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# Eco-morphologic and taxonomic studies on *Quercus* hybrids (*Fagaceae*) in Sicily

**Résumé**

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In the genus *Quercus* L., distinction between nothotaxa and parental species is usually quite difficult, even impossible since macro-morphological characters are often inadequate to taxonomical delimitation at specific rank. On the contrary, a better knowledge of the hybrids can greatly help in the taxonomical understanding of the parents. In this contribution, micro-characters such as stomata, hairs, waxes and trichomes on leaf blades, have been studied by SEM, in both the hybrids *Quercus* ×*soluntina*, *Q.* ×*morisii*, *Quercus* ×*crenata*, *Q.*×*bivoniana*, *Q.* ×*fontanesii* and the relevant parental taxa occurring in Sicily. This, in order to evaluate their possible employ in the current taxonomical practise. The results show that superficial microstuctures and wood anatomy as well, could be encouraged as additional characters to traditional taxonomy.

## Introduction

Within the project "Sisiphus", which aims to give the taxonomic and ecological definition of the *Fagaceae* in Europe and to provide a contribution to the knowledge of the genus *Quercus*, a study on the Sicilian taxa has been set up.

Notably this study attempts to focus an morphological and micromorphological characters as well as ecology of the *Quercus* hybrids – or postulated as such – in order to clarify their relationship with the known or postulated parents occurring in the Region. In fact, intermediate characters of these nothotaxa could clarify features not readily apparent in their parents. This possibility appears interesting, especially since Sicilian species, such as *Quercus pubescens* and *Q. cerris*, that recently have inconsistently been treated by different authors (Greuter & al. 1986, Schwarz 1993, Pignatti 1982, Brullo & al. 1999). With these purposes, in this research the most remarkable and frequent hybrids have been considered.

## Material and methods

The taxa taken into account are *Q.* ×*bivoniana, Q.* ×*crenata, Q.* ×*morisii*, *Q.* ×*soluntina*, and *Q.* ×*fontanesii* that by tradition are considered of hybrid origin. Their study has been based on the examination of both herbarium specimens (PAL) and fresh samples col-

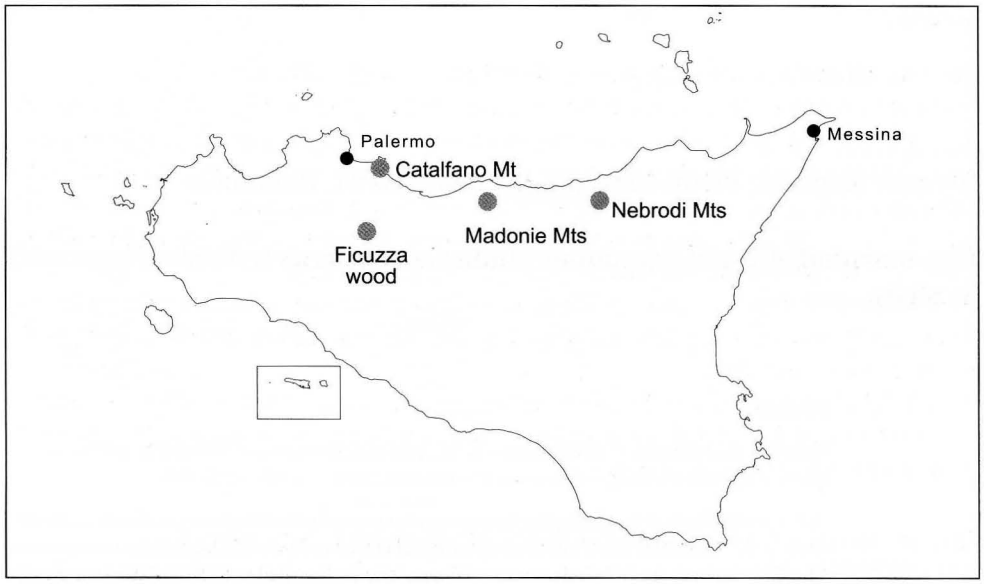


Fig. 1. Collection localities (●) of the hybrids studied.

lected in Northern and Western Sicily (Nebrodi and Madonie Mountains, Monte Catalfano and Ficuzza the wood, near Palermo) (Fig. 1).

The following features have been considered:

- Morphology of leaves, buds, fruits and twigs according to the method proposed by Filippello & Vittadini (1975) and by Moggi & Paoli (1972);
- SEM (Leica S 420) micro-morphology of stomata, hairs on leaf blades, waxes, trichomes according to the method suggested by Huttunen & Laine (1983). Classification of stomata and relevant terