

## **BOTANY, TAXONOMY AND CYTOLOGY OF CROCUS VERSICOLORES SERIES**

### **ABSTRACT**

The genus *crocus* (family - Iridaceae) contains ca. 100 small, corm-bearing, perennial species distributed across Europe, North Africa, South Asia and West China. These species are highly valued as ornamental plants due to their colourful flowers, horticultural varieties and in industrial applications. Sub-genus *crocus* series *crocus versicolores* series are closely related species; and are difficult to be separated taxonomically and have a complex cytology. Botany of the *C. versicolores* series, taxonomy of their species and their infraspecific taxa are presented, and their distribution, ecology and phenology; full description and chromosome counts are provided with key of their identification.

**Key words** *Crocus*, Taxonomy, Geographic area, Cytology, Chromosome, *Crocus versicolores* series.

### **INTRODUCTION**

The genus *crocus* (family- Iridaceae or Iris) comprises some 85 - 100 species having an old world distribution, primarily in the Mediterranean - Europe and Western Asia. The limits of the entire genus lie within the longitude 10° W to 80° E and latitude 30° N to 50° N. Phytogeographically, the majority of the species occur within the Mediterranean floristic region, extending eastward into the Irano-Turanian region; both of these areas are characterized by cool winters and warm summers with very little rainfall; the genus *crocus* is well adapted to such conditions, with the plants actively growing from autumn to late spring and surviving the summer drought below ground by means of a compact corm. Many species have their above ground growth at the onset of autumn rains and flower almost immediately; some of these produce their leaves and flowers concurrently or nearly so, while others bloom without leaves and delay their leaf production until the onset of warmer weather, usually in spring.<sup>1,2</sup>

Crocuses are some of the most vibrantly beautiful flowering plants, and are therefore widely popular among gardeners in the know. They mix well with creeping or dense greenery, and will push their way right up through even the densest vegetation and burst into colourful bloom. While new gardeners may feel intimidated by the process of planting and caring for *crocus* bulbs, the process is easier than it may appear with understanding of the *crocus* growth cycle, it becomes possible to plant and cultivate these glorious additions to any garden or landscape.

Cultivation and harvesting of *crocus* was first documented in the Mediterranean, notably on the Island of Crete. Frescos showing them are extant at the Knossos site of Crete as well as comparably aged sites on Santorini. An early spring bloomer, *crocus* bulbs, are technically corms. They are solid inside, if cut than open, and then have papery outer covering which is called Tunic. Each *crocus* usually makes many corms.<sup>3,4</sup>

A species evolution is generally accompanied or followed by partial changes in the chromosome complement and there can be few genera where such a wide range of variation occurs. The variation is, however, difficult to deal with or without information of breeding systems, hybridization potential and the production of hybrids. So far, it has only been possible to make a comparative analysis of chromosome number and morphology, but these differences and similarities can be significant, and may well indicate barriers to successful interbreeding. Although similar karyotypes do not reveal the presence of symmetrical structural changes, it may generally be assumed that if the phenotypes are also alike, there is a probability that there are no barriers to gene exchange. On the other hand, when karyotypes are obviously different, successful interbreeding is less likely.<sup>2,5-6</sup> Such chromosome barriers are of obvious importance and can lead to further divergence which may eventually give rise to acceptable species. The closely related species have been difficult to separate taxonomically and have also been found to be complex cytologically, and have been treated as a series.<sup>7-9</sup> These physiological features of the corm tunics, bract,

bracteoles, leaves, flowers and seed, have been discussed by the genus into a hierarchy of sub-genera, section and series of crocus versicolores.

#### TAXONOMY

01. Domain	Eukaryota
02. Kingdom	Plantae
03. Sub-kingdom	Viriaeplantae
04. Phylum	Tracheophyta
05. Sub-phylum	Euphyllophytina
06. Infra-phylum	Radiatopses
07. Class	Spermatopsida
08. Sub-class	Liliidae
09. Super-order	Lilianae
10. Order	Asparagales
11. Family	Iridaceae ( Iris)
12. Sub-family	Crocoideae
13. Tribe	Lxieae
14. Genus	Crocus

**Genus crocus** : **Herb** - small perennial, cormous. **Corm** - oblate, covered with a tunic. **Leaves**- few, all basal, green, linear, adaxially with pale, median strips, base surrounded by membranous, sheath like leaves. **Aerial stem** - not developed. **Flowers** - emerging from ground, with peduncle and ovary- subterranean. **Perianth**- white, yellow or lilac to dark purple. **Perianth tube** - long slender. **Segments** - similar, equal or sub-equal. **Stemen** - inserted in the throat of perianth tube. **Style** - 1, slender, distally with three to many branches. **Capsule** - small, ellipsoid or oblong-ellipsoid.<sup>6,10.</sup>

- Sub-gnus** : Anthers with extrose dehiscence.
- Section crocus** : Scape subtended by a membranous prophyll.
- Series crocus versicolores** : spring - flowering, corms with tunics, which for the most part have parallel fibers, flowers with conspicuous exterior striping. The following species of crocus are induced for description :

*Crocus cambessedesii* J. Gay<sup>8, 11-15</sup>

#### Synonym (s) :

\* *Crocus cambessedesianus* Herb

\* *Crocus cambessedesii* var. *magontanus* J.J. Rodr.

**Common name** : Saffron.

We often think of our alpinas as being little jewels of the mountain-soor, like the American writer Claude Bare Jewels of the plain so but the delicate form of *Crocus cambessedesii* does indeed strick me as Jewel like. Flowering as it does after the great panoply of colour of the autumn Cyclamen, crocuses golden strenbergians and great showy lilac and purple goblets of *Colchicum* it could well risk being dwarfed by their memory. E.A. Bowles wrote that it ` looks as though the Fairy Queen had tried to make crocus for a doll`s house`. It belongs to the group of bulbous and tuberous.

**Native** : Majorca and Minorca Island. **Native climate** : Mediterranean. **Wild habitat** : open, stony places, scrub, pine wood. **Altitude** : up to 1500 m. **Height** : 8 cms. **Spread** : 38 cms. **Distribution** : Balearic Island. **Corm** : tunic parallel fibres, splits- parallel fibres at the base. **Leaves** : narrow upto 1 mm. in width, deciduous, simple, alternate, linear and sessile with entire margins and parallel venation, appearing with flowers. **Flowers**: 5 - 8 cm. tall, cup- shaped, periant- segments less than 2 cm. long, white or pale lilac with prominent purples strips and feathering out-side . **Fruit** : loculicidal capsule.  $2n = 16$ .

**Phenology** : Flowering : November - March.

**Characteristic** : Crocus can be blooming single plant Spain and Majorca. Autumn flowering species with small ( often exquisitely beautiful) attractive flowers and valuable for its early flowering. Much smaller flowers than the spring flowering crocus corsicus and crocus minimus and less shorter stable branches.

Crocus versicolor Ker Gawl.<sup>6, 16 - 24.</sup>

**Vernacular name** : Deutsch : silberlack - Krokus.

**Synonym (s)** :

**Homotypic** : Crocus crestensis Eugene.

**Heterotypic** : \* Crocus crestensis Eugene.

- \* Crocus fragrans Haw.
- \* Crocus mendionalis Risso.
- \* Crocus reinwardtii Rchb.
- \* Crocus subapenninus Herb.
- \* Crocus versicolor subsp. crestensis (Eugene) Nyman.
- \* Crocus versicolor var. affinis Sabine.
- \* Crocus versicolor var. elegans Sabine.
- \* Crocus versicolor var. fiorobundus Sabine.
- \* Crocus versicolor var. gallicus Herb.
- \* Crocus versicolor var. gawlen Sabine.
- \* Crocus versicolor var. haworthii Sabine.
- \* Crocus versicolor var. inconspicuous Sabine.
- \* Crocus versicolor var. lineatus Sabine.
- \* Crocus versicolor var. morieon Sabine.
- \* Crocus versicolor var. negiectus Sabine.
- \* Crocus versicolor var. peotinatus Sabine.
- \* Crocus versicolor var. plumosus Sabine.
- \* Crocus versicolor var. princeps Herb.
- \* Crocus versicolor var. propinquus Sabine.
- \* Crocus versicolor var. purpureus Sabine.
- \* Crocus versicolor var. similis Sabine.
- \* Crocus versicolor var. stellatus Sabine.
- \* Crocus versicolor var. urbanus Sabine.
- \* Crocus versicolor var. venustus Sabine
- \* Crocus versicolor var. violaceus Sabine.

**Botanical name** : Crocus versicolor `Picturatus`.

**Common name** : Cloth - of - silver crocus.

**Other name** : Crocus versicolor Picturatus.

Once very widely grown with many name cultivars, to-day only `Picturatus` is widely available. It is very attractive and straight forward plant with added bonus of a honey scent ( in at least one widely cultivated clone). **Habit** : erect, clump - forming. **Native** : mountains France and Italy. **Distribution** : SE France, Monaco, New Italy. **Native climate** : Mediterranean. **Wild habituated** : stony and grassy places, open woodlands and over lime stone. **Altitude** : 1500 m. **Height** : 5-8 cm. **Spread** : 0.1 m. **Total maturity**: 2-5 years. **Corm**: tunic membranous ageing parallel fibres. **Leaves** : grey-green, 1.5 - 3.0 mm. wide, 3 - 5 usually reaching the base of the flowers. **Flowers** : range from cup to goblet shaped, 10 - 12 cm. high, fragrant, white to mid purple usually conspicuously dark-striped on the

exterior, sometimes on a yellowish ground. **Throat** : usually pale-yellow, hairless. **Spathes** : present. Bract : solitary or accompanied by a narrow bracteole. **Segments** : obtuse or subacute. Perianth : lobes, 2.5 - 3.5 cm. X 7 - 10 mm. **Anther** : yellow. **Style** : divided into 3 yellow or orange branches, each expanded and sometimes slightly lobed at the apex.  $2n = 26$ .

**Phenology** : Flowering : February - March.

**Characteristic** : The most frequently, cultivated variant of this species is a white - flowered. Conspicuously striped cultivar known as `Picturatus`. The closest relatives are *crocus imperati*, *crocus malyi* and *crocus minimus*. *Crocus imperati* usually has much more richly lilac coloured flowers and `greener` leaves, while *crocus versicolor* are some what `grey-green`. *Crocus malyi* has almost uniformly white flowers which lack outer strips and also differs in some leaf characteristic. It is also related to *crocus minimus*, which is often has much larger purple stain on the outer petals and petals of slightly different shape.

*Crocus corsicus* Vanucchi ex Maw <sup>6,22,24 - 34</sup>.

**Synonym (s)**

- \* *Crocus insularis* var. *major* Herb.
- \* *Crocus minimus* sub-var. *corsicus* Vanucchi.

**Common name** : *Crocus corsicus*, Corsican crocus, Korsicher Krokus.

Flowering later in spring and an equally good garden plant, *crocus corsicus*, is another species offering a dramatic colour change. At its name suggests it is native to Corsica. **Habit** : tufted. **Native** : Corsica. **Distribution** : Corsica. **Native climate** : Mediterranean. **Wild habitat** : rocky hillside, in scrub. **Altitudes** : 100 - 600 m. **Height** : 10 cm. **Spread** : 0 - 0.1 m. **Time of ultimate height** : 2 - 5 years.

**Corm** : tunic with fine fibres, netted in the upper part, growing up to 8 - 10 cm. tall, flowering as the leaves develop. **Stem** : swollen, serves as a strong organ, looks almost like bulb, but botanically it is distinct - a bulb is a short piece of plant stem that is surrounded by fleshy leaves, which form the bulb. **Leaves** : 3 - 4, 1 - 1.5 mm. wide, slightly shorter than or about equaling the flower, green. **Foliage** : dark green in spring and summer. **Flowers** : fragrance, pale to deep purple on the interior, often yellowish with 1 - 3 violet strips and finer veining on the exterior. **Bract** : solitary. **Perianth** : lobes usually 2 - 3.5 cm. X 7 13 mm. **Anther** : Yellow. **Styles** : divided into 3, orange or red branches, each expanded or slightly sub-divided at the apex.  $2n = (22), 18$ .

