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Characters distinguishing Osier-willow Clones

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(Received 30th October 1986)

Summary

The following characters are very useful to distinguish osier willow clones: sex, colour of the rod in winter, shape of the leaf bud, presence of black bud scales, time of leaf unfolding, colour of the petiole, presence of leaf-like organs on the petiole, glaucousness of under-surface of leaf, length/width ratio of the leaf blade. Of limited use are: hairiness of rod and leaf, position of the rods on the stool, persistence of stipules, length of the leaf blade.

Typical *S. fragilis* L. is often wrongly regarded as *S. alba* \times *fragilis* by many authors. Special attention is paid to *S.*

fragilis var. *decipiens* (HOFFM.) KOCH and the here newly appointed cultivar groups Vitellina and Basfordiana.

Key words: *Salix*, *Salix fragilis*, *Salix alba*, *Salix triandra*, *Salix viminalis*, clone distinction and classification.

Zusammenfassung

Die nachfolgenden Merkmale haben sich als sehr nützlich erwiesen, um Flechtweiden-Klone zu unterscheiden: Geschlecht, Winterfarbe der Langtriebe, Form der vegetativen Knospen, Vorhandensein von schwarzen Knospenhüllen, Austriebszeitpunkt der Blätter im Frühjahr, Farbe des Blattstiels, Anwesenheit von blattähnlichen Petiolar-Drüsen, Glaukfärbung der Blattunterseite, Verhältnis zwischen Länge und Breite der Blattspreite. Weniger nützlich

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sind: Intensität der Behaarung der Blätter und Triebe, Richtung der Zweige am Wurzelstock (für die Steckholzgewinnung), Dauerhaftigkeit der Nebenblätter, Länge der Blattspreite.

Die typische *Salix fragilis* L. ist von vielen Autoren fälschlicherweise als *S. alba* × *fragilis* betrachtet worden.

Besondere Beachtung findet in diesem Beitrag die *S. fragilis* var. *decipiens* (HOFFM.) KOCH und die hier eingeführten Sortengruppen Vitellina und Basfordiana.

Introduction

Formerly, the products from the osier grounds were highly esteemed in the Netherlands. In the course of ages willows have been domesticated for several purposes (making of hoops for barrels, binding purposes, ornamental purposes, basketry, dike maintenance etc.).

The resulting landraces were generally a mixture of clones differing much in yield, disease and pest resistance, morphology, technical properties etc. Scientific selection started at the beginning of this century. An international osier willow assortment consisting of Dutch, German, English, Belgian and French clones was tested by Ir. W. D. J. TUINZING in a governmental trial field in Langbroek (Province of Utrecht) from 1933 until 1955. Around 1955 demand for products from the osier grounds dwindled because of cheap imports of basketry from East Block countries and plastics taking over other packing materials. In order to conserve the osier willow clones the Dorschkamp Research Institute for Forestry and Landscape Planning at Wageningen started a large international collection of willow clones in 1960. Most of the clones found in this collection belong to *Salix alba* L., *S. fragilis* L., *S. triandra* L. and *S. viminalis* L., to which species this study is restricted. The study aimed at a better understanding of the basic principles of clonal distinction in order to identify clones in nurseries, osier grounds etc. Another aim (not treated in this paper) was to get a clearer view upon possible hybridisation between *S. alba* and *S. fragilis*. Many plant characters were screened for suitability to distinguish clones. By means of herbarium and literature study and observations of living plants the botanical names of all accessions were verified.

Material and Methods

Field observations were carried out between January and December 1983 in four different collections (see Table 1). The main collection ("Dorschkamp") was on a dry sandy soil. In 1982 growth of the stools was very poor, so the collection was also planted on a clay soil, more suitable for willows (see: "Lienden"). By comparing the two locations, showing extreme differences in growth, some clues could be obtained about habitat effects. Characters of the flowers and of the free-grown plants could be investigated in the "Rijnschans" and "Polder" collections. Both collections also consist of plants obtained from the main collection ("Dorschkamp"). Winter characters were observed in situ or in the laboratory in the Rijnschans and Lienden collections. Five representative rods of each collection number were cut and observed in the laboratory, for some characters a stereo binocular microscope was used. With "rod" is always meant: the vigorous one-year shoots produced by cuttings stools or coppiced osiers. Observations of bud characters were done in the middle of the rods. The colour was examined with the R.H.S. Colour Chart (1966) in artificial light (T. L. PHILIPS no. 55). Every rod was observed only on the side which had been exposed to the sun, once

Table 1. — Collections used.

name of collection	number of clones	number of plants per clone	plant distance (m)	year of lay-out	soil	quality of plants
Dorschkamp	311	5	1.0 x 1.2	1979	sand	1*
Lienden	270	10	0.5 x 1.0	1983	clay	2*
Rijnschans	79	3	1.5 x 1.0	1980	clay	3*
Polder	172	45	4.0 x 4.0	1970	clay	4*

* 1 = stools (cut every year); 2 = plants from 1-year cuttings (in 1983); 3 = stools until 1981, free growth after 1981; 4 = free growth.

in the middle and once near the top. Observation of flower characters were taken in the "Polder" and "Rijnschans" collections in situ and in the laboratory. Leaf characters were observed in August and September 1983 from all four sites. Of each clone and collection 30 leaves were picked at about 3/4 length of the 1-year old rod (this part of the rod has the longest leaves) and examined in the laboratory. Length and width of leaf blade and length of petiole were measured. Leaf phenology were observed on April 19 and October 28 1983 in the "Rijnschans" collection. Petioles were observed in the "Dorschkamp" and "Lienden" collections.

Results and Conclusions

1. Winter characters

Colour of the young shoots is sometimes very useful to discriminate clones. The cultivar groups Vitellina* (belonging to *Salix alba* L.) and Basfordiana** (*S. fragilis* L. or *S. alba* × *S. fragilis*) are easy to recognise by the conspicuous shoot colour: yellow turning to orange towards the top of the twig. Clones belonging to var. *decipiens* (HOFFM.) KOCH of *S. fragilis* can easily be told apart from the rest of *S. fragilis* by the polished and very light-coloured rods (greyed orange group according to the R.H.S. Colour Chart). In *S. triandra* and *S. viminalis* rod colour can vary greatly between different clones, from light greenish-yellowish to very dark. A clone with dark rods can easily be distinguished from those with light-coloured rods. In the collection, dark coloured *S. viminalis* clones were wanting. Nevertheless, *S. viminalis* with very dark rods can be seen frequently in osier beds or in naturally occurring seedling populations. Sometimes, as in *S. alba* and *S. viminalis*, rod colour can be influenced by hairiness of twigs. Rod colour is rather habitat dependent. Rods of the "Dorschkamp" willows (on poor sand) generally had brighter colours compared to rods of the same clones in the "Lienden" collection (on rich clay). More light (sunny side of shoot or tree) also brightens colours. Position of the rods on the stool has

* *S. alba* Vitellina group. Synonyms: *S. vitellina* L., *S. alba* var. *vitellina* (L.) STOKES.

Herbarium specimen: Linn. Society, London, Herb. Linnaeus: no. 1158.13

Clone numbers of the Dorschkamp collection: 421, 535, 537, 542, 546, 549, 579, 597, 625, 626, 810, 965, 973, 974.

** *Salix* Basfordiana group. Synonyms: *S. basfordiana* J. SALTER, *S. sanguinea* J. SALTER, (see: SALTER, 1882), *S. × rubens* nothovar. *basfordiana* (SCALING ex SALTER) MEIKLE, *S. × rubens* nothovar. *basfordiana* forma *basfordiana* MEIKLE, *S. × rubens* nothovar. *basfordiana* forma *sanguinea* MEIKLE, (see MEIKLE, 1984).

Herbarium specimens: Kew, London, Herb. Leeft: "*Salix Basfordiana* Scaling 2-5-1874", "*Salix Basfordiana* Scaling 22-8-1874". Clone numbers of the Dorschkamp collection belonging to this group: 526, 580, 681, 706, 707, 708.

