25. *List of the Chromosome Numbers in the Genus Crocus.*

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Introduction

The genus *Crocus*, according to Bailey (1924), comprises probably seventy-five species, most of them being found in the Mediterranean region and Asia Minor. It belongs to the Iridaceae, and is usually propagated by the corm. Scarcely more than four or five species have been commonly cultivated in our gardens. Although many other species have been grown either by botanists or by fanciers for special purposes, they are quite rarely cultivated in Japan.

Due to the abundant chromosome variations which is comparable to that of the genus *Crepis*, the genus *Crocus* has furnished excellent materials for cytological studies. As pointed out by Propach (1939), the genus shows a unique chromosome series which is ranging from 3 to 15 in haploid number, among the thousands of higher plants. Another striking fact about this genus is the occurrence of several species with haploid number as low as 3, whereas in other genera, such as *Callitriche*, *Crepis*, there are only one or two species with such remarkably low chromosome number (cf. Karasawa, 1939).

The first cytological studies in this genus were made by Himmerbaur (1926) in *Crocus sativus*, and also by Heitz (1926) in five species. Following these studies, Morinaga and Fukushima (1931) observed the somatic chromosomes of two species, and Brittingham (1934) reported the somatic counts of six species.

Mather (1932), in his comprehensive studies, observed the somatic chromosomes of thirty-nine species and eight varieties. My cytological studies on this genus, which were begun in 1932, the same year as Mather's, have been continued for the past ten years (Karasawa, 1932, 1933, 1935, 1937, 1939, and 1940).

Recently Propach (1939) observed the somatic chromosomes of certain species, and gave a cytological review of this genus. Pathak (1940) reported the somatic counts of twelve species and one variety, and the meiotic counts of two species. Most of his results agreed with those of the previous workers.

The object of this paper is to list my own chromosome counts of over one hundred *Crocus* of various species, varieties, and forms, together with the results of other investigators.

Material and Methods

The common *Crocus* were mostly collected from Tokyo Nôsan: a few of them were gathered from Yamato Syubyô and Takii. The other rare *Crocus* were obtained directly from Barr & Sons and C. G.

van Tubergen. One species, *Crocus reticulatus*, was kindly sent by the John Innes Horticultural Institution. The root-tips were mostly fixed in Navashin's fluid, some being treated with Flemming's fluid. Chloral hydrate was sometimes used in order to obtain clear figures. The somatic chromosomes were counted by staining exclusively with Heidenhain's iron-alum haematoxylin. The meiotic chromosomes were mostly observed with aceto-carmin, although a few of them were counted from permanent preparations.

Figs. 1-13. A chromosome series in the genus *Crocus*. 1, *C. Olivieri* ($2n=6$). 2, *C. aureus* ($2n=8$). 3, *C. cancellatus* ($2n=10$). 4, *C. pulchellus* ($2n=12$). 5, *C. Heuffelianus* ($2n=14$). 6, *C. sativus* ($2n=16$). 7, *C. speciosus* ($2n=18$). 8, *C. Koralkowii* ($2n=20$). 9, *C. asturicus* ($2n=22$). 10, *C. Salzmannii* ($2n=24$). 11, *C. Imperati* ($2n=26$). 12, *C. Pestalozzae* ($2n=28$). 13, *C. Tournefortii* ($2n=30$). $\times 1600$.

