



CHARACTERISTICS OF FLOWERS OF SELECTED IRIS SPECIES AND VARIETIES FROM *LIMNIRIS* SECTION

Magdalena Kulig

*Department of Dendrology and Landscape Architecture
University of Agriculture in Krakow, Poland*

ABSTRACT

Studies were carried out on seven taxa from beardless (*Limniris*) section: grassy leaved iris (*Iris graminea* L.), yellow iris (*I. pseudacorus*) and Siberian iris (*I. sibirica* L.), as well as hybrids from *Sibiriceae* section: *I. 'Dreaming Yellow'*, *I. 'Towanda Redflare'*, *I. 'Violet Meer'* and *I. 'Wiltrud Gissel'*. The following parameters were assessed: flower size, the length and width of stamens, the length of pistil, the color of: flower petals, pistil, stamen and pollen. It is considered that tetraploids have twice bigger flowers. The investigations confirmed this opinion. Iris 'Dreaming Yellow', which is tetraploid, has twice bigger individual elements of perianth than diploid taxa. Determining the sizes of individual elements of parental plants' perianth allowed to formulate a standard. It will serve for comparing morphological features of hybrids obtained in future. The identification of colour by means of Royal Horticultural Society Colour Chart occurred not enough precise.

Key words: beardless iris, flower size, petals, pistil, color

INTRODUCTION

Irises are perennials known since the antiquity. At that time they were cultivated mainly for their medicinal and aromatic properties [1, 5]. Initially they were collected on natural sites but with time people started to cultivate them in gardens. Only in modern times, especially in the Renaissance, not only the beauty of iris flowers was appreciated but the diversity of their colors roused general admiration. Iris flowers occur in all colors of rainbow, therefore the Latin name *Iris* given to the genus in honor of Greek goddess of the rainbow [3, 7, 9, 13]. In modern times not only species were known and identified [7], but also the first varieties of irises [5]. First collections were established in gardens. With time people started to seek the plants with larger flowers and more abundant inflorescences, but also characterized by various shapes of perianth sepals or untypical leafy pistils.

However, the literature lacks detailed data on the sizes or colors of individual flower elements in various species and varieties. Therefore, research was undertaken to investigate this problem. In result of initial investigations, seven

taxa were selected for further breeding works within a single *Iris* genus, from beardless (*Limniris*) section: grassy leaved iris (*Iris graminea* L.), yellow iris (*I. pseudacorus*) and Siberian iris (*I. sibirica* L.), as well as hybrids from *Sibiriceae* section: *I.* 'Dreaming Yellow', *I.* 'Towanda Redflare', *I.* 'Violet Meer' and *I.* 'Wiltrud Gissel'. Determining the sizes of individual elements of parental plants' perianth allowed to formulate a standard. It will serve for comparing morphological features of hybrids obtained in future.

MATERIAL AND METHODS

In August 2005 a collection of beardless irises was started in Bibice. The plants were planted in the native soil, which was a light loam with pH approximate to neutral. The beds were mulched with bark, which was supplemented each year, whereas weeds were removed mechanically. In March 2006 the plants were fertilized with 5–6-month old Osmocote Exact Standard (16 N + 9 P + 12 K + 2.5 MgO + microelements) dosed 20 g per a plant in the ground. In order to protect irises against pests, Diazol preparation was administered for pest control and additionally the plants were sprayed by Confidor preparation at 10-day intervals (from the moment when flower buds first appeared until all flowers faded). Flower characteristics were conducted on three-year-old iris clumps growing in the collection in Bibice.

Three native iris species: grassy-leaved iris (*Iris graminea* L.) (Fig. 1), yellow iris (*I. pseudacorus* L.) (Fig. 2) and Siberian iris (*I. sibirica* L.) (Fig. 3), together with hybrids from *Sibiriceae* section: *I.* 'Dreaming Yellow' (Fig. 4), *I.* 'Violet Meer' (Fig. 5), *I.* 'Towanda Redflare' (Fig. 6) and *I.* 'Wiltrud Gissel' (Fig. 7) were selected for the flower assessment. Each taxon was represented by three clumps. The plants chosen for the analyses were diploids, except for the tetraploid 'Dreaming Yellow' species [2, 8]. One of numerous features which must be identified in order to recognize the partners for breeding works is the measurement of individual elements of a flower [6] and determining the flower color. 15 flowers from each clump of a given taxon were gathered to assess the features of reproductive organs. The following parameters were assessed:

- flower size, expressed as the length and width, which in a flower displaying radial symmetry equaled its diameter; the length and width of the inner and outer perianth segments and inflorescence pedicels;
- the length and width of stamens (filaments and anther),
- the length of pistil (from beginning of stigma to the point of leafy style connation, the length of connate style and the length and width of ovary),
- the color of flower petals, pistil (style and ovary), stamen (filament and anthers), pollen.

The tables contains the range of scale, arithmetic mean and the variation coefficient (V%) of every investigated parameter.



Fig. 1. Three-year-old clumps of grassy leaved iris (*I. graminea*) in Bibice in 2008 (photo by M. Kulig)



Fig. 2. Three-year-old-clumps of yellow iris (*I. pseudacorus*) in Bibice in 2008 (photo by M. Kulig)



Fig. 3. A plot of three-year-old clumps of Siberian iris (*I. sibirica*) in Bibice in 2008 (photo by M. Kulig)



Fig. 4. *Iris* 'Dreaming Yellow' in Bibice in 2009 (photo by A. Michalik)



Fig. 5. *Iris* 'Violet Meer' in Bibicach in 2009 (photo by A. Michalik)



Fig. 6. *Iris* 'Towanda Redflare' in Bibicach in 2009 (photo by A. Michalik)



Fig. 7. *Iris* 'Wiltrud Gissel' in Bibicach in 2009 (photo by A. Michalik)

During the investigation the date of beginning and the end of flowering period of each taxon was noted.

Linear measurements were made using Handy Worth caliper with electronic scale and total accuracy of 0.01 mm. The color was identified by means of Royal Horticultural Society Colour Chart [14].

RESULTS

Generative phase and characteristics of irises' flowering. The irises selected for the analyses differed with their flowering dates. Grassy leaved iris flowered first, in mid-May, followed by yellow iris and then Siberian iris, and hybrids: *I.* 'Towanda Redflare', *I.* 'Violet Meer' and *I.* 'Wiltrud Gissel', whereas *I.* 'Dreaming Yellow' flowered as the last one, but proved the longest flowering one and single flowers appeared even at the beginning of July. The durability of a single iris flower was between 2 and 5 days, depending on the species and variety. Afterwards the flowers withered and fell together with stamens and leaf-like pistil. Differences in the structure of reproductive organs were observed between the analyzed taxa during the flowering period. Selected morphological traits of the investigated irises were presented in Tables 1–6.

Considering the studied taxa, average length of a single flower pedicle fluctuated from 2.1 cm in *I. graminea* to 7.3 cm in *I.* 'Dreaming Yellow'. However, the greatest variability was observed in *I. pseudacorus* (21.4%) (Tab. 1–3).

The largest flowers with a width of about 12.3 cm had *I.* 'Dreaming Yellow'. Yellow iris had the smallest flowers (with a diameter of 6.3 cm), but was distinguished by a bigger variability of size (8.1%), as compared with the other species. The diameter of *I. sibirica* flowers was also variable (9.1%). On the other hand, flowers of *I.* 'Violet Meer', *I.* 'Wiltrud Gissel' and *I.* 'Dreaming Yellow' were equalized, with variability of respectively 1.2%, 2.3% and 2.9% (Tab. 3).

The longest flowers between the studied taxa, had *I.* 'Violet Meer' and *I.* 'Wiltrud Gissel' on average length of 7.7 cm. On the other hand the *I.* 'Wiltrud Gissel' had the biggest variability of size equal 13.7%. *Iris graminea* had the shortest flowers (with mean 3.5 cm) but was also distinguished by smaller variability of size (4.3%). *Iris sibirica* had the less variable length of flower equal 3.0% (Tab. 3).

I. 'Dreaming Yellow' had the longest and the widest inner perianth leaves, on average 6.1 cm long and 3.6 cm wide. *I. pseudacorus* had the narrowest – 0.6 cm and the shortest inner perianth leaves – 2.7 cm. On the other hand, *I. graminea* revealed the greatest variability of perianth leaves' width ($V\% = 20.2$) (Tab. 1–3).