**Phenology** : Flowering : February - March.

**Characteristic** : very attractive and straight forward plant with added bonuses of a honey scent ( in at least one widely cultivated clone). Closely related to *crocus minimus*, which is often has much larger purple stain on the outer petals, petals of slightly different shape and strongly feathered purple but open to reveal vibrant lilac inner surface.

*Crocus imperati* Tenore M.

**Synonym (s)**

- \* *crocus albiflorus* subsp. *neapolitanus* ( Ker Gawl) Suess.
- \* *crocus imperati* var. *albiflorus* Ten.
- \* *crocus imperati* var. *reidii* Maw.
- \* *crocus imperatorianus* Herb.
- \* *crocus imperatorianus* var. *albus* Herb.
- \* *crocus imperatorianus* var. *montanus* Herb.
- \* *crocus imperatorianus* var. *princeps* Herb.
- \* *crocus imperatorianus* var. *rupestris* Herb.
- \* *crocus incurvus* Donn ex Steud.
- \* *crocus neapolitanus* ( Ker Gawl) Ten.
- \* *crocus recurvus* Haw.
- \* *crocus reflexus* Donn.
- \* *crocus vernus* var. *neapolitanus* Ker Gawl.

**Botanical name :** *Crocus imperati*

**Common name :** Early crocus, Imperati's crocus.

**General Description of *Crocus imperati* Tenore M.** <sup>35</sup>.

**Corm :** ovoid to subglobose ( rarely pyriform), (6-) 10 - 22 (- 24) wide and (7-) 11 - 22 (-24) mm. long. **Tunics :** membranaceous - filamentous, with parallel fibres, often scarcely reticulated ( especially towards the apex), rarely somehow papyraceous. **Cataphylls :** generally 3 - 5, membranaceous, but usually with weak greenish veins and herbaceous apex. **Leaves :** glabrous, dark green, already present at flowering time, bending at the beginning and then procumbent at anthesis, ( 6.5 - ) 9 - 39 (-49) x (1.2- 1.5 - 3.7 (-4.7) cm. **Scope :** with prophyll. **Flowers :** 1 - 3 (-5), vernal, odourless, with one bracteole. **Bract and bracteole :** acute to acuminate, sometimes bifid, white - greenish. **Flower length :** ( 4.5-) 5.6 - 20.0 (-23.0) cm. with perianth tube whitish with purple strips. **Inner tepals :** ovate to lanceolate, with a rounded to obtuse ( sometimes acute) apex, (23-) 27 - 45 (-48) mm. long and (9-) 12 - 22 (-25) mm. wide, uniformly lilac to violet( rarely purplish to white. **External tepals :** subequalling the inner ones, but usually slightly narrower and longer, concolorous with the inner tepals on the internal side, but externally much lighter ( pale lilac to whitish, rarely ivory coloured) with deep purple irregular longitudinal stripes. **Throat :** orange to yellowish, without hairs. **Anther :** extrorsely dehiscent. **Staminal filament :** (5-) 6 - 12 (-15) mm. long, half to as long as the anther, which are ( 9-) 11 - 18 (-19) mm. long. **Stigmas :** fimbriate, orange to reddish, shorter or longer than stamens. **Capsule :** oblong to ellipsoid, reaching the level of the ground or above at maturity, 10 - 30 mm. long and 5 - 13 mm. wide. **Seeds :** reddish to pale brown, subglobose, 2 - 4 mm. long, distinctly winged and with a caruncle.

*Crocus imperati* subsp. *imperati* Tanore M. <sup>24,32,36 - 39.</sup>

**Habit :** tufted. **Distribution :** W Italy ( south from Naples : Capri). **Native climate :** Mediterranean. **Wild habitat :** short tuft and thin woodland. **Height :** up to 10 cm. **Spread :** 0 - 0.1 m. **Time of ultimate height :** 2 - 5 years. **Corm :** tunic parallel fibres. **Root :** bulb tuber, at the time of flowering fusiform and naked below, the fusiform root sometimes extending to the depth of 15 cm., sometimes producing a shorter one from the upper part. **Leaves :** 3 - 6, 2-3 wide, equaling or exceeding the flower. When in the flower recurved, spread or laying on the ground, narrowly linear, keeled, dark green marked in the longitudinal with line on the upper side, a line and a half in breadth, and from 8 - 14 cm. in length revolute at the margins. **Flowers :** mid to deep purple on the interior and yellowish with 1 - 5 conspicuous violet strips on the outside. **Throat :** yellow to orange, hairless. **Spathe :** present. **Bracts :** 2. **Perianth :** lobes, 2.3 - 4 cm. x 7 - 18.2 mm. **Anther :** extrorsely dehiscent. **Staminal filament :** 6 - 12 mm. long, half to as the anther, which are approximately 11 - 18 mm. long, stigmas fimbriate, orange to reddish, shorter or longer than stamens. **Capsule :** oblong to ellipsoid, reaching the level of the ground or above at maturity, 10 - 30 mm. long, 5 - 13 mm. wide. **Seed :** reddish to pale brown, sub-globose, 2 - 4 mm. long, distinctly winged and with a caruncle.  $2n = 26$ .

**Phenology :** Flowering : April - May.

**Characteristic :** differs from other sub-species by having two bracts sheathing the tube instead of one. Planted in the ground in Northern California it is a reliable bloomer, coming back each year, but blooming months December - January. Our wettest months when the flowers are often destroyed by the rain.

*Crocus imperati* subsp. *suaveolens* ( Bertol ) Mathew B. <sup>18, 20, 40-42.</sup>

**Synonym (s):**

- \* *Crocus imperati* subsp. *suaveolens* Bertol.
- \* *Crocus imperati* var. *suaveolens* ( Bertol) Fiorinom superfl.
- \* *Crocus minimus* var. *italicus* (Bertol) J. Gay.

**Basionum :** *Crocus suaveolens* Bertol.

**Common name :** Roman crocus ( *Crocus suaveolens*), Fragrant crocus.

This very pretty vernal crocus is found wild in Rome, and in other parts of Italy, and was first recognised as distinct species by Professor Bertoloni. **Habit :** bulb, corm, tuber. **Distribution :** West Italy. **Habitat :** Mediterranean forest, woodlands and scrub. **Life form :** tuber geophytes. **Height :** 10 cm. **Spread :** 5 cm. **Time of ultimate height :** 2 - 5 years. **Corm :** tunic parallel fibres. **Leaves :** 3 - 6, 2 - 3 mm.

wide, equaling or exceeding the flower, green. **Flowers** : purple, yellow ( violet, buff). **Foliage** : green. **Landscape uses** : rich violet on the inside and yellow to buff coloured on the outside with violet spring on the back. **Throat** : yellow to orange, hairless. **Spathe** : present. **Bract** : 1 , solitary. **Perianth** : lobes. **Anther** : dehiscent, 8 - 12 mm. **Filament** : 3 - 5mm. long. **Style** : branched, yellow or orange.  $2n = 26$ .

**Phenology** : Flowering : January - March.

**Characteristic** : It is distinguished from the other subsp. by having only one bract. Blooming for first time from seed in January 2004. Parts of crocus imperati subsp. suaveolens spring flg are considered toxic.

Crocus minimus DC. <sup>23,25,33,39,43 - 46.</sup>

**Common name** : Wild crocus, snow crocus, specie crocus.

**Native** : southern Corsica in Sardinia. **Habit** : bulb, corm, tuber. **Distibution** : Sardinia, Scorsica. **Habitat** : Mediterranean. **Wild habitat** : stony and sandy situations, in grass of scrub. **Altitudes** : 100 - 600 m. ( altitude west coast of Corsica app. 700 m., but grows at higher altitudes in Sardinia). **Height** : 2 cm. Spread : 8 cm. **Corm** : tunic fibrous, the fibres parallel, sometimes merging at the apex of the corm. **Cataphylls** : usually 2, membranous, white. **Leaves** : synanthous, 3 - 5, 0.5 - 1.5 mm. wide. **Flowers** : 1 - 2, varying pale to deep lilac, often stained dark purple externally. **Throat** : white or rarely faintly yellow, glabrous. **Prophyll** : present. **Bract and bracteole** : present, well exserted from the cataphylls, often brown or greenish - spotted, unequal, the bracteole more or less narrowly linear and partially hidden by the bract. **Perianth tube** : 5 - 11 cm. long, white or lilac near the apex. **Segments** : ( 1.7 - ) 2 - 2.7 cm. long, 0.4 - 0.8 cm. wide, both inner and outer more or less equal, oblanceolate, obtuse. **Filaments** : 0.6 - 0.8 cm. long, white, glabrous. **Anther** : 0.6 - 1 cm., linear, yellow. **Style** : yellow to orange, usually equaling or overtopping the anthers deeply divided into about 3 branches, each branch either expanded and frilled or obscurely lobed.  $2n = 24$ .

**Phenology** : Flowering : January - April.

**Characteristic** : crocus minimus eaten in west mediterranean Island ( part unknown). Parts of plant are poisonous if ingested handly plant may cause skin irritation or allergic.

Crocus corsicus Vanucci ex Maw and crocus minimus D> are closely related species causing some problems for the taxonomist. The classifications of the genus based on the characters of the corm-tunic are successful for the most crocus species but in few cases, closely allied taxa become artifactly separated if the infra generic criteria are applied strictly. Crocus minimus has parallel - fibrous corm tunic falls into **Fibromembranacei** while crocus corsicus is placed **Reticulati** because its corm- tunic has netted fibres. Although it is possible to separate these two species on their corm-tunic features it must be admitted that it is sometimes, since it is possible for crocus corsicus to have tunics with rather weakly reticulated fibres and for crocus minimus to sometimes have fibres which anastomose to a small degree - the first stages of becoming truly reticulated. <sup>33, 49.</sup>

The chromosome number of crocus corsicus was counted by contandriopoulos,  $2n = 22$  for her collection from Puntadell Oriente confirming by Karsawa and Brighton, but material was unknown. <sup>50,51.</sup> Crocus minimus recorded  $2n = 24$  previously recorded. <sup>25,52 - 53</sup>

The mixed populations of crocus corsicus and crocus minimus occurring in the region of Bastelica, in the forest of Ospedate and Zonza. It is also reported finding hybrids near Bastelica. <sup>25, 54.</sup>

Crocus malyi Visiane. <sup>8,18 - 21, 36, 55.</sup>

This species is found in Yugoslavia. **Habit** : tufted. **Distribution** : W Croatia, Velebit mountains. **Native** : Croatia and Bosnia-Herzegovina. **Native climate** : Mediterranean. **Wild habited** : short truff and pinewood margins, over lime stone. **Height** : 5 - 8 cm. **Spread** : 0= 0.1 m. Altitude : 520 m. **Time of ultimate height** : 2 - 5 years. **Corm** : tunic finally fibres, the fibres more or less parallel or obscurely reticulate at the apex of the corm. **Leaves** : 33 - 5, 15 - 25 mm. wide, present at anthesis, deciduous, simple leaves alternate, linear and sessile with entire margins and parallel venation. **Flowers** : 1 - 2, solitary white cup-shaped, some tinged with blue or brown at the base, externally white and yellow in spring. **Throat** : deep yellow, pubescent. **Prophyll** : present. **Bract and bracteole** : present , well exserted from the cataphyll, membraruses, white, very unequal, the bracteole much narrower then bracts, more or less linear. **Perianth tube** : 4 - 9 cm., white , sometimes suffused yellow, brown or purple. **Segments** : 2 - 4 x 0.8 - 1.9 cm., oblanceolate, subacute



or obtuse. **Anther** : yellow. **Style** : yellow to deep orange, exceeding the stamens, divided into 3 branches, each branch expanded and after shortly lobed at the apex. **Capsule** : loculicidal. Seed : unknown.  $2n = 24$ .

**Phenology** : flowering : March - April.

**Characteristic** : In spite of statements the contrary in the literature, this species grown in the Velebit Planina as well as reportedly on the borders of Erna and Hercegovina. The difference between *Crocus imperator* and *Crocus versicolor* in its white flowers unmarked on the exterior of the petals. Attractive and flowering late enough to miss the worst of the winter weather.

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