Crocus cartwrightianus on the Attica Peninsula

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Abstract

Crocus cartwrightianus is the closest relative of C. sativus, and is commonly found in limestone areas on the Attica peninsula. It is autumn flowering and diploid with 2n = 16 with white to purple flowers and a characteristic bright red style, deeply divided into three long branches. Flowers and style resemble those of C. sativus and like those of C. sativus, the styles can be used as a wild source of saffron. The close relationship between the two is quite clear, however, it is still unclear whether more species have taken part in the ancient hybridisation events resulting in the triploid C. sativus (2n = 24).

INTRODUCTION

In an ongoing study of the flora of Greece (Strid & Tan, 1997) we have studied the diploid *Crocus cartwrightianus* Herbert in its natural habitat on the Attica peninsula. It is an inhabitant of open, grazed lowland hill- and mountainsides mostly on limestone in grass and among various shrubs. It is not seen so often in places where the shrubs become too large.

C. cartwrightianus belongs to the series *Crocus* (Mathew, 1980), a series which is characterized by having a long, striking red style which is deeply divided into three branches (Figure 1). All species of the series flower during autumn, from October to November, and into December, with a leaf development starting at flowering time or later during the spring. Besides *C. cartwrightianus*, the series comprises seven other species, viz. *C. sativus* L., *C. moabiticus* Born. & Dinsm., *C. oreocreticus* B.L. Burtt, *C. pallasii* Goldb., *C. thomasii* Ten., *C. hadriaticus* Herb., *C. asumaniae* B. Mathew, and *C. mathewei* Kerndorf & Pasche. *C. asumaniae* has 2n = 26, *C. sativus* has 2n = 24, *C. moabiticus* has 2n = 14, *C. pallasii* has 2n = 12, 14, 16, and the other species are diploids with 2n = 16.

C. sativus, the saffron crocus, is a sterile triploid, generally assumed to be of autotriploid or hybrid origin. *C. cartwrigthianus* is no doubt a parent, however, other species with 2n = 16 may have taken part in a hybridisation event. The morphological appearance of the flower of *C. cartwrightianus* is quite close to that of *C. sativus* and it is used as a wild source of saffron (e.g. Maw, 1886; Mathew, 1999). *C. sativus* is only known from cultivation and traditionally grown from Spain in the west and to Kashmir and China in the east.

DISTRIBUTION

C. cartwrightianus has a limited distribution, found on the Greek (Figure 2) mainland only around Athens and especially on the Attica peninsula, the island of Euboea, Crete, and the Cyclades, recorded on the islands of Andros, Giaros, Ios, Kythnos, Mykonos, Naxos, Paros, Serifos, Skiros, Syros, and Tenos (Mathew, 1980). On the Attica peninsula it is found in neighbouring mountain areas of Athens, i.e. Mt. Imitos (150 m), Mt. Merenda (580 m), Mt. Painio (460 m) and neighbouring lowlands, i.e. Church of Taxiarches (100 m), Plaka (100 m), south east of Keratea (100 m), and rocky outcrops near the sea, e.g. south east of Voulyagmeni (20 m), and south east of Lavrio (30 m). In Crete it is found on the Akrotiri peninsula near Khania, in lowland shrub land of about

300 m.

On Mt. Painio large populations have been observed on the south and southeastern slopes at an altitude of below 500 m. Plants were scattered among small shrubs, grass, and often sheltered between rocks. In some places there was quite a distance between the specimens, while in other places, several specimens could be found within one square meter. Generally the plants were single corm plants, and vegetative reproduction was minimal. The flowers were mostly of the usual blue striped colour, but some sub-populations showed a continuous variation of different colours ranging from pure white forms to white with faint purple stripes and/or with a deep blue centre to varying deep blue coloured forms.

On Mt. Merenda, at an altitude of more than 500 m, the vegetation was generally taller than that of Mt. Painio, and the *Crocus* were scattered around, in various densities. Many specimens had rather large flowers in deep blue colours.

Only within the courtyard of the Church of Taxiarches plants were observed which formed clones, i.e. corm aggregations with e.g. 5-7 or more flowering corms. This locality and population no doubt represents an atypical habitat and behaviour, an abundance of nutrients no doubt being present due to human activities. Normally *Crocus* species are seed propagated resulting in a scattered distribution of plants, and a clone formation would result in a within bulb competition.

At Plaka, there was a tendency that the plants form one or two additional corms. The Plaka locality is unusual for *C. cartwrightianus* as it is on granite which gives an acid pH in the soil. Here the *Crocus* were found at the base of a hill under some *Pinus* trees, where nutrients no doubt are carried down the hillside with the water, and further nutrients are supplied from a sheep and goat path. This enriched nutrient supply probably compensates for the low pH in the granite soil.

On Mt. Imitos, *C. cartwrightianus* grows on a rather disturbed southwest-facing slope, with only a sparse vegetation to protect the plants. The soil is the typical deep red clay originating from the underlying limestone.

At the sea level sites at Lavrio and Voulyagmeni the plants also inhabit limestone soil, and characteristically the flowering period in these lowland areas begins later than at higher altitudes. When brought into cultivation, plants from low altitude areas started flowering in late November whereas plants from the 500 m region flowered in early November.