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List of chromosome numbers

Species	n (Investigator)	2n (Investigator)
1 <i>Crocus Balansae</i>	3 _{II} (Karasawa 1939)	6 (Mather 1932) (Karasawa 1939)
2 <i>C. candidus subflavus</i>	3 _{II} (Karasawa 1939)	6 (Karasawa 1939)
3 <i>C. graveolens</i>		6 (Mather 1932)
4 <i>C. Olivieri</i>	3 _{II} (Karasawa 1937)	6 (Mather 1932) (Karasawa 1937) (Pathak 1940)
5 <i>C. hyemalis</i>	3 _{II} +f _{II} (Karasawa 1940)	6+4f (Mather 1932), 6+2f (Karasawa 1940), 6, 6+3f (Propach 1939)
6 <i>C. aerius</i> "Gray Lady"		8 (Mather 1932) (Pathak 1940) (Karasawa unpublished)
7 <i>C. aureus</i>	4 _{II} (Karasawa 1937)	8 (Mather 1932) (Karasawa 1937)
8 <i>C. biflorus</i>	4 _{II} (Karasawa 1937)	8 (Mather 1932) (Karasawa 1937)
9 <i>C. chrysanthus</i>	4 _{II} (Karasawa 1937)	8 (Mather 1932) (Karasawa 1937), 9 (Mather 1932)
10 <i>C. Danfordiae</i>		8 (Mather 1932)
11 <i>C. etruscus</i>	4 _{II} (Karasawa 1937)	8 (Karasawa 1937), 11 (Mather 1932)
12 <i>C. zonatus</i>	4 _{II} (Karasawa 1937)	8 (Mather 1932) (Brittingham 1934) (Karasawa 1935) (Pathak 1940)
13 <i>C. banaticus</i>		9 (Karasawa unpublished)
14 <i>C. cancellatus</i>	5 _{II} (Karasawa unpublished)	10 (Heitz 1926) (Karasawa unpublished), 16 (Mather 1932)
15 <i>C. ochroleucus</i>	5 _{II} (Karasawa 1937), (Pathak 1940)	10 (Mather 1932) (Karasawa 1937) (Pathak 1940)
16 <i>C. reticulatus</i>	5 _{II} (Karasawa unpublished)	10 (Mather 1932) (Karasawa unpublished)
17 <i>C. stellaris</i>	10 _I (Karasawa 1940)	10 (Mather 1932) (Karasawa 1940)
18 <i>C. pulchellus</i>	6 _{II} (Karasawa 1937)	12 (Heitz 1926) (Mather 1932) (Karasawa 1937) (Pathak 1940)
19 <i>C. Heuffelianus</i>		14 (Mather 1932) (Karasawa unpublished)
20 <i>C. Kittiwake</i>		15 (Karasawa unpublished)
21 <i>C. maesiacus</i> "Large Yellow"	Univalents, bivalents and tri-valents mixed (Karasawa 1935)	15 (Karasawa 1932)
22 <i>C. susianus</i> "Cloth of Gold"	Univalents, bivalents and tri-valents mixed (Karasawa 1935), 6 (Pathak 1940)	15 (Karasawa 1935), 12 (Propach 1939) (Pathak 1940)
23 <i>C. hadriaticus</i>		16 (Mather 1932), 24 (Karasawa unpublished)
24 <i>C. Tomasinianus</i>	8 _{II} (Karasawa unpublished)	16 (Mather 1932) (Brittingham 1934) (Karasawa unpublished) (Pathak 1940), ca 18 (Heitz 1926)
25 <i>C. sativus</i>	8 _{II} (Karasawa 1940)	16 (Karasawa 1940)
	8 _{III} (Karasawa 1933)	24 (Himmerbaur 1926) (Morinaga and Fukushima 1931) (Karasawa 1933) (Pathak 1940)
	8 _V (Karasawa 1940)	40 (Karasawa 1940)
26 <i>C. Sieheanus</i>		16 (Karasawa unpublished)
27 <i>C. vernus</i>	8 _{II} (Karasawa 1935)	16 (Morinaga and Fukushima 1931) (Karasawa 1932), 18 (Mather 1932) (Brittingham 1934)
28 <i>C. speciosus</i>	9 _{II} (Karasawa 1937)	18 (Mather 1932) (Karasawa 1937) (Pathak 1940)

Species	n (Investigator)	2n (Investigator)
29 <i>C. Fleischeri</i>	10 _{II} (Karasawa 1940)	20 (Karasawa 1940), 28 (Propach 1939)
30 <i>C. karduchorum</i>		20 (Mather 1932)
31 <i>C. Korolkowii</i>	10 _{II} (Karasawa 1940)	20 (Mather 1932) (Brittingham 1934) (Karasawa 1940) (Pathak 1940)
32 <i>C. Leichtlini</i>		20 (Mather 1932)
33 <i>C. asturicus</i>	11 _{II} (Karasawa unpublished)	22 (Mather 1932) (Karasawa unpublished), 22-(24) (Heitz 1926)
34 <i>C. corsicus</i>		22 (Mather 1932) (Karasawa unpublished)
35 <i>C. dalmaticus</i>		22 (Karasawa unpublished)
36 <i>C. medius</i>		22 (Karasawa unpublished)
37 <i>C. Sieberi</i>	11 _{II} (Karasawa 1937)	22 (Mather 1932) (Karasawa 1937)
38 <i>C. Boryi marathoniseus</i>		24 (Mather 1932)
39 <i>C. Malyi</i>		24 (Mather 1932)
40 <i>C. minimus</i>		24 (Karasawa unpublished)
41 <i>C. Salzmannii</i>	12 _{II} (Karasawa 1940)	24 (Mather 1932) (Karasawa 1940) (Pathak 1940)
42 <i>C. Imperati</i>	13 _{II} (Karasawa 1937)	26 (Mather 1932) (Brittingham 1934) (Karasawa 1937)
43 <i>C. iridiflorus</i>		26 (Mather 1932) (Karasawa unpublished), 24-(26) (Heitz 1926)
44 <i>C. laevigatus Fontenayii</i>		26 (Mather 1932) (Karasawa unpublished)
45 <i>C. versicolor</i>	$\left\{ \begin{array}{l} 13_{II} \text{ (Karasawa unpublished)} \\ 13_{III} \text{ (Karasawa 1937)} \end{array} \right.$	$\left\{ \begin{array}{l} 26 \text{ (Mather 1932) (Brittingham 1934)} \\ 39 \text{ (Karasawa 1937)} \end{array} \right.$
46 <i>C. longiflorus</i>	14 _{II} (Karasawa unpublished)	28 (Mather 1932) (Karasawa unpublished)
47 <i>C. Pestalozzae</i>		28 (Karasawa unpublished)
48 <i>C. Tournefortii</i>	15 _{II} (Karasawa unpublished)	30 (Mather 1932) (Pathak 1940) (Karasawa unpublished)
49 <i>C. nudiflorus</i>		ca 46 (Mather 1932) (Karasawa unpublished)

