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Article

An update on the cultivar registration of *Populus* and *Salix* (Salicaceae)

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Abstract

The long history of *Populus* and *Salix* in cultivation has resulted in numerous selections of cultivars with superior technical and ornamental characteristics. As selection and hybridization within these genera continue to expand and new cultivars are entering into commercial production, their clear and standardized records are important multi-national goals. Many scientific advances related to *Populus* and *Salix* have been produced through the International Poplar Commission (IPC), which holds the International Cultivar Registration Authority (ICRA) for poplars and maintains the *Populus* Cultivar Register. Recently the IPC was appointed as the ICRA for willows as well, and compilation of the *Salix* Cultivar Checklist, along with the establishment of the *Salix* Cultivar Register, is currently in progress. Effective outreach efforts to all involved in cultivar development are required to facilitate comprehensive compilation of international records. These important initiatives will contribute to the nomenclatural stability of cultivated poplars and willows.

Keywords: cultivar, International Cultivar Registration Authority, International Poplar Commission, Salicaceae, *Saliceae*, *Salix*, *Populus*

Introduction

Tribe *Saliceae* includes two major genera of woody plants that play important roles in many ecosystems, serve as model organisms for basic research in molecular biology and genetics as well as in plant domestication and conservation.

Populus L. and *Salix* L. are the two genera of the tribe *Saliceae*, family Salicaceae, order Malpighiales. The genetic resources of the family also comprise infraspecific taxa integrated within wild and domesticated populations. The hierarchy of infraspecific differentiations includes subspecies, varieties, forms, populations, and individual genotypes (Stanton *et al*., 2013). In addition, natural interspecific hybrids and numerous hybrids induced through artificial cross-pollination add to the complexity of the genetic resources of the family. The two genera together embrace about 480 species (Argus, 2010; Eckenwalder, 2010). The

number of species included in poplar and willow is not well defined because of competing species concepts by different authors. Poplars have a wide natural distribution from the equatorial tropics to the latitudinal and altitudinal limits of tree growth and constitute a defined group of about 30 species in 6 taxonomic sections (Eckenwalder, 2010). There are about 450 species of *Salix* worldwide (Argus, 2010) predominantly in temperate and arctic zones, but also in subtropical and tropical. The representatives of the genus *Salix* are divided into five subgenera and numerous sections.

Domestication of poplars and willows

The unique combination of characters in poplars and willows as well as their broad physiological and ecological amplitudes and adaptations to a wide range of climates have resulted in their widespread cultivation around the world.

Poplars and willows were already used by ancient civilizations for many necessities, such as shelter, wood, fences, sweat lodges, wickerwork, and numerous utilitarian objects: snow shoes, arrow shafts, fish traps, whistles, nets, rope, etc.

Later, willow and poplar wood was used in the manufacturing of furniture and reconstituted wood products, construction lumber, veneer and plywood, paper and pulp, and also artificial limbs, sporting goods, such as cricket bats and hockey sticks. Willows and poplars have also been employed as forage for livestock; as a source of chemical compounds, such as tannin and salicin; and for obtaining nectar necessary for honey production. Both genera have traditionally been used in forestry or integrated into many temperate and subtropical agricultural systems in developed and developing countries providing a wide range of goods important for human livelihood (Dickmann, 2001; Kuzovkina *et al.,* 2008). In addition to many utilitarian uses, the long history of poplar and willow cultivation and domestication has been distinguished by the selection of a number of ornamental cultivars for their unique growth habits or color of stems, leaves, or inflorescences. The cultivation of Lombardy poplars and weeping willows, the most widely planted ornamental trees in the world (Li, 1996), has been well documented throughout the history and played important roles in cultural expressions around the world through frequent depiction in art and literature (Knowles, 2009).

Most recently *Populus* and *Salix* have become important sources of biofuel, as they meet the requirements for renewable energy sources and are broadly used for various ecosystem services (Zalesny and Coyle, 2011). The potential of poplar and willow plantations

in mitigating climate change, including bioenergy production and carbon sequestration capabilities, as well as ecological restoration and the environmental monitoring potential of these genera are under investigation.