Iris 'Dreaming Yellow' had the longest and the widest outer perianth leaves, on average 7.5 cm long and 5.3 cm wide. *Iris graminea* had the narrowest – 1.6 cm and the shortest outer perianth leaves – 3.8 cm. The greatest diversification of of outer perianths leaves' width was characteristic for *I.* 'Towanda Redflare' (36%) (Tab. 1–3).

Table 1. The sizes and shapes of inner and outer perianth leaves of studied iris species (photo M. Kulig)




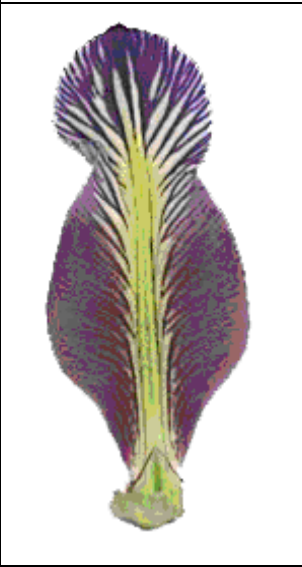


Perianth leaf	Variety or species		
	<i>I. graminea</i>	<i>I. pseudacorus</i>	<i>I. sibirica</i>
Inner			
Outer			

Table 2. The sizes and shapes of inner and outer perianth leaves of studied iris species (photo M. Kulig)









Perianth leaf	Variety or species			
	<i>I. 'Dreaming Yellow'</i>	<i>I. 'Towanda Redflare'</i>	<i>I. 'Violet Meer'</i>	<i>I. 'Wiltrud Gissel'</i>
Inner				
Outer				

Table 3. Morphological characteristics of flowers and perianth elements of the analyzed iris species and varieties

Species or variety	Flower pedicel length (cm)			Flower width (cm)			Flower length (cm)			Perianth leaves											
										inner						outer					
										length (cm)			width (cm)			length (cm)			width (cm)		
	range	mean	V%	range	mean	V%	range	mean	V%	range	mean	V%	range	mean	V%	range	mean	V%	range	mean	V%
<i>I. graminea</i>	2.1–3.1	2.8	13.9	6.5–7.3	6.8	5.7	3.3–3.6	3.5	4.3	3.0–3.4	32.0	4.6	0.8–1.6	1.0	20.2	3.5–4.3	3.8	6.3	1.5–1.8	16.0	7.0
<i>I. pseudacorus</i>	2.2–4.3	3.1	214.0	5.4–7.0	6.3	8.1	5.4–6.5	6.1	6.6	2.3–3.6	2.7	10.6	0.4–0.8	0.6	17.6	5.9–6.6	6.3	2.8	3.7–4.6	4.0	5.5
<i>I. sibirica</i>	4.9–5.4	5.1	4.3	6.5–7.5	7.1	9.1	5.6–5.9	5.7	3.0	4.7–5.3	5.0	4.1	1.9–2.3	2.2	6.0	5.0–6.1	5.4	6.1	3.3–4.7	3.7	12.1
<i>I. 'Dreaming Yellow'</i>	6.9–7.3	7.1	4.3	12.1–12.6	12.3	2.9	6.1–6.5	6.3	5.2	6.0–6.5	6.1	3.0	3.4–3.8	3.6	3.7	7.3–7.6	7.5	1.8	5.1–5.4	5.3	2.0
<i>I. 'Violet Meer'</i>	5.2–5.5	5.3	4.0	8.9–9.1	9.0	1.2	6.9–8.4	7.7	4.1	5.1–5.9	5.5	6.3	2.4–2.6	2.4	4.2	6.8–7.6	7.2	3.8	4.9–5.1	4.9	2.2
<i>I. 'Towanda Redflare'</i>	4.7–5.4	5.2	10.4	6.6–7.3	7.0	6.9	5.3–5.9	5.6	7.6	4.5–5.7	5.1	1.6	2.0–2.4	2.2	15.5	5.3–6.4	5.6	12.9	3.0–4.9	3.9	36.0
<i>I. 'Wiltrud Gissel'</i>	5.2–5.6	5.3	5.3	12.6–13.2	12.9	2.3	8.9–7.3	7.7	13.7	4.9–5.3	5.3	2.8	2.1–2.4	2.3	4.4	6.9–7.5	7.0	4.1	4.7–5.0	4.8	3.0

The stamen was invisible in the studied irises, as it was hidden under the peat-like branching style. The mean length of the whole stamen varied from 2.5 cm in *I. 'Wiltrud Gissel'* to 3.5 cm in *I. 'Dreaming Yellow'*. *I. 'Wiltrud Gissel'* revealed the highest variability (11.3%). In majority of the irises the filament was longer than the anther, whereas the opposite was noticed only in *I. 'Wiltrud Gissel'*. The width of filament and anther was not diversified. The width of filament was between 0.1 cm in *I. pseudacorus* and *I. sibirica* to 0.3 cm in *I. 'Dreaming Yellow'*. The width of anther was 0.1–0.2 cm (Tab. 4).