Variety and Form	n (Investigator)	2n (Investigator)
I <i>Crocus Olivieri</i>		
1 <i>C. Aucheri</i> ¹⁾		6 (Mather 1932)
II <i>C. aerius</i>		
2 <i>Celeste</i>		14 (Mather 1932)
III <i>C. aureus</i>		
3 <i>maesiacus</i>		8 (Karasawa unpublished)
4 <i>sulphureus concolor</i>	4 _{II} (Karasawa unpublished)	8 (Karasawa unpublished)
IV <i>C. biflorus</i>		
5 <i>argenteus</i>		8 (Karasawa unpublished)
6 <i>Barrii</i>		7 (Mather 1932) (Karasawa unpublished)

1) According to Mather, *C. Aucheri* may be only a variety of *C. Olivieri*.

Variety and Form	n (Investigator)	2n (Investigator)
7 <i>Parkinsonii</i>		8 (Karasawa unpublished)
8 <i>pusillus</i>		8 (Mather 1932) (Karasawa unpublished)
9 <i>Weldeni</i>	5 _{III} (Karasawa unpublished)	15 (Karasawa unpublished)
10 <i>Weldeni albus</i>		20 (Karasawa unpublished)
V <i>C. cancellatus</i>		
11 <i>albus</i>		16 (Karasawa unpublished)
VI <i>C. chrysanthus</i>		
12 <i>canary bird</i>	5 _{II} (Karasawa unpublished)	10 (Mather unpublished)
13 <i>fusco-tinctus</i>		10 (Mather 1932)
14 <i>E. A. Bowles</i>		8 (Karasawa unpublished)
15 <i>E. P. Bowles</i>		8 (Karasawa unpublished)
16 <i>Snow Bunting</i>		8 (Karasawa unpublished)
VII <i>C. Salzmannii</i>		
17 <i>erectophyllus</i>	12 _{II} (Karasawa 1940)	24 (Karasawa 1940)
VIII <i>C. sativus</i>		
18 <i>cappadocicum</i>		14 (Mather 1932)
19 <i>Elwesii</i>	7 _{II} +1 _I (Karasawa 1937)	15 (Mather 1932) (Karasawa 1937) (Pathak 1940)
IX <i>C. speciosus</i>		
20 <i>Aitchisonii</i>	6 _{II} (Karasawa 1940)	12 (Karasawa 1940)
	7 _{II} (Karasawa 1940)	16 (Karasawa 1940)
21 <i>albus</i>	6 _{II} (Karasawa 1940)	14 (Karasawa 1940)
		12 (Mather 1932) (Karasawa 1940) (Pathak 1940)
22 <i>artabir</i>		14 (Karasawa 1940)
23 <i>cassiope</i>		12 (Karasawa 1940)
24 <i>globosus</i>		14 (Karasawa 1940)
25 <i>pollux</i>		16 (Karasawa 1940)
X <i>C. stellaris</i>		
26 <i>pallidus</i>	8 _I (Karasawa 1940)	8 (Karasawa 1940)
IX <i>C. vernus</i>		
27 <i>albus</i>	4 _{II} -8 _I (Karasawa 1940)	8 (Mather 1932) (Karasawa 1940)
28 <i>obovatus</i>		19 (Mather 1932)
29 <i>Baron van Bruno</i>	8 _{II} (Karasawa 1935)	16 (Karasawa 1935)
30 <i>King of the Blue</i>		16 (Karasawa 1932)
31 <i>Meier Bear</i>		16 (Karasawa 1935)
32 <i>Mikado</i>	8 _{II} (Karasawa 1935)	16 (Karasawa 1935)
33 <i>Mont Blanc</i>	8 _{II} (Karasawa 1935)	16 (Karasawa 1932)
34 <i>Hero</i>		24 (Karasawa unpublished)
35 <i>Lord Fielding</i>	8 _{III} (Karasawa 1935)	24 (Karasawa 1932)
36 <i>President Grant</i>		24 (Karasawa 1935)
37 <i>Prince Albert</i>		24 (Karasawa 1932)
38 <i>Vanguard</i>	8 _{III} (Karasawa unpublished)	24 (Karasawa unpublished)
39 <i>White Lady</i>		24 (Karasawa unpublished)
40 <i>Julia Culp</i>	8 _{IV} (Karasawa 1935)	32 (Karasawa 1932)

