

# A new hybrid of the genus *Origanum* L. (Lamiaceae): *Origanum* × *symes* Carlström

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## ABSTRACT

**Background and Aims:** *Origanum* × *symes* was described as a new species by Carlström in 1984 on the Aegean Island of Symi (Dodecanese, Greece). In this work, a taxonomic re-evaluation of *O. symes* is proposed in light of new findings.

**Methods:** New specimens belonging to *Origanum symes* from the island of Symi were collected by the first author in 2017. These specimens were carefully examined and compared with the type specimen of *O. symes*. Also, the new *Origanum symes* specimen was compared morphologically with *O. calcaratum* and *O. onites*, which are possible parents, and their calyces were drawn.

**Results:** The new hybrid was morphologically compared with its putative parents *Origanum calcaratum* and *O. onites*. Its diagnostic features, description, figures, and distribution map were provided.

**Conclusion:** It has been determined that *O. symes* has intermediate characteristics between its two parents in terms of features such as leaves, calyx, and corolla. These determinations led us to hypothesize that *O. symes* is a hybrid. As a result, it was concluded that *O. symes* was a hybrid between *O. calcaratum* and *O. onites*, and was re-arranged as *Origanum* × *symes* Carlström.

**Keywords:** *Origanum symes*, hybrid, Dodecanese, Symi

## INTRODUCTION

*Origanum* L. (family: Lamiaceae, subfamily: Nepetoideae, tribe: Mentheae, subtribe Menthinae) consists of about 42 species (49 taxa) and 22 hybrids worldwide, including the new hybrid described here (Dirmenci et al., 2021). Türkiye is a hotspot of *Origanum* diversity, with 21 species (24 taxa, 13 endemic) and 13 hybrids (12 endemics) (Ietswaart, 1980, 1982; Harley, 2004; Dirmenci, Yazıcı, Özcan, Çelenk, & Martin, 2018; Dirmenci, Özcan, Yazıcı, Arabacı, & Martin, 2018; Dirmenci et al., 2019; Arabacı, Dirmenci, & Yildiz, 2020; Dirmenci, Özcan, Arabacı, Çelenk, & Martin, 2020; Arabacı et al., 2021; Dirmenci et al., 2021). Greece counts 9 species of *Origanum* (6 endemics) and 3 hybrids: *O. × intercedens* Rech.f. (1961: 395), *O. × minoanum* P.H. Davis (1953: 137) (endemic), and the new endemic *O. × symes* Carlström (1984: 19) (Rechinger, 1944, 1961; Davis, 1953; Ietswaart, 1980; Carlström, 1984; Kokkini & Vokou, 1993; Dimopoulos, Raus, & Strid, 2018). Hybridization in natural habitats, as well as in cultivation, is common in Lamiaceae, especially in the genera *Origanum*, *Phlomis* L., *Thymus* L., *Salvia* L., and *Sideritis* L. (Celep, Rader & Drew, 2020; Dirmenci et al., 2021; Dadandi & Duman, 2003). Hybridization in *Origanum* is possible even between species belonging to different sections (Ietswaart, 1980; Dirmenci et al., 2019, 2020, 2021).

During a revisional study of the genus *Origanum* in Greece, it was noticed that *O. symes* is morphologically intermediate between *O. calcaratum* Juss. (1789: 115) and *O. onites* L. (1753: 590). Both taxa are characterized by the same chromosome number, 2n=30,

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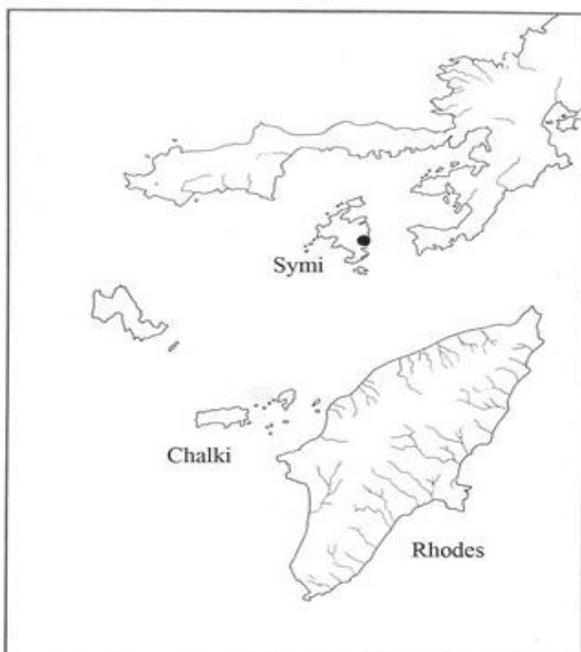
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and this type of diploidy is reported for most of the species belonging to the genus *Origanum*, though in a few cases, the chromosome number is  $2n = 28$  and/or  $32$  (Arabaci et al., 2021; Martin, Dirmenci, Arabaci, Yazıcı & Özcan, 2020). Ample botanical research has been carried out on Symi since the work of Orphanides in 1856, namely by Desio (1924), Rechinger (1944), Davis (1965-1985), Carlström (1987), Keitel & Remm (1991), Jahn (Strid 2016), Chilton (2010), Galanos (2016), Galanos & Tzanoudakis (2017, 2019), Burton & Tan (2017), Cattaneo & Grano (2017, 2018, 2019), and Cattaneo (2020), and only *O. onites* and *O. symes* have been detected on the island. *O. calcaratum* has not been found on Symi, but it is the only species that overlaps with *O. onites* in this area. *O. calcaratum* occurs on several islands and islets of the Cyclades and the Dodecanese, such as Keros, Anidros, Amorgos, Astypalea, Ofidoussa, Kounoupi, Safora, Sirina, and Chalki, and also in eastern Crete (Sitia). The nearest island to Symi where *O. calcaratum* occurs is Chalki (43 km), while Crete is the most distant island from Symi with a distance of 222 km. It grows on the crevices of vertical limestone cliffs at 50-500 m (Strid, 2016). *O. onites* has a wider distributional range and is mostly found in southern Greece, and western and southern Türkiye. It is a phrygic element, and grows on dry, rocky slopes at 0-800 m. A taxonomic re-evaluation of *O. × symes* is proposed.

## MATERIAL AND METHODS

The specimens of *Origanum × symes* were collected from Aghios Dhysalonas Bay on Symi Island between two, shaded, vertical limestone cliffs close to the sea by the first author in 2017 (Figure 1). Carlström previously found this taxon at the same site (Carlström, 1984). It has not been found anywhere else, but considering the difficulty of conducting research at this site due to its tall, vertical limestone cliffs, the presence of a wider population of *O. × symes* is not excluded. The collected specimens were identified by comparing them with Carl-



**Figure 1.** Distribution map of *Origanum × symes* on Symi Island.

ström's samples, preserved at LD Herbarium (Figure 2). Voucher specimens were deposited in Cattaneo's personal herbarium (Figure 3). Calyx drawings are given in Figure 4. In addition, the new hybrid is morphologically compared with its putative parents *O. calcaratum* and *O. onites* in Table 1.

## RESULTS

### Morphological observations

Description of the hybrid

*Origanum × symes* Carlström (Willdenowia 14: 19-21 (1984) (Figures 2-4)

(*Origanum calcaratum* Jussieu (Sect. *Amaracus* (Gleditsch) Benth.) × *Origanum onites* L. (Sect. *Majorana* (Miller) Benth.)

Type: [Greece] Symi, Georgiou Disalona Bay, near s.l., Carlström 8363 (holo. LD-photo!).

**Description:** Subshrub. Stems ascending, up to 35 cm tall, light yellow or yellow-brown, pubescent at base, hairs c. 1 mm, hairy above. Branches of first order usually present, mostly in upper part of the stems, up to 6 pairs per stem, 3–5 cm long, not rami-



**Figure 2.** *Origanum × symes* holotype (reproduced with permission of the Director of the Biological Museum of Lund).



Figure 3. Specimen of Cattaneo's personal herbarium.

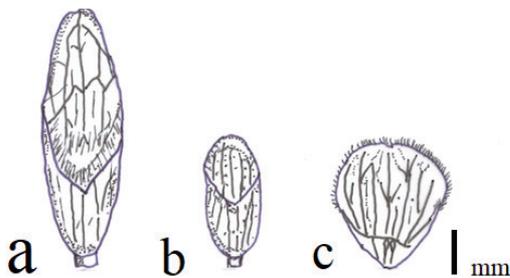


Figure 4. Calyx of *Origanum calcaratum* (a), *O. × symes* (b), and *O. onites* (c).

fied and with stalked glands. Leaves up to 15 pairs per stem, 13–28 mm long, 9–17 mm wide, cordate to ovate, obtuse to acute at apex, with marked veins raised at the undersides and with numerous sessile glands (up to 1000 per cm<sup>2</sup>), lower leaves lanate with a distinct petiole, c. 1.5 cm long, upper leaves ciliate, subsessile. Spikes usually erect, oblong-ovoid, 20–30 mm long, 10–20 mm wide. Bracts 8–12 pairs per spike, imbricate, ovate to suborbicular, rounded at apex, 7–10 mm long, 7–9 mm wide, glabrous, sessile glandular, green. Flowers 2 per verticillaster, subsessile. Calyx 3.3–3.8 mm long, c. 1.3 mm wide, with colored sessile and colorless stalked glands; upper lip entire; lower lip absent; throat glabrous. Corolla 2-lipped, c. 13 mm long, pink, clearly saccate, with scattered glands; upper lip subentire or divided into 2 lobes, 0.3–0.5 mm long; lower lip divided into 3 subequal lobes, 1.5–2 mm long. Stamens 4, all stamens protruding from upper lip of corolla; filaments c. 1.5–11 mm long; anthers c.

Table 1. Comparison of diagnostic characters in *O. calcaratum*, *O. × symes*, and *O. onites*.

	<i>O. calcaratum</i>	<i>O. × symes</i>	<i>O. onites</i>
Stems	erect, up to 35 cm, hirsute or slightly lanate, branches up to 6 pairs per stem and up to 2.5 cm	ascending, up to 35 cm, pubescent at base, branches 6 pairs per stem and up to 5 cm	erect or ascending, up to 100 cm, hirsute and glandular, branches up to 8 pairs per stem and up to 7.5 cm
Leaves	(sub)sessile, roundish to ovate, 6–28 × 5–25 mm, hirsute or slightly lanate, with sessile glands up to 600 per cm <sup>2</sup>	subsessile to petiolate, cordate-ovate, 13–28 × 9–17 mm, ciliate, lanate with numerous sessile glands up to 1.000 per cm <sup>2</sup>	shortly petiolate, cordate, ovate or oval with an acute apex, 3–22 × 2–19 mm, hirsute and glandular-pilose with sessile glands up to 1700 cm <sup>2</sup>
Inflorescence	spikes cylindrical or pyramidal, 10–40 × 9–17 mm	spikes oblong-ovoid, 20–30 × 10–20 mm	spikes subglobose, ovoid, or quadrangulo-cylindrical, 3–17 × 3–5 mm
Bracts	roundish to oval, acute at apex, 5–13 × 4–10 mm, glabrous, partly slightly purple	ovate-suborbicular, rounded at apex, 7–10 × 7–9 mm, glabrous, glandular, green	oval or ob-ovate, acute at apex, 2–5 × 1.5–4 mm, hairy, light green
Calyx	5–8 mm, 1-lipped, upper lip (sub)entire, with a pilose throat	3.3–3.8 mm, 1-lipped, upper lip entire, with a glabrous throat	2–3 mm, 1-lipped, upper lip entire or denticulate
Corolla	10–17 mm, pink, saccate, more or less glabrous	13 mm long, pink, saccate	3–7 mm, white, pilosellous
Stamens	4, exserted from corolla	4, exserted from corolla	4, or absent, if present, slightly exserted from corolla

0.4 mm long. Style protruding between the filaments, up to 18 mm long. Nutlets c. 1 × 0.5 mm, light-brown, slightly tuberculate, with two depressions exclusively on one side.

Habitat: Shaded limestone sea cliffs.

Flowering time: June

#### Comparison of the hybrid with the parental species

Carlström described *Origanum × symes* as a new species (Carlström, 1984), including it in the section *Amaracus* (Gled.) Benth.

She underlined the closeness of *O. × symes* with *O. calcaratum*, but also pointed out some differences, namely: its less compact inflorescences with always green, ovate to suborbicular bracts, compared to *O. calcaratum*'s usually elliptical bracts with acute apex; the calyx in *O. × symes* is smaller, 3.3–3.8 mm long, with a glabrous throat, whereas in *O. calcaratum* it is 5–8 mm long and the throat is usually hairy (Figure 4); and lastly, the differently shaped spikes which in *O. × symes* are not pyramidal as they are in *O. calcaratum*.

Moreover, *Origanum × symes* differs from *O. calcaratum* in several other features (Table. 1); its stems are glabrous to puberulent (not hirsute or lanate); leaves rounded to ovate, ciliate (not hirsute), up to 15 pairs per stem (not 35 pairs per stem); lower leaves with a distinct petiole ca. 1.5 cm (not (sub)sessile); sessile glands up to 1000 per cm<sup>2</sup> (not 600 per cm<sup>2</sup>); bracts with rounded, very glandular apex, 7–10 × 7–9 mm (not acute apex, slightly glandular, 5–13 × 4–10 mm); calyx with glabrous throat, 3.3–3.8 mm long (not pilose throat, 5–8 mm long); and corolla 13 mm long (not 10–17 mm long). *O. × symes* is more similar to *O. calcaratum*, but it also has intermediate characters with *O. onites*, such as the appearance of the leaves with marked veins on the undersides, and the shape and size of the calyx. *O. symes* differs from *O. onites* in puberulent-ciliate leaves, up to 15 pairs per stem, 13–28 × 9–17 mm with sessile glands up to 1000 per cm<sup>2</sup> (not hirsute leaves up to 28 pairs per stem, 3–22 × 2–19 mm with sessile gland up to 1700 cm<sup>2</sup>), bracts up to 12 pairs per spike 7–10 × 7–9 mm (not up to 34 pairs per spike 2–5 × 1.5–4 mm).

## DISCUSSION

Hybridization is a common phenomenon in the genus *Origanum*. Hybrids can form between species belonging to different sections and exhibit features similar to those of one parent or that are intermediate between both parents. In particular, leaf, bract, calyx, and corolla size and shape are usually intermediate between the parents (Rechinger, 1961; Duman, Başer, & Aytac, 1996; Bakha et al., 2017; Dirmenci et al., 2018a, 2018b, 2020). Indeed, this is clearly recognizable in examples such as *O. × aytacii* Dirmenci, T. Yazıcı & Arabacı (2020: 4) (Arabacı et al., 2021) and *O. × intermedium* P.H. Davis (1949: 410), which is more similar to *O. sipyleum* L. (1753: 589), *O. × intercedens*, which is closer to *O. vulgare* subsp. *hirtum* (Link) Letsw. (1980: 112), and *O. haradjanii* Rech.f. (1952: 64), which is closer to *O. syriacum* subsp. *bevanii* (Holmes) Greuter & Burdet (1985: 301) (Dirmenci et al., 2020; Arabacı et al., 2021).

In the genus *Origanum*, most hybrids co-exist with their parents in the same area, but some of them may not share the same geographical proximity. This is the case with *O. × munzurense* Kit Tan & Sorger (1984: 534), *O. × malatyanum* Yıldız, Arabacı & Dirmenci (2020: 10), and *O. × intercedens* (Tan & Sorger, 1984; Kokkini & Vokou, 1993; Dirmenci et al., 2019; Arabacı et al., 2020). However, the alleged absence of one or both parents could also be related to faults in the research. In the case of *O. × symes*, only one putative parent (*O. onites*) has been observed in its proximity, but the complexity of investigating in the area could have been what led to the other putative parent (*O. calcaratum*) not being found. This led Carlström to identify *O. × symes* as a new species.

Although *O. × symes* shows intermediate characteristics between both parents, it is much more similar to *O. calcaratum* in terms of general appearance and from an ecological point of view. Indeed, *O. calcaratum* and *O. × symes* are both chasmophilous species that grow on the crevices of vertical limestone cliffs (Cattaneo & Grano, 2019). *O. × symes* seems to avoid direct irradiation, as it was found in a shaded, deep cleft of a cliff. *O. calcaratum* belongs to the section *Amaracus*. This section is characterized by the usual presence of branches of the first order, and seldom those of the second order; leaves are usually leathery; spikes large, usually nodding; bracts imbricate, membranous, partly purple, more or less glabrous; flowers usually 2 per verticillaster, hermaphrodite and subsessile; calyx 1- or 2-lipped, corolla saccate and all stamens long exerted from corolla (letswaart, 1982). *O. onites* belongs to the sect. *Majorana*, which is characterized by the consistent presence of branches of the first order, and sometimes those of the second or third order; leaves herbaceous; spikes (sub)globose, often quadrigonus-cylindrical, small, erect; bracts different from leaves, densely imbricate, ± as long as calyces, enclosing marginally, herbaceous, whitish, greyish, green, hairy; flowers hermaphrodite or female, small; calyces 1-lipped corolla usually 2-lipped flattened. Stamens unequal, shortly protruding from corolla (letswaart, 1982).

## CONCLUSION

In this study, *Origanum × symes* has been taxonomically re-evaluated. Following a careful study of its morphological features, it was possible to identify the hybrid nature of the species, highlighting the similarities with and the differences from its parents *O. calcaratum* and *O. onites*.

In Symi, the presence of *Origanum onites* has been ascertained but not *O. calcaratum*, however the morphological closeness and the geographical proximity of *O. calcaratum*, which occurs on the nearby island of Chalki (southwest of Rhodes), have led the authors to believe that this is one of the putative parents. Floral characters are very important in the identification of putative parents in hybrids. In *O. × symes*, the corolla is very close in shape (clearly saccate), size, and color (pink) to that of *O. calcaratum*, whereas the calyx is closer in shape and size to that of *O. onites*. In *O. × symes*, all stamens are long-exserted from the corolla, as in *O. calcaratum*. Furthermore, while the stem size and number of branches bring *O. × symes* closer to *O. calcaratum*, the cordate-ovate leaves, rich in sessile glands, are reminiscent of those of *O. onites*.

Within *Amaracus* sect., in addition to *Origanum calcaratum*, *O. dictamnus* L. (1753: 589) could also be considered another putative parent of *O. × symes* because of its general appearance. The calyx is similar, but in *O. × symes* it is smaller and the corolla is more or less saccate, while in *O. × symes*, it is clearly saccate, as with *O. calcaratum*. Moreover, stem and leaves in *O. dictamnus* are lanate with branched hairs (exclusive feature of *O. dictamnus*), while in *O. symes*, the stem is pubescent only at the base, the upper leaves are ciliate, and the lower ones are lanate. Also, from a geographical point of view, *O. dictamnus* occurs only on Crete, which is quite distant from Symi compared to Chalki, where *O. calcaratum* occurs. In conclusion, both for morphological and geographical reasons it is assumed that *O. calcaratum* and *O. onites* are the putative parents of *O. × symes*.

Species belonging to the genus *Origanum* are mainly found in the Mediterranean region (Zohary, 1973) and most species occur exclusively in the Eastern Mediterranean region (Ietswaart, 1980). Hybridization is a common phenomenon in the genus *Origanum* and should be considered the most important speciation mechanism in the genus. An example is provided by *O.* × *lirium* Heldr. ex Halácsy (1899: 192), which originated from hybridization between *O. scabrum* Boiss. & Heldr. (1846: 48) and *O. vulgare* subsp. *hirtum* (Link.) Ietsw. (1980: 112). Hybrids and hybrid zones are widespread in some plant genera. Hybrids are expected to form only between closely related, genetically similar taxa. However, many such taxa are reproductively isolated from one another by very effective prezygotic isolating mechanisms such as geographic barriers, divergent phenology, divergent pollinators, and mating system differences, as well as postzygotic mechanisms involving immigrant and hybrid inviability. These barriers are likely to prevent such species from hybridizing and forming hybrid zones in sympatric and parapatric situations unless they are disrupted by natural or anthropogenic disturbance. Furthermore, hybrid zones could be a result of climate or geological change, or secondary contact after allopatric divergence (Abbott, 2017). In Greece only three hybrids: *O.* × *intercedens*, *O.* × *minoanum* P.H. Davis, and *O.* × *symes*, have been detected so far, but there may be many more in the overlapping areas of different species.

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