 Swedish government – raises the target for renewables to 2020 to 50% in total and 10% in the transport sector

• 2012 A national vision to become independent of fossil fuels within the transport sector by the year 2030 is adopted

• 2012 A national vision to have zero net greenhouse gas emissions by 2050 is also launched

• 2015 EU stresses the importance of renewable energy to reduce global emissions

The general energy policy has supported biomass for energy although specific policies have changed with time. Research, development and demonstration have been continuously promoted, and some subsidy schemes have been applied within the frame of national Swedish as well as European regulation.

Today there are no support activities for establishment and management of Salicaceae species on forest land, but new directives supporting activities have been launched for agricultural land.

The Basic Payment Scheme is part of the European Common Agricultural Policy and is operated on the basis of payment entitlements allocated to farmers in the first year of application of the scheme and activated each year by the farmers. Farmers can only claim BPS on land that is eligible for the scheme and is 'at their disposal'. *Salix* and *Populus* are both eligible.

Financial support from the rural development program can be provided for seedlings and planting of *Salix* and *Populus* on agricultural land. Financial support can also be given for fencing to wildlife if needed. However, applications are processed by the county administrative boards and there may be regional restrictions on supported activities.

The investment must amount to at least 50,000 SEK in order to get support and up to 40 % of eligible costs can be compensated. The cost is calculated based on templates:

• seedlings and planting, as well as additional expenses associated with the preparation of sites for production: 14 500 SEK per hectare

• fencing: 25 000 SEK per hectare

Eligibility for the Basic Payment Scheme is a precondition for farmers to receive also other direct payments such as the green direct payment. The 2013 reform of the CAP introduced a green direct payment which is paid to farmers on the condition that they undertake practices that are beneficial to the climate and to the environment. The basic practices that farmers must undertake are: maintaining permanent grassland, crop diversification, having 5% (later 7%) of their land as ecological focus area (EFA). In Sweden, Salicaceae is the only SRC that can be used as an EFA, and with a conversion factor of 0.3.

II. TECHNICAL INFORMATION

1. Identification, registration and varietal control

There are currently two *Populus* cultivars registered at the Swedish Forestry Agency (www.skogsstyrelsen.se/Aga-och-bruka/Lagen/Handelsregler/Rikslangden-och-National-List/). One consists of 15 clones of hybrid aspen (*P. tremula* × *P. tremuloides*; KB-002) which is delivered to practice as a clone mixture. The other cultivar consists of 12 poplar clones (KB-003), and is also delivered as a mix. This mix of pure species and hybrids consists of species mainly from the section *Tacamahaca* (balsam poplars) but also section *Aigeiros* (black poplars) of *Populus* is included. Both cultivars have been tested by the Forestry Research Institute of Sweden. New tests for improved material, suitable for larger areas of the country, are in progress.

Commercial breeding of *Salix* started in the middle of 1980s and over twenty varieties have been developed since then. All of them have gained Community Plant Variety Right and hence are protected throughout the European Union. A list of the Swedish varieties is given in Table 1. In a published 'Handbok för salixodlare' at www.jordbruksverket.se, the following clones are

recommended for areas exposed to frost in the northern part of the country: Klara; for average sites: Tora, Tordis, Inger, Stina, Lisa, Sven, Olof and Torhild; and for dry sites: Inger and Tordis.

During the recent period 2012–2015 more *Salix* clones gained Community Plant Variety Right and have been added to Table 1 since the last country report. Further clones are in the pipeline.

Table 1. *Salix* varieties from Lantmännen and EWB in Sweden with granted PBR (Plant Breeders' Rights) date and expire date.

Variety name	PBR grant date	PBR expire date
Ulv	1996	2022
Tora	1996	2026
Rapp	1996	2026
Orm	1996	2022
Jorunn	1996	2026
Jorr	1996	2026
Björn	1996	2026
Loden	1997	2027
Helga	1998	2028
Torhild	1999	2029
Sven	1999	2029
Olof	2000	2030
Tordis	2002	2032
Gudrun	2002	2032
SW Inger	2003	2033
Karin	2005	2030
Doris	2005	2030
Klara	2008	2033
Nora	2008	2038
Lisa	2010	2035
Stina	2010	2035
Dimitrios	2010	2035
Linnea	2012	
Petra	2014	
Erik	2014	
Birgit	2014	
Estelle	2014	
Wilhelm,	2014	
Ester	2015	

2. Production Systems and Cultivation

The interest in cultivation of fast-growing woody species on agricultural land has resulted in a new edition of the handbook for *Salix* growers (Hollsten et al. 2013, http://webbutiken.jordbruksverket.se/sv/artiklar/handbok-for-salixodlare.html), and also in a new handbook for growers of poplars and hybrid aspen (Persson et al. 2015, http://webbutiken.jordbruksverket.se/sv/artiklar/ovr355.html). Both handbooks were ordered and supported by the Swedish Board of Agriculture.

Reviews or similar works on production systems and cultivation, where *Salix* and/or *Populus* species are included, have been published during the recent period (Tullus *et al*. 2012, 2013, Rytter et al. 2013, Weuh 2013, Mola-Yudego et al. 2014, Dimitriou & Rutz 2015), and the Swedish Forest Agency supported a new edition of the chapter *Silviculture of birch, alder and aspen* (Rytter et al. 2014) in their silviculture series published on the net (http://www.skogsstyrelsen.se/Aga-och-bruka/Skogsbruk/Skogsskotselserien/Skotsel-av-bjork-al-och-asp/).

During the period the Swedish Energy Agency has promoted research work on *Salix* and *Populus* species, but also other fast-growing tree species. One project they supported in collaboration with SLU and Lantmännen is SAMBA (Salix Molecular Breeding Activities). Information about the project can

be found on its homepage www.samba.se. Another focus area during this 4-year-period has been on increased efficiency and success of establishment of Salicaceae on both agricultural and forest land. The effect of vegetation control on establishment has been studied (Albertsson et al. 2014, Böhlenius & Övergaard 2015a), as well as the influence of clone and plant type (Verwijst et al. 2012, Edelfelt et al. 2015, Böhlenius & Övergaard 2015b) and fertilization (Böhlenius & Övergaard 2014).

Also the opportunities to use natural regeneration in the next generation of poplar and hybrid aspen have been investigated (Johansson & Hjelm 2012, Mc Carthy et al. 2014, Mc Carthy & Rytter 2015).

Investigations of productivity in planted stands of *Populus* have been published by Johansson (2013 and Rytter and Stener (2014) and in *Salix* by Mola-Yudego et al. (2015). The productivity of naturally regenerated stands of hybrid aspen was reported by Mc Carthy & Rytter (2015). Rytter (2013a) followed the effect of varied thinning strengths on the development of hardwood species, including aspen.

More basic physiological research has also been performed. Rytter (2013b) studied the effect of nutrients and water on resource allocation to fine roots and fine root turnover of *Salix*, including considering the usefulness of minirhizotrons (Rytter & Rytter 2012). Soolanayakanahally et al. (2015) investigated different growth characteristics for *Populus* species, while Vayssières et al. (2015) explored ectomycorrhizal on poplar. The growth conditions for the northern *Salix herbacea* was examined by Sedlacek et al. (2014) and Wheeler et al. (2015).

3. Genetics, Conservation and Improvement

A large number of genetic studies on the gene level has been published during 2012–2015 (e.g. Ismail et al. 2012, Srivastava et al. 2013, Berlin et al. 2014, Keefover-Ring et al. 2014, Robinson et al. 2014, Du et al. 2015, Eriksson et al. 2015, Fogelqvist et al. 2015; more references are found in the literature list). Large centres for these studies have been Umeå Plant Science Center and Swedish University of Agricultural Sciences. Some of the works point out the effects of traits on for example mycorrhiza and arthropod communities (Hrynkiewicz et al. 2012, Robinson et al. 2012). Other studies have coupling to drought tolerance (Berlin et al. 2014, Puchol et al. 2015), wood formation (Vahala et al. 2013, Biswal et al. 2014), phenology (Ghelardini et al. 2014, Hallingbäck et al. 2015) or damage risks (Gandla et al. 2015, Puentes et al. 2015).

Practical breeding of willows has been carried out by SW Seeds but the business has at the moment been mothballed. Today most material is developed by European Willow Breeding (EWB). Breeding of *Populus* species, i.e. poplars and hybrid aspen, is mainly carried out by the Forestry Research Institute of Sweden (Skogforsk), but some poplar improvement is also done by SweTree Technologies (STT).

4. Forest Protection

The works dealing with forest protection have had a focus on the genetic coupling to insect resistance and have been carried out on *Salix* clones (Axelsson et al. 2012, Dalin et al. 2012, Höglund et al. 2012, 2015, Lehrman et al. 2012, 2013, Björkman et al. 2013, Austel et al. 2015). The biocontrol of the parasitoid *Perilitus brevicollis* has also been investigated (Baffoe et al., 2912, Stenberg 2012).

At the Umeå Plant Science Centre research has been carried out showing that geographical variation exists in genes involved in plant defence against antagonists (Bernhardsson 2012, Bernhardsson & Ingvarsson 2012). Roe et al. (2014a, 2014b) studied how poplars, which easily form hybrids, can still maintain their distinct species boundaries. The studies were performed in Canada but Umeå University has been involved.

5. Harvesting and Utilization

Important questions for delivering wood for different purposes are the amounts that can be produced, the economy and sustainability of the supply chain. The latter was compiled and analysed within work of IEA (Smith et al. 2015). Aronsson et al. (2014) evaluated the effect of N fertilization on yield and economy of willow plantations, while Rosenqvist et al. (2013) focused on the prospects of cost reduction in willow production. A closer look at the effects of different cultivars has also been done (Stolarski et al. 2015).

During the reported period tools for improved estimations of biomass were developed for poplar (Hjelm & Johansson 2012, Johansson & Hjelm 2012, Hjelm 2013, 2015) and willows (Verwijst & Albertsson 2015), while growth development models were produced for poplar (Hjelm et al, 2015) and hybrid aspen (Johansson 2013). Existing tools have also been tested for their usefulness (Englund et al. 2012).

During 2012–2015 some research has been done on wood and wood formation. The properties for using aspen as board were investigated by Ahmed et al. (2013a, 2013b). The frequency of so called false heartwood of poplar was investigated by Johansson and Hjelm (2013). More physiological aspects on wood formation in aspen have also been reported (Roach et al. 2012, Mahboubi et al. 2013, 2015), while the practical use of wood for heat production was studied by Porsö et al. (2014).

6. Environmental Applications

Cultivation of fast-growing Salicaceae species will influence the environment in one or another way. A comprehensive review on the topic has been published as a chapter in the IPC book on poplars and willows (Isebrands et al. 2014), in which chapter Swedish researchers participated. Other reviews of a general orientation have been published elsewhere (González-García et al. 2012a, 2012b, Langeveld et al. 2012, Dimitriou & Fištrek 2014).

Research on the effect of cultivation on biodiversity has continued and has been directed both at plants and animals (Baum et al. 2012a, 2012b, 2012c, Åström et al. 2013, Lindbladh et al. 2014). Studies have also been focused on the effects on the soil (Dimitriou et al. 2012a, Baum et al. 2013) and on water quality (Dimitriou et al. 2012b, Nordborg et al. 2014). The topic of studying the possibilities to use Salicaceae species for extracting toxic elements from the soil was studied by Greger and Landberg (2015) and Kidd et al. (2015).

The effect of climate variables on species distribution has been investigated in the North by Cortés et al. (2014) and Cortés (2015).

Rytter (2012) estimated the carbon sink potential of willow and poplar in Sweden and a later study (Rytter et al. 2015) showed that willows exhibited a positive carbon balance when growing on abandoned agricultural land already after 5 years. An assessment of the climate effect of using willow as bioenergy in Sweden was performed by Hammar et al. (2014).

Practical implications by using sludge for increasing growth of willow were reported by Heinsoo and Dimitriou (2014).

III. GENERAL INFORMATION

1. Administration and Operation of the National Poplar Commission

The National Poplar Commission has been active during the period with several annual meetings of the board as well as an annual meeting for the general public, with elections of the board, and accompanied by excursions to different hosts where issues of interest for *Salicaceae* were presented and discussed. The national commission has become official as a non-profit association. Efforts were earlier also made to get a more official status from the government. This work has been successful as the government declared the Swedish University of Agricultural Science as the official body for the National Commission by January 20 2012. The University now has the responsibility for the international work of the commission.

2. Literature involving the family Salicaceae

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3. Relations with other countries

Swedish researchers have an extensive international network and the there are four Swedish members in the Executive Committee and Working Parties of IPC. The new ongoing clone tests for hybrid aspen and poplar include material from other countries, i.e. Belgium, Finland, Italy, Latvia and Germany. This means we have an organized exchange of plant material with those countries. Sweden has also been much involved in the work of International Energy Agency (IEA) and is one of the founding countries. During the period we have for example have Task leaders in IEA Bioenergy. With economic support from Nordic Energy Research the project “Wood based Energy Systems from Nordic Forests (ENERWOODS)” has been implemented during the period, and included management

systems with hybrid aspen and poplar. The project was a collaboration among the Nordic and Baltic countries. Results of the project are shown on the homepage: http://enerwoods.ku.dk/.

IV. SUMMARY STATISTICS

1. Administration and Operation of the National Poplar Commission

See Appendix I.