The exploration of poplar and willow germplasm has resulted in selection or breeding of many genotypes that could be successfully applied for various economic purposes. Specialized institutions and programs have been geared toward selection of new clones (Stanton *et al*., 2013).

More than one hundred years of poplar breeding were started with the development at the Royal Botanic Gardens, Kew, of a widely planted hybrid *Populus* ×*generosa* A.Henry, followed by the hybridization work of Stout and Schreiner at the New York Botanical Garden which resulted in obtaining poplar hybrids now planted in many parts of the world (Stout *et al*., 1927).

The earliest documented willow hybridization studies were conducted by M. Wichura in the mid-1800s (Wichura 1854, 1865). More willow hybridization work was undertaken in the early 1900s by N. Heribert-Nilsson of Sweden (Heribert-Nilsson, 1918).

These initial hybridization efforts were followed by the establishment of significant germplasm depositories and specialized institutions. The oldest center for willow selection was established in the early 1900s in the United Kingdom**,** at Long Ashton Research Station. A unique *Salix* gene bank was assembled there, and innumerable clones were selected for many practical applications ranging from basketry and cricket bat manufacturing to amenity plantings and from horticultural shelter and riverbank stabilizers to pulpwood production (Stott, 2001).

Due to the importance of poplar wood for Italian industries, the Istituto di Sperimentazione per la Pioppicoltura (currently Consiglio per la Ricerca e sperimentazione in Agricoltura – Unità di ricerca per le produzioni legnose fuori foresta – CRA-PLF) was founded in 1939 in Casale Monferrato, Italy, to promote the cultivation of poplars and increase the national production of wood. Many new poplar clones with improved characteristics, such as fast growth rates, disease resistance, high-quality wood for plywood production and broad adaptation to varying soil environments were developed there and consequently planted all over the world (e.g., 'I-214' bred by G. Jacometti over 80 years ago, the most planted poplar clone worldwide (Fig.1). Today the CRA-PLF has one of the largest poplar and willow germplasm collections (including seeds, pollen, living plant material, as well as archival records) used for a breeding program for wood, paper, and energy (Fig.2).

Other European institutions with a long tradition of poplar domestication and conservation are the Rijksstation voor Populiernteelt (currently Research Institute for Nature and Forest, INBO) in Geraardsbergen, Belgium; Institute for Forest Genetics and Forest Tree Breeding in Grosshansdorf, Germany; Hessian Forest Research Station in Hann Muenden, Germany; and Dorschkamp Institute (currently the Center for Genetic Resources) in Wageningen, Netherlands.

Extensive breeding programs have been carried out at Argentina's National Institute of Agricultural Technology (INTA, Buenos Aires) (Ragonese and Alberti, 1958; Pourtet, 1959; Ragonese, 1976) and at the Botanic Gardens of the Ural Branch of the Russian Academy of Sciences in Yekaterinburg, where the Salicetum has been maintained since the 1960s managing germplasm for breeding efforts and promoting clone selection for landscape uses, basketry, furniture production, and revegetation (Shaburov, 1986; Shaburov and Belyaeva, 1995). Novelty clones with straight trunks and long stems, high flexibility and density, rich in tannin content as well as cold-hardy ornamental hybrids suitable for revegetation in northern climates were developed there.

Figure 1. 'I-214', an Italian clone of *Populus* ×*canadensis* Moench, is the best example of a widely adapted selection (CRA-PLF in Casale Monferrato, Italy). Photo by L. Vietto

The remarkable potential for increase in poplar and willow yields through hybridization has been utilized in extensive plant breeding programs that annually introduce new superior

clones with useful traits. When revitalization of poplar and willow cultivation took place in the mid-1980s, a new wave of breeding efforts was initiated. Exploitation of the wide biological variations within these genera introduced numerous traits important for biomass production, including high yield, resistance to leaf rust, insects, and frost, improved growth habits and also improved technical characteristics related to wood quality: viscosity, moisture content, wood density, and fiber length, etc.

Figure 2. *Populus nigra* L.(left) and *Salix* cultivars (right) collections at CRA-PLF in Casale Monferrato, Italy. Photo by L. Vietto

The extent and importance of modern culture of plants of tribe *Saliceae* for many countries is manifested by the fact that there are about 60 active poplar and willow breeding programs worldwide (Fig 3). It is widely recognized that domestication strategy should rely on ongoing programs to provide a continued and regular release of superior cultivars that meet new challenges, such as minimization of disease problems associated with the overreliance on a limited range of genotypes.

The most common poplar species under investigation today include the North American species *Populus balsamifera* L., *P. deltoides* Marshall, *P. trichocarpa* Torrey & Gray, and *P. tremuloides* Michx.; the Eurasian species *P. alba* L., *P. cathayana* Rehd., *P. ciliata* Wall. ex Royle, *P. euphratica* Oliv., *P. suaveolens* Fisch., *P. nigra* L., *P. simonii* Carrière, and *P. tremula* L.. Within *Salix*, a few shrub species belonging to the subgenus Vetrix Dumort., *S. gmelinii* Pall., *S. eriocephala* Michx., *S. miyabeana* Seemen, *S. purpurea* L., *S. schwerinii* E.L.Wolf, *S. viminalis* L., and *S. udensis* Trautv. & C.A.Mey., appear to be promising for

bioenergy plantings in Europe and North America. Some arborescent willows belonging to the subgenus *Salix*, *S. alba* L., *S. babylonica* L., *S. humboldtiana* Willd., *S. nigra* Marshall, and

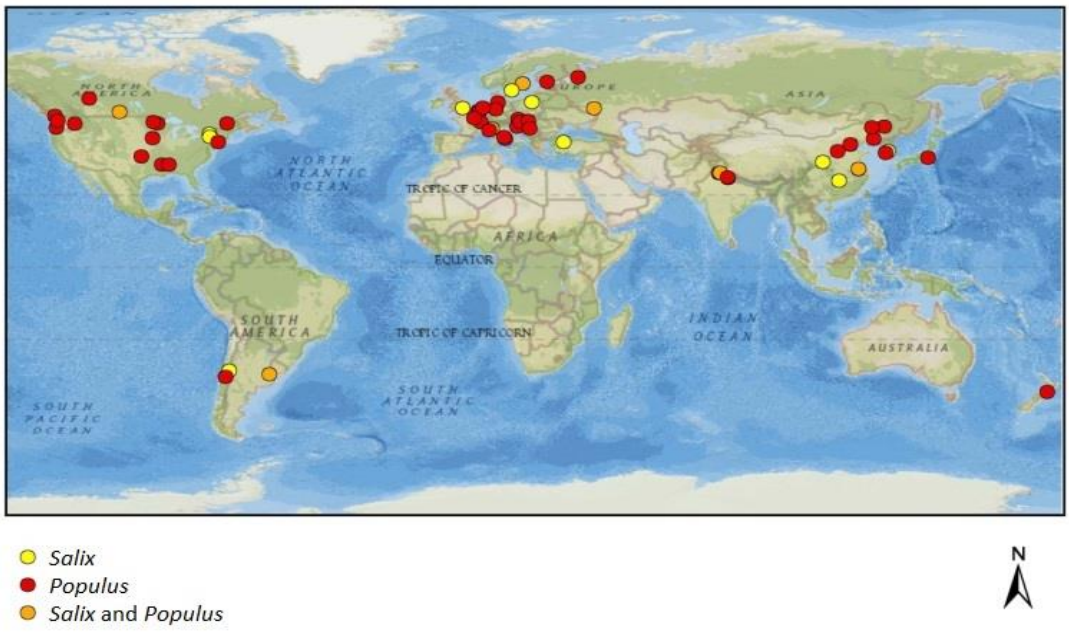

Figure 3. Global distribution of *Salix* and *Populus* breeding programs. Map by A. Chabaeva (based on Stanton *et al.*, 2013)

S. tetrasperma Roxb., are under investigation in subtropical countries for their potential usage in wood production and environmental projects. Interspecific hybridization induced through artificial cross-pollination has resulted in recognition of hundreds of cultivars, many of which possess a genome derived from more than two species. The recent trend toward the cultivation of indigenous species is resulting in studies of genetic diversity within native populations and selection of clones of native species of poplars and willows in many countries.

Thus, research on *Populus* and *Salix* is becoming a specialized science requiring careful consideration and attention to detail when dealing with infraspecific variation and clonal characteristics. The scientific research related to Salicaceae has progressed to the investigation of precise genotypes (Dickmann, 2001). New technologies enable scientists to gather data in order to discover, describe, select, and create specific genotypes, which has led to significant accumulation of information. There is active exchange of poplar and willow germplasm between some European countries, Argentina, Brazil, Canada, Chile, the People's Republic of China, and the United States through various breeding and conservation programs and international projects (International Poplar Genome Consortium, Aspen FACE, EUFORGEN, etc.).

"There is great value in extending global inter-specific hybridization programs of selected provenances of several of the key species to many countries beyond their native ranges" (Stanton *et al*., 2010). Solid information about genetic material, consistency of records is critical for extensive international exchange.

Taxonomy and nomenclature of cultivated plants and the international system for cultivar registration

While traditionally taxonomy deals with plants at the species and subspecies level, nomenclature for cultivated plants entails a different approach, one that allows for depicting processes and patterns involved in plant domestication and for showing plant variation in more detail (McNeill, 2008).

Understanding variation within species requires delineation of special categories describing objects "whose origin and selection is primarily due to intentional human activity" (Brickell *et al*., 2009), such as cultivar and cultivar group. These categories were developed in order to facilitate effective communication and stability in descriptions of organisms. Principles of this approach were outlined in the International Code of Nomenclature for Cultivated Plants (ICNCP) published by the International Society for Horticultural Science (ISHS) in the series *Scripta Horticulturae* (Brickell *et al*., 2009). In addition, a voluntary, non-statutory system called the International Cultivar Registration Authority (ICRA), functioning under the ICNCP, has been in operation for over 50 years contributing to the stability of cultivated plant nomenclature. Its aim is to ensure that names in the denomination class for which an authority has accepted responsibility (usually a *genus*) are in agreement with the latest edition of the ICNCP. The ICRA system ensures that each plant cultivar receives a unique name, which is formally established, i.e., published with a description in a dated publication. Upon such publication, the name has precedence for its use for a particular plant. Based on the ICNCP, the cultivar name can have different statuses – "established", "acceptable," or "accepted", which respectively correspond to "validly published", "legitimate", or "correct" in terms of the International Code of Nomenclature for algae, fungi, and plants (McNeill *et al*., 2012). While the ICRA system does not confer any legal protection over the name or the plant itself, it aims to provide stability in the naming of cultivated plants by promoting generating lists of authenticated names for commonly cultivated plant genera. The ISHS appoints the ICRAs and monitors their work (http://www.ishs.org/sci/icra.htm). A wide range of specialist organizations (societies and institutions) interested in particular groups of plants are appointed as ICRAs for

appropriate plant genera. They maintain registers of cultivar names, and the new names are verified against this reference to avoid repetition of epithets.

Populus International Cultivar Registration Authority

The International Poplar Commission (IPC) is a technical statutory body of the Food and Agriculture Organization, which promotes the cultivation, conservation, and utilization of species in the Salicaceae family and supports poplar and willow cultivation as regards its scientific, technical, social, and economic aspects.

The first attempt to organize the genetic resources of poplar was made in 1953 at the 7th Session of the IPC held in Germany (Baden-Baden and Cologne). At that time the IPC decided to set up a sub-committee of the Executive Committee on Nomenclature and Registration with the task of developing a model for poplar cultivar registration and responsibility for establishing a register of poplar names. The ISHS appointed the IPC to serve as the ICRA for the genus *Populus* (International Commission for the Nomenclature of Cultivated Plants, 1958). Because of success in poplar cultivation and increasing number of poplar cultivars, their registration became of great importance allowing to correctly name the new releases, avoiding possible confusion with names, and facilitating cultivar exchanges among users.