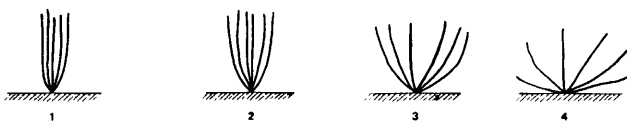


Fig. 1. — Stool types according to position of the rod on the stool. 1: rods erect; 2: rods ascending; 3: rods semi-erect; 4: rods spreading.

some value within *S. fragilis* and *S. alba* × *S. fragilis*. I distinguished four position types (see Fig. 1). Clones which have horizontal rods (type 4) were characterised by wide branch angles and very broad tree shape, clones with erect rods (type 1) had smaller branch angles and a narrower crown shape.

Hairiness of rods and buds is a rather intractable character (habitat-dependent and difficult to quantify), and is only of some importance when differences are large. The more hairy *S. fragilis* clones will often point to hybridisation with *S. alba*. *S. alba* Vitellina group generally has rather bald rods whereas the var. *splendens* (BRAY) ANDERSS. is extremely hairy. Within *S. viminalis* cultivars can be found with almost glabrous rods. Number and size of lenticels vary too much, even within one rod to be of any use.

Shape of the leaf bud can be very useful in identification of clones. According to type of impression of the surface, the following bud types can be distinguished (see Fig. 2).

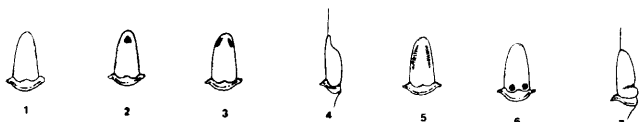


Fig. 2. — Bud types according to type of impression of the surface of the bud. 1: smooth surface; 2: one impression near the apex; 3: two impressions near the apex; 4: bud with flattened top (side view); 5: bud marked with depressed lines near the edge; 6: bud with two or three impressions near the base; 7: bud with incision towards the base (side view).

1. Bud with smooth surface (without any impression).
2. Bud with one impression near the apex of the bud.
3. Bud with two impressions near the apex.
4. Bud with flattened top (side view).
5. Bud marked with depressed lines near the edge.
6. Bud with two or three impressions near the base.
7. Bud with incision towards the base (side view).

Clones belonging to *Salix* Basfordiana group have in most cases bud type 2, whereas clone nr. 707 of this group has type 5. *S. alba* and *S. alba* × *S. fragilis* very often have bud type 5. *S. fragilis* clones can have bud types 1, 2, 4 or 6. *S. viminalis* always has type 1 whereas *S. triandra* always has type 7, sometimes combined with type 3.

Depending to appression to the rod the following bud types can be distinguished (see Fig. 3).

- a. Appressed to rod.
- b. Apex of bud not appressed.
- c. Apex of bud bent backwards (side view).

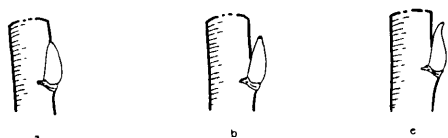


Fig. 3. — Bud type according to appression to the rod. a: appressed to the rod; b: apex of bud not appressed; c: apex of bud bent backwards.

Black, dried bud scales can sometimes be found in a high frequency in clones of *S. fragilis*, especially in var. *decipiens*. Length of the leaf bud is a tricky character to use in identification of clones since even within one rod buds vary enormously in size. In an unbranched rod buds are generally short and broad near the base and longer and narrower near the top. The small side twigs of a rod have smaller buds than the main rod — a special handicap of the intensely branched *S. alba* rods. The catkin buds of *S. viminalis* are markedly larger than its leaf buds. Buds are smaller on less vigorously grown rods. Length/width ratio of the leaf bud does not show enough variation between the clones of a species to be of any use.

2. Flower characters

The sex of the clone is the most important character in clone discrimination. A willow clone has either pistillate or staminate catkins. Very rarely (more often in *S. cinerea* L. or in interspecific hybrids) hermaphroditism or monstrosities can be found. One *S. alba* × *S. fragilis* clone (coll. nr. 536) has staminate flowers and a high frequency of flowers with organs somewhere intermediate between stamens and pistils. No relation could be found between sex and other characters of a clone. Length of the catkin is too variable within one plant to be of much use in distinction of clones.

3. Leaf characters

3.1. Leaf phenology

In free-grown trees and shrubs the time of leaf unfolding can sometimes be useful, *S. triandra* nr. 677 unfolded in leaves about two weeks later than the six other investigated *S. triandra* clones.

Between *S. fragilis* clones differences were less extreme. No significant differences in time of falling of the leaves could be detected between different clones of one species.

3.2. Stipules

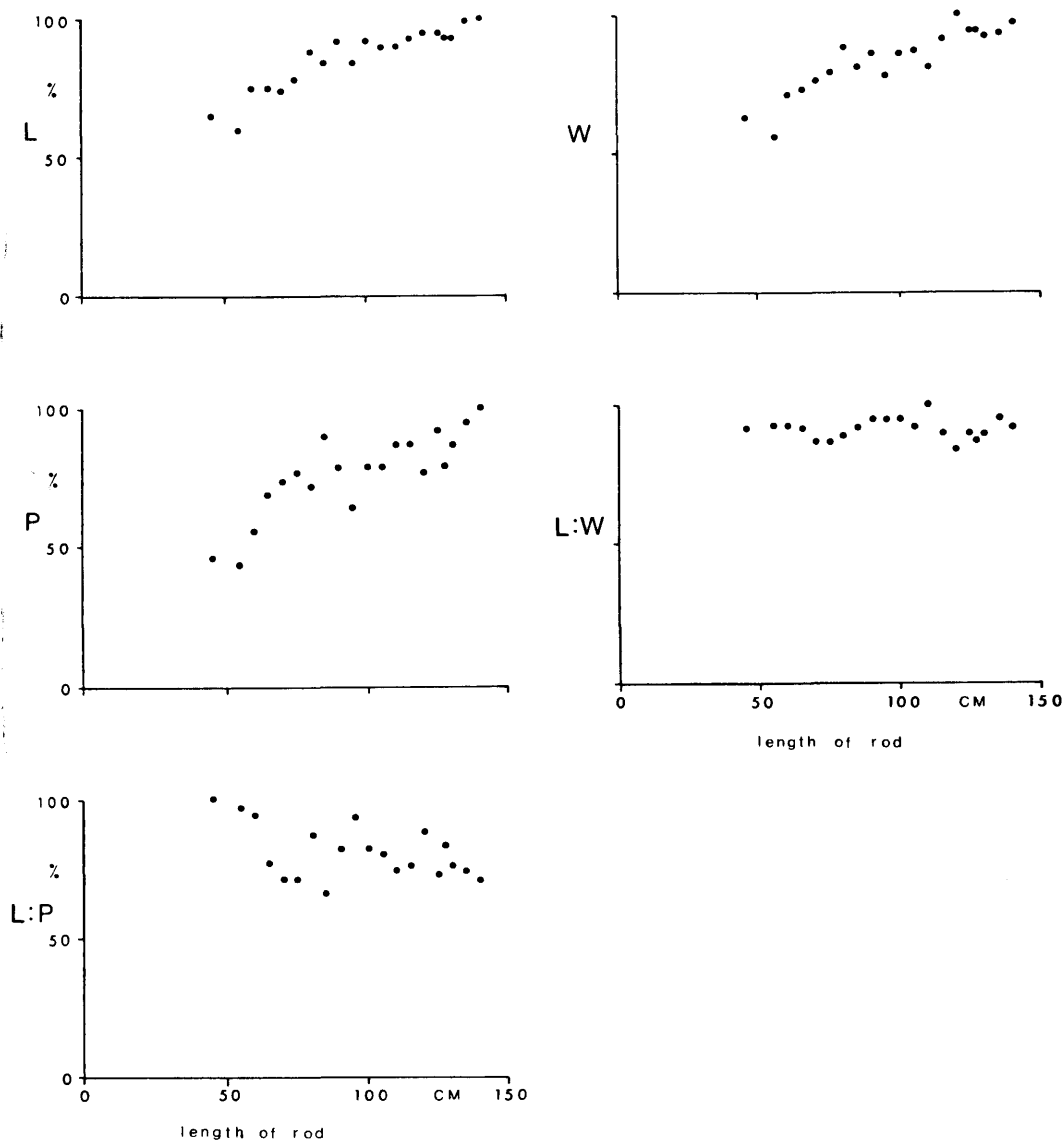
Shape and size of stipules are very important characters for identification of species but not for identification of clones. In vigorously grown rods stipules are more persistent than in poorly grown ones. In *S. alba* stipules fall or dry very early, therefore in this species stipules can only be detected on young leaves. Persistence of stipules has some importance in discrimination of *S. fragilis* clones.

3.3. Petiole

In *S. alba* and *S. fragilis* some variation can be found in colour of the petiole: red or green or some intermediate colour. In some clones the glands on the petiole metamorphose into small leaflike organs. This in the species *S. fragilis* and *S. triandra*, not in *S. alba*.

3.4. Leaf blade

Some clones of *S. fragilis* and *S. triandra* have leaves with glaucous under-surfaces. Hairiness of the leaves is strongly related to hairiness of rods and buds — see winter characters. Leaf size is highly dependent on environmental conditions. Fig. 4 shows the effect of length of the rod on leaf dimensions. Length of petiole, width and length of leaf blades increase with increasing length of rod in this *S. fragilis* clone. In contrast, length/width ratio of leaf blade remained constant. The same relation was found in other clones belonging to *S. fragilis*, *S. triandra* and *S. viminalis*. When comparing similar clones in "Lienden" (vigorously grown rods) and "Dorschkamp" (poorly developed rods) plants of the "Lienden" collection had longer (about 20%) and wider leaf blades (about 20%) and longer petioles



L = mean length of leaf blade, relative value (100% = 13.4 cm)
 W = mean width of leaf blade, relative value (100% = 2.5 cm)
 P = mean length of petiole, relative value (100% = 0.78 cm)
 L : W (100% = 6.1)
 L : P (100% = 24.2)

Fig. 4. — Relationship between length of rod (horizontal axis) and dimensions of the leaf. *S. fragilis* clone no. 534, Dorschkampcollection. Each point is the mean value of 5 leaves.

(about 40% !). Length/width ratio of leaf blade stayed constant in the two collections.

Length/width ratio of the leaf blade turned out to be the most valuable leaf parameter in clone discrimination within the species *S. alba*, *S. fragilis* and *S. triandra*: it proved to be independent of environmental conditions, and the species show a high degree of variation for this parameter. In *S. viminalis* this parameter is somewhat influenced by changing environmental conditions.

Combined with length/width ratio, the length of the leaf blade provides in some cases some additional information when environmental effects are eliminated. E.g.: *S. fragilis* clone no. 607 can be discriminated from *S. fragilis* clone no. 582 by the longer leaves (607: about 25 cm.; 582: about 16 cm in the "Lienden" collection) whereas leaf/width ratio of the leaf blade is similar in both clones (about 5).

Petiole length is extremely dependent of environmental effects and for this reason this parameter should not be used in clone discrimination.

Discussion

The willow species *Salix alba* L., *S. fragilis* L., *S. triandra* L. and *S. viminalis* L. can easily be recognised throughout the year, even on stools and 1-year old plants from cuttings. In botanical literature about *Salix* hardly any attention is paid to stipules in discrimination of species. The main reason for this is probably that in free grown plants (in contrast to stools and plants in osier grounds) stipules are smaller and less persitant. Stipule characters are extremely important in vigorously growing shoots of coppiced osiers for species identification.

The investigated *S. fragilis*, *S. alba* and *S. triandra* clones showed much infraspecific variation and by this reason

Table 2. — List of some cultivar names and collection numbers

Salix species	cultivar name	cultivar group, botanical var.	collection number	sex***	country of origin
<i>S. alba</i>	Belders	-	440	m	Netherlands
<i>S. alba</i>	Mittlere Isar I	Vitellina group	625	m	Fed. Rep. Germ.
<i>S. alba</i>	Vitellina Nova	Vitellina group	810	?	United Kingdom
<i>S. fragilis</i>	Leerteen	var. <i>decipiens</i>	679	f	Netherlands
<i>S. fragilis</i>	?	var. <i>decipiens</i>	545	m	Germ. Dem. Rep.
<i>S. fragilis</i>	?	var. <i>decipiens</i>	863	f	Netherlands
<i>S. fragilis</i>	Belgisch Rood	-	582	f	Netherlands
<i>S. x rubens</i> ?	Saule Jaune des Ardennes	Basfordiana group	706	?	Belgium
<i>S. x rubens</i> ?	?	Basfordiana group	526	f	Austria
<i>S. x rubens</i> ?	Frans Geel	Basfordiana group	580	f	Netherlands
<i>S. x rubens</i> ?	Sanguinea ?	Basfordiana group	681	?	United Kingdom
<i>S. triandra</i>	Zwarte Driebast	-	562	f	Netherlands
<i>S. triandra</i>	Hengelaarsgrauw	-	686	f	Netherlands
<i>S. triandra</i>	Black German	-	729	?	United Kingdom
<i>S. triandra</i>	Semperflorens	-	869	m	Netherlands ?
<i>S. triandra</i>	?	-	561	m	Netherlands
<i>S. viminalis</i>	Groene Daggelder x Koningskat	-	676	?	Netherlands
<i>S. viminalis</i>	?	-	420	m	Netherlands
<i>S. eriocephala</i> **	Americana	-	407=530=577	m	Netherl., Yugosl.

*) *S. x rubens* SCHRANK = *S. alba* × *S. fragilis*

**) *S. x eriocephala* MICHX. Synonyms: *S. cordata* MÜHL., *S. rigida* MÜHL.

***) m = masculin; f = feminin

it was usually not difficult to distinguish clones. To some extent the observed variation is due to hybridisation with *S. alba*. In my study of Linnaean literature and herbarium Linnaeus concept of *S. fragilis* proved to be something which many 20th century taxonomists regard as *S. alba* × *S. fragilis*. However, these typical *S. fragilis* clones could be the result of hybridisation between *S. alba* and an extreme *S. fragilis* population (probably the var. *decipiens*).

In *S. viminalis* clone discrimination is less easy. In naturally occurring *S. viminalis* population variation turned out to be larger than in the investigated collections. Clones with dark-coloured rods were not present in the collections. Dark-coloured rods and very brittle rods go together in *S. viminalis* and this is probably the reason that clones with dark rods are lacking in this collection of cultivated clones. In more cases a relationship can be found between colour and toughness of the rod. *S. alba* Vitellina group and *Salix* Basfordiana group (belonging to *S. fragilis* or *S. alba* × *fragilis*) both have the same remarkable rod colour (yellow turning to orange towards the top of the rod or orange turning to red) and the same extremely tough rods. Another infraspecific group easily recognisable in winter by shoot colour is *S. fragilis* var. *decipiens* (HOFFM.) KOCH.

Table 2 lists some cultivars of willows. The use of cultivar names for cultivated willows is often very tricky. In many cases no names were given to (once) very frequently planted clones. A cultivar name (e.g.: 'Belgisch Rood', 'Frans Geel') may cover a number of clones. These clones may differ in sex, habitus of the tree or shrub, bud shape etc. At the time these names originated the willow clones

were not yet selected as uniform clones. For instance, 'Frans Geel' willows had yellow twigs, being extremely tough and without any side branchlets. Whether such a cultivar consisted of male or of female plants was immaterial at that time.

In other cases (e.g.: 'Americana', 'Zwarte Driebast', 'Hengelaarsgrauw') cultivar names belong to a particular clone.

Acknowledgements

I would like to thank the following persons for their contributions to this study: Ir. W. D. J. TUINZING for his inspiring remarks about use and history about certain willow-clones, Ir. W. A. BRANDENBURG for his ideas and suggestions about cultivars and cultivar-groups, Mrs. W. WESSELS for making the drawings and Prof. L. J. G. VAN DER MAESEN for correcting the English text.

Literature

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