FLOWERING AND POLLINATION

C. cartwrightianus is insect-pollinated, the main pollinators are Honey Bees (*Apis mellifera*) but other smaller bees and flies are also seen in the flowers. The peak flowering period is late October throughout November into December, depending on the altitude of the locality, temperature and onset of rainfall. The flowers open in the morning, only slightly at day one, with the red tip of the stigmas appearing just at the opening of the narrowly wine glass-shaped flower. Later on the flower opens more and the stigmas fall out between the perianth segments rendering little possibility for pollination. Once open the flowers only close slightly at night time for the rest of their lifespan, perhaps indicating that they thereafter only serve as an advertisement in order to attract insects of the area, and perhaps also as pollen donors.

It seems that the onset of flowering may be genetically regulated. Populations of *C. cartwrightianus* from different altitudes brought into cultivation and exposed to the same cultural conditions, flower according to their geographical origin, viz. populations from high altitudes (Mt. Painio and Mt. Merenda) flower about two to three weeks before plants originating from low altitudes (Voulyagmeni and Lavrio). Plants from Crete, Akrotiri peninsula, flower about the same time as plants from the coast on the Attica peninsula.

OTHER SPECIES OF SERIES CROCUS

Flowers of C. hadriaticus and C. cartwrightianus may look alike, especially when

dealing with whitish forms and more or less unstriped forms of *C. cartwrightianus*. The two species are not known to inhabit the same areas, as *C. hadriaticus* is a western Greek taxon, while *C. cartwrightianus* is a southeastern taxon (except perhaps for a yet not fully investigated plant resembling *C. hadriaticus* from the Attica peninsula). So knowledge of the place of origin of a given plant will most likely settle the question of identity. Otherwise the two species can be distinguished morphologically by the length of the style segments. In *C. cartwrightianus* the style is deeply divided, the length of the branches being more than half the length of the perianth segments, and the branches usually hanging out in between the segments. In *C. hadriaticus* the length of the style branches are less than half as long as the perianth segments and the branches are usually stout and erect.

C. oreocreticus is endemic to Crete, e.g. on Mt. Psiloritis on limestone formations, at 900-2000 m. It is no doubt closely related to *C. cartwrightianus*. The flowers are generally smaller and less variable in colours, being mostly lilac to purple with darker veining, the exterior segments are silvery or buff-coloured. Albinos seem to be rather rare contrasting the not infrequent occurrence in *C. cartwrightianus* populations. In flowers of *C. oreocreticus* the apical part of the style branches do not protrude from the opening flower as is the case in *C. cartwrightianus*. Nor do the style branches flip over and hang out as they do in flowers of *C. cartwrightianus*.

C. pallasii is divided into four subspecies mainly according to geographic distribution and chromosome number. The main distribution area is S Turkey and N Syria. However, *C. pallasii* ssp. *pallasii* (2n = 14) is found in the eastern Mediterranean region and locally in the Balkan mainland and on the island of Lesbos and western Turkey. Some plants of the Lesbos populations have black anthers (an interesting character also found in some subspecies of e.g. *C. biflorus* and locally in *C. chrysanthus*). *C. pallasii* ssp. *hausknechtii* has 2n = 16 and a southeastern distribution from Jordan to Iran.

C. thomasii is found in Italy and in the mountains of the Adriatic coast. The flower colours are rather homogenous pale to deep lilac with yellow throat.

C. mathewei is known only from a small region in southwest Turkey, and is characterized by the white flowers with a deep blue centre.

C. moabiticus resembles *C. cartwrightianus* quite a bit, but has narrower perianth segments and a chromosome number of 2n = 14.

Crocus sativus

Crocus sativus is an almost completely sterile triploid (2n=3x=24). Although it has generally been considered to be an auto-triploid, there may still be some uncertainty as to whether it is an alloploid or an autoploid, as e.g. Agayev (2002) suggests it to be alloploid based on cytogenetic analyses. One of its parents is no doubt C. cartwrigthianus (2n=16) while the other (if alloploid) might be C. hadriaticus, or C. oreoreticus. Both belong to the Series *Crocus*, and have a chromosome number of 2n=16, and are found in present day Greece. However, we do not know the localization of a possible hybridisation event. The event may have taken place in cultivation as is the case of the well-known Crocus 'Golden Yellow' (Ørgaard et al., 1995). Taking this into consideration several autumn flowering species having 2n=16 may be possible parents, e.g., C. thomasi, from Italy and Croatia, C. mathewii from Turkey, and C. pallasii ssp. haussknechtii from Iran-Iraq-Jordan. Perhaps even C. cancellatus Herbert, a species belonging to Series Reticulati, could come into consideration as a potential parent, as ssp. mazziaricus (Herbert) B. Mathew (from Greece and W Turkey) also has 2n = 16 (although the karyotypes differ somewhat), and is frequently found growing - and flowering - together with C. cartwrightianus on e.g. the Attica peninsula. C. laevigatus Bory & Chaub. also grows together with C. cartwrightianus on the Attica peninsula, and it flowers from late November and through December and some also in January. However, it has a chromosome number of 2n = 26, which does not make it a liable candidate as a parent of C. sativus.

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Figures



Fig. 1. Crocus cartwrightianus Herbert. Cultivated specimens from Mt. Imitos, Attica peninsula, Greece. Phot. N. Jacobsen.



Fig. 2. The known distribution of *Crocus cartwrightianus* Herbert is confined to present day Greece in regions with a hot and dry summer climate.