Under the chairmanship of Jean Pourtet, who headed the Executive Committee from 1969 to 1975, the Sub-Committee made great progress. The Registration Form then created comprised 85 fields, 40 of which were reserved for descriptive characteristics of poplar cultivars in the section *Aigeiros* and *Tacamahaca* and their hybrids. 52 cultivars were described using the Revised Form (FAO/IPC/75/49), as it was reported during the 15th Session of the IPC held in Rome in 1975 (Viart and Fugalli, 1998). Following the scientific progress achieved in this field by the International Union for the Protection of New Varieties of Plants (IUPV), the Form was updated and extended to include poplars of the sections Leuce, Turanga, and Leucoides (Report of the 31st Session of the Executive Committee of the IPC, 8-9 September 1982, Casale Monferrato, Italy).

Cultivars released for cultivation should be named in accordance with the rules of the ICNCP (Brickell *et al.*, 2009) and registered at the national level by a registration authority duly mandated by the government. Subsequently, an application providing a proposed denomination (cultivar epithet), essential information on the origin, and a synthetic description should be sent to the IPC. In case the proposed denomination is compliant with the international rules described in the ICNCP and the information required for the registration has

been provided, the new cultivar is included in the International Register of *Populus* Cultivars. The Sub-Committee produces and maintains the Register of cultivar names in the public domain, which makes it available to the international community as a free service.

The first edition of the Poplar Register was published in 1992 (Viart, 1992) and included more than 300 cultivars, of which 63% were of hybrid origin and 37% were selections of pure species. Upon receiving a number of applications for the registration of new cultivars, an updated version of the International Register of Poplar Cultivars was produced in May 2000 for the 21st Session of the International Poplar Commission (Portland, OR, USA). Comprehensive data on 332 cultivars are still available at www.populus.it.

Since then, only a limited number of entries have been filed with the Register. On the occasion of the 24th Session of the International Poplar Commission, Dehradun, India (2012), the Sub-Committee reviewed an extensive body of relevant publications, mainly the National Poplar Commissions Reports, and discovered that during this time more than 200 cultivars had been selected, named, and introduced into cultivation. Most of these new clones should have been listed in the Register, since many are reported as widely planted (such as ones cultivated in France or Belgium) and applications have been filed for their protection in Europe.

It became obvious that the existing effort for the comprehensive collation of data on poplar cultivars following the previously established protocol for registration was ineffective. Several weaknesses became apparent in the functioning of the registration system. First, the existence of the Register was unknown to breeders and relevant national authorities that control forest reproductive material, as no countries ever requested preliminary authorisation from the Register for the naming of cultivars. Secondly, most National Poplar Commissions did not ensure that the information on new cultivars was forwarded to appropriate national authorities or the IPC Sub-Committee. There was no system for the registration of poplar cultivar names for those countries that were not members of the IPC. Moreover, Canada had no national regulations for the identification, registration, or control of poplar clones; in the United States there was not any poplar or willow certification/registration program in place, either (and this situation has not changed as of today).

Several other factors possibly contributed to this decline of entries processed through the ICRA. The primary reason could be confusion among breeders about the registration process: other registration systems were developed for different purposes and various organizations and committees took responsibilities for different aspects of cultivar approval.

This especially applies to those countries where poplar and willow are considered important economic crops having significant effects on the national economy and the livelihood of people. Therefore, in addition to the registration of cultivar names through the ICRA, the statutory schemes now include international and national offices granting plant breeders' rights and providing legal protection for new cultivars, for example, the International Union for the Protection of New Varieties of Plants in Europe (http://www.upov.int/portal/index.html.en) or the US Patent and Trademark Office (http://www.uspto.gov/).

In some countries national regulatory bodies and committees issue performance certificates for new cultivars based on the requirements for high-quality planting stock, as determined through trials or tests, such as the DUST – Distinctness, Uniformity, and Stability Test. These committees often operate under a ministry of agriculture: for example, the National Clone Register of the National Institute of Agricultural Technology (INTA) in Argentina.

Consequently, various organizations grant certificates for new cultivars fulfilling various statutory regulations based on different criteria, so that the registration of cultivars often requires submissions to up to three separate bodies.

Further, many worldwide organizations are involved in the selection of *Saliceae* continuously introducing new cultivars and describing new genotypes. This complex organizational structure, which includes not only international organizations, governmental and academic institutions along with coordinating agencies, but also various formal and informal groups, results in fragmentation into multiple distinct associations, which adopt their own levels of knowledge creation, transfer, and collaboration (Table 1). Records related to the biodiversity of the tribe *Saliceae*, including information about cultivars, are fragmented and frequently restricted to various fields or organizations, complicating the comprehensive collation of data from breeders. As a result, this information is stored in multiple public and private databases.

Consequently, synonymies, homonymies, and misidentifications e.g., two different clones showing the same genetic identity, genetic differences found within material labeled in nursery as the same clone, mistakes in clone identifications at stool beds occur in several European countries and affect the EU basic material lists.

A series of inconsistencies in the respective national registers of poplar clones have been already detected through multiplexed SSR identification in the collections. Researchers have succeeded in eliminating redundant clones and giving the clones the correct names (De Lucas *et al.*, 2008; Rathmacher *et al.*, 2009). Bypassing the national control, a pseudo-new

Table 1. Levels of organizations involved in the various aspects of *Populus* and *Salix* domestication programs.

Organizational level and remit	**Examples**
International focus Knowledge creation, transfer, and collaboration within an international organization	International Poplar Symposium (IPS, IUFRO) International Poplar Commission (IPC, FAO) (though its remit is international, it operates through a series of national representatives: National Poplar Commissions)
Continental focus Knowledge creation, transfer, and collaboration within a continent	Pro-Populus (Europe) North American Willow Geneticists
National focus Knowledge creation, transfer, and collaboration within a single country	National Poplar Commission of Argentina Poplar Council of Canada
Group focus Knowledge creation, transfer, and collaboration among interacting teams without a formal organization	Willow geneticists from the USA, Canada, UK, Sweden involved in collaborative projects or exchange of information
Professional focus Knowledge creation, transfer, and collaboration within a professional association	Adopted by researchers in some fields (for example, knowledge can be transferred among taxonomists – members of botanical associations; their interactions with researchers and users of *Saliceae* limited, resulting in a shortage of taxonomic expertise among users)

poplar variety could be registered by the Community Plant Variety Office, as the register offices only use phenotypic traits as criteria of distinctness. It is urgent to coordinate efforts in assessing genetic identity of all the poplar clones used in Europe, to detect discrepancies or weaknesses, and improve clone identification at a broad level – also because the ongoing boom in short rotation and a faster clone turnover will aggravate the situation.

The previous approach adopted by the Sub-Committee on Nomenclature and Registration relied on the assumption that plant breeders were fully aware of the registration process through the ICRA. However, it has not been the case. Due to complications associated with the registration process in general and complexity of the existing organizational structure, the future strategy for obtaining voluntary submissions should rely on effective outreach to poplar breeders. Therefore, the urgent goal is to raise awareness among breeders of the importance of plant registration through the ICRA. Significant improvements in cooperation between all organizations and individuals regarding the process for cultivar registration through ICRA are needed in order to update records. While the ICRA system is international in its scope, its success depends upon the assistance of all those involved with the creation of new plants. An integrated approach to networking with breeders and outreach to all organizations involved in domestication programs are fundamental for development of an international database and its effective adoption for domestication programs and scientific research.

Salix International Cultivar Registration Authority

Clonal selections and hybridization programs with willows are rapidly expanding due to the increasing global significance of their cultivation and exploitation of the wide biological variations within the genus *Salix*. However, even though the current ICRA system covers a considerable number of horticulturally significant plant genera, no ICRA had been appointed for *Salix* until very recently.