Table 4. Morphological characteristics of stamens of investigated iris species and varieties

Species or variety	Length (cm)									Width (cm)					
	stamen			filament			anther			filament			anther		
	range	mean	V (%)	range	mean	V (%)	range	mean	V (%)	range	mean	V (%)	range	mean	V (%)
<i>I. graminea</i>	2.4–2.5	2.5	3.5	1.1–1.7	1.3	17.7	1.2–1.4	1.3	5.1	0.3	0.3	0.0	0.1	0.1	0.0
<i>I. pseudacorus</i>	2.2–3.0	2.6	6.9	1.0–1.7	1.3	12.5	1.1–1.5	1.3	7.0	0.1–0.2	0.1	25.5	0.2	0.2	0.0
<i>I. sibirica</i>	2.8–3.0	2.9	2.8	1.9–2.0	1.9	3.3	1.1–1.2	1.1	4.5	0.1–0.2	0.1	4.0	0.1–0.2	0.2	10.0
<i>I. 'Dreaming Yellow'</i>	3.4–3.6	3.5	1.4	2.0–2.2	2.1	3.6	1.4–1.5	1.4	3.0	0.3–0.4	0.3	5.7	0.2	0.2	0.0
<i>I. 'Violet Meer'</i>	2.7–2.8	2.7	3.1	1.5–1.5	1.5	1.9	1.4	1.4	0.0	0.2	0.2	0.0	0.1–0.2	0.2	4.9
<i>I. 'Towanda Redflare'</i>	2.9–3.0	2.9	3.4	1.9–2.0	1.9	4.8	1.0–1.2	1.1	10.1	0.1–0.2	0.2	9.4	0.1–0.2	0.1	5.1
<i>I. 'Wiltrud Gissel'</i>	2.3–2.8	2.5	11.3	1.1–1.5	1.2	20.0	1.3–1.4	1.4	4.8	0.2	0.2	0.0	0.1–0.2	0.1	31.5

The length of a leafy style in all analyzed taxa ranged from 3.0 cm in *I. graminea* to 4.8 cm in *I. 'Dreaming Yellow'* (Tab. 5). The highest variability in the length of leafy not connate style and connate (of three leafy branchings) style segment was registered in *I. 'Towanda Redflare'*, respectively 12.7% and 18.1%. On the other hand, the length of style from the connation point of three leafy branchings fluctuated from 0.2 cm in *I. graminea* to 1.1 cm in *I. pseudacorus*. The longest ovary, on average 2.5 cm was noted in *I. pseudacorus* and the shortest on average 1.7 cm in *I. sibirica*. The greatest diversification of ovary sizes was characteristic for *I. graminea* (15%). The ovary mean width in the examined irises was no larger than 0.7 cm (*I. 'Wiltrud Gissel'* and *I. 'Dreaming Yellow'*). *I. sibirica* and *I. 'Towanda Redflare'* had the narrowest ovaries, whereas the greatest variability (18.5%) was registered in *I. graminea* (Tab. 5).

Table 5. Morphological characteristics of pistils of the studied iris species and varieties