Variety and Form	n (Investigator)	2n (Investigator)
41 <i>Purpurea Grandiflora</i>		32 (Karasawa 1935)
42 <i>Cloth of Silver</i>		32 (Karasawa 1935)
43 <i>Remembrance</i>		32 (Karasawa unpublished)
44 <i>Striped Beauty</i>		32 (Karasawa unpublished)
45 <i>Agnes</i>		20 (Karasawa unpublished)
46 <i>Albion Striped</i>		20 (Karasawa 1935)
47 <i>King of the White</i>	10 _{II} (Karasawa unpublished)	20 (Karasawa 1935)
48 <i>Maximilian</i>	10 _{II} (Karasawa unpublished)	20 (Karasawa 1935)
49 <i>President Galivan</i>		20 (Karasawa unpublished)
50 <i>Queen Victoria</i>		20 (Karasawa unpublished)
51 <i>Zaxass</i>		20 (Karasawa 1935)
52 <i>Pallas</i>	10 _{III} (Karasawa unpublished)	30 (Karasawa 1935)
53 <i>Enchantress</i>		ca 21 (Karasawa unpublished)
54 <i>Jubilee</i>		ca 23 (Karasawa unpublished)
55 <i>Potter</i>		25 (Karasawa unpublished)
56 <i>Kathleen Parlow</i>		27 (Karasawa unpublished)
57 <i>Snowstorm</i>		27 (Karasawa unpublished)
58 <i>Gladstone</i>		ca 28 (Karasawa unpublished)
59 <i>The Bishop</i>		ca 28 (Karasawa unpublished)
60 <i>Albion</i>		ca 29 (Karasawa unpublished)
61 <i>Albion Purple</i>		29 (Karasawa unpublished)
62 <i>Excelsior</i>		ca 29 (Karasawa unpublished)

Literature cited

- Bailey, L. H. (1924) Manual of Cultivated Plants. Macmillan, London. Pp. 8+851.
- Brittingham, W. H. (1934) Cytological studies on some genera of the Iridaceae. Amer. Jour. Bot., 21: 77-82.
- Heitz, E. (1926) Der Nachweis der Chromosomen. Zeit. f. Bot., 18: 625-681.
- Himmerbaur, W. (1926) Zur Entwicklungsgeschichte von *Crocus sativus*. Tschirch-Festschrift, Leipzig. 335-350.
- Karasawa, K. (1932) Karyological studies of some flowering *Crocus*. Bot. Mag., Tokyo. 46: 800-802.
- (1933) On the triploidy of *Crocus sativus*, L. and its high sterility. Jap. Jour. Genetics, 9: 6-8.
- (1935) Cytological studies on the cultivated *Crocus*. Ibid, 11: 162-168.
- (1937) Karyological studies in *Crocus* I. Jap. Jour. Bot., 9: 1-15.
- (1939) On the chromosomes of *Crocus Balansae* and *Crocus candidus subflavus*. Genetica, 21: 88-91.
- (1940) Karyological studies in *Crocus* II. Jap. Jour. Bot., 11: 129-140.
- Mather, K. (1932) Chromosome variation in *Crocus* I. Jour. Genetics, 26: 129-142.
- Morinaga, T. and Fukushima, E. (1931) Chromosome numbers of cultivated plants III. Bot. Mag., Tokyo. 45: 140-145.
- Pathak, G. N. (1940) Studies in the cytology of *Crocus*. Ann. of Bot., N.S. 4: 227-256.
- Propach, H. (1939) Cytogenetik bei Zierpflanzen. (Sammelreferat). Züchter, 11: 174-184.