At the 23rd IPC Session held in Beijing, it was proposed that, before the *Salix* cultivar records become more complicated and difficult to interpret, the IPC would establish the ICRA for *Salix* cultivars, since the Commission already was holding the ICRA for *Populus*. During the following months, the IPC submitted its application to the Executive Committee of the ISHS Commission for Nomenclature and Cultivar Registration for its authorization as the ICRA for the genus *Salix*. During 2008-2012, a number of preliminary projects, including compilation of a list of willow cultivars recently introduced for agroforestry applications, were undertaken by the Sub-Committee in order to provide a solid foundation for this establishment. The IPC National Reports from 2008 to 2012 were analysed, and data pertaining to willows were extracted similarly to the way it had been done for the revision of poplar cultivars described above.

It became obvious that during the period 2008-2012 more than 80 cultivars had been introduced into cultivation from Argentina, Canada, P.R. China, Italy, Romania, Serbia, Sweden, and the USA. The Commission for Nomenclature and Cultivar Registration endorsed the application, and effective July 2013, the IPC was designated as the ICRA for *Salix*, the official body for the registration of willow cultivars. The compilation of *Salix* cultivar checklist was identified as the most urgent step. Publication of this checklist would serve as the starting point for the regulation of nomenclature in the *Salix* cultivars denomination class, while assuring adherence to the ICNCP rules.

A major challenge to such a comprehensive compilation of *Salix* names is presented by a subset of ornamental cultivars whose numerous records are scattered and have to be retrieved from many sources. While only a few names were published in academic journals, the majority are dispersed across conference proceedings, horticulture and landscape magazines, nursery and garden catalogs, and gardening newspapers. To further complicate the issues, only rarely have these entries been accompanied by effective publications compliant with the current rules for cultivar name establishment. More frequently, the requirements for name establishment

were not met due to a lack of accompanying descriptions or references to descriptions in print (after January 1, 1959 and after January 1, 2012 also accepted if published electronically).

It had been generally understood that providing authentic data for the checklist of cultivars was essential, and yet it became clear that compiling a historically accurate document was hardly possible and a different strategy had to be developed by the Sub-Committee.

The most prominent horticultural references of the 20th century, such as Bailey (1924), Rehder (1927; 1949), Späth (1930), Krüssman (1978), and Bean (1980) referenced many ornamental cultivars of *Salix*, and these will be used as the starting point for the preparation of the *Salix* cultivar checklist. Significant compilations of *Salix* cultivars contained in modern databases (Hoffman, 2010; Lord, 2005) will be used to complement the checklist. These databases employ names collected through surveys of contemporary nursery catalogs and may include validation of these names. However, within their brief descriptions they usually do not include establishment dates for any names.

In addition, numerous utilitarian selections, such as willow basketry cultivars that proliferated during the culmination of the craft in the late 19th – early 20th centuries, will be included in the *Salix* Cultivars Checklist to be certain that new cultivar names have not been used before.

In order to accommodate the needs of different users, two different publications on cultivar registration are planned: one for ornamental cultivars, to be published in a horticultural journal; the other – for various utilitarian cultivars used in agroforestry, to be published in an appropriate technical journal. The goal for the ICRA, as regards *Salix*, is to become a valuable resource for all interested parties.

Conclusions

Today many scientific centers around the world are involved in *Saliceae* research. As new cultivars are selected, referral to these taxa and their detailed descriptions must be established and maintained. International registration of cultivar names is vital for achieving certainty and stability in the denomination of plant material. While the ICRA system is international in its scope, its success depends upon the assistance of all those involved with the creation of new plants. An effort must be made to improve the existing version of the *Populus* Register and produce the *Salix* Cultivar Checklist, which has to be followed by the establishment of the *Salix* Register. This will contribute to the nomenclatural stability of cultivated poplars and willows. The urgent goal of the Sub-Committee is to raise awareness

among poplar and willow breeders of the importance of the registration through the ICRA in order to facilitate the comprehensive collation of data from breeders. Thus, significant outreach efforts and cooperation between all organizations and individuals involved in the process of cultivar registration are needed to construct a vehicle for improvement of records. An integrated approach to networking with breeders and effective outreach programs to all organizations involved in domestication programs are fundamental for developing an international database and its effective utilization for domestication programs and scientific research.

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