Species or variety	Length of pistil elements (cm)						Width (cm)					
	leafy style			connate style			ovary			ovary		
	range	mean	V (%)	range	mean	V (%)	range	mean	V (%)	range	mean	V (%)
<i>I. graminea</i>	3.00–3.6	3.2	5.8	0.2–0.3	0.3	14.6	1.7–2.2	1.9	15.0	0.5–0.7	0.6	18.5
<i>I. pseudacorus</i>	3.9–4.7	4.3	4.3	0.9–1.4	1.1	12.6	2.1–2.7	2.5	6.2	0.5–0.6	0.5	6.6
<i>I. sibirica</i>	3.4–4.2	4.1	8.9	0.8–1.0	0.9	12.5	1.7–1.8	1.7	4.1	0.4–0.5	0.4	4.6
<i>I. 'Dreaming Yellow'</i>	3.8–4.8	4.2	10.8	0.7–0.8	0.8	6.5	2.3–2.4	2.3	3.1	0.7–0.8	0.7	3.8
<i>I. 'Violet Meer'</i>	3.7–4.2	3.9	5.9	0.6	0.6	0.0	2.1–2.4	2.3	12.3	0.6	0.6	0.0
<i>I. 'Towanda Redflare'</i>	3.5–4.2	3.8	12.7	0.8–1.0	0.9	18.1	1.8–1.9	1.8	5.8	0.4–0.5	0.4	4.8
<i>I. 'Wiltrud Gissel'</i>	3.8–3.9	3.9	1.8	0.39–0.4	0.4	1.5	1.9–2.3	2.1	8.9	0.7	0.7	0.0

Table 6. Colors of the perianth elements, pistils, stamens and pollen of the studied iris species and varieties according to Royal Horticultural Society Color

Species or variety	Flower color		Pistil color						Stamen color				Pollen color	
			leafy style		connate style		ovary		filament		anthers			
	RHS CC		RHS CC		RHS CC		RHS CC		RHS CC		RHS CC		RHS CC	
<i>I. graminea</i>	purple-yellow	no equivalent	blue-purple	no equivalent	light green	154C	green	134A	amaranth	80B	amaranth-yellow	no equivalent	dark yellow	9A
<i>I. pseudacorus</i>	yellow	158D	yellow	9B	light green	142A	green	134A	light yellow	8C	yellow-brown	no equivalent	yellow	9C
<i>I. sibirica</i>	purple	96C	purple	96C	light green	142B	green	134B	purple	96D	dark purple	89B	blue	100C
<i>I. 'Dreaming Yellow'</i>	white-yellow	155D/9B	cream white	no equivalent	light green	154C	green	134A	white	155C	cream white	11D	cream white	155D
<i>I. 'Violet Meer'</i>	puple	95C	light blue	101C	light green	142B	green	134B	purple	96D	dark purple	89B	cream	158D
<i>I. 'Towanda Redflare'</i>	amaranth	78B	amaranth	10B	light green	154C	green	134B	cream	150D	amaranth	80B	yellow	10B

Iris flowers differed with the color of perianth, filament, anthers and the color of pollen. Most flowers were unicoloured, only *I. graminea* and *I. 'Dreaming Yellow'* stood out with their double colored flowers, respectively purple-yellow and white-yellow. The pistil (the style and ovary) were of a similar color but of different shades, respectively light green and green (Tab. 6).

DISCUSSION

Irises are valued for diversity of their colors and sizes of flowers. The species belonging to *Limniris* section deserve particular attention. Their flowers are smaller but the clumps bloom more abundantly. Studies on the flower size allowed to classify the flowers of examined taxa to the iris group with large or medium flowers [4, 10].

Iris flowers differed with the size and structure of their reproductive organs. Tetraploid *I. 'Dreaming Yellow'* had visibly larger perianth segments, as has been confirmed by the studies conducted by McEwen [11, 12]. The Author's own investigations of pistil and stamen length confirmed iris heterostyly, which was described by Strassbourger [15]. All iris taxa were characterized by protandry. Pollen matured and poured out from the stamens placed under the leafy style immediately when the flowers opened.

The color of flowers and leaves was assessed in the irises selected for breeding works. A method of comparison of the individual flower elements with RHS CC standard was applied. The investigations revealed that the analysis the colors of iris perianth parent forms using RHS CC standard was difficult due to an extended area of the elements and numerous veinings and copigmentation of flowers. In some cases it was impossible to establish the color. The standards obtained in Author's own investigations will serve to compare the perianth color of F1 hybrids in further breeding works.

CONCLUSIONS

1. The investigated iris flowers were of medium and large size.
2. Diploid taxa were characterized by a similar size of individual perianth elements.
3. Tetraploid species stood out by their twice larger individual perianth elements.
4. A more precise method than comparing the colours with RHCC standards should be used to determine the precise color of the perianth elements, e.g. determining flower colors using spectrophotometer.

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Magdalena Kulig
Department of Dendrology and Landscape Architecture
University of Agriculture in Krakow
al. 29 Listopada 54, 31-427 Kraków, Poland
e-mail: mkulig@ar.krakow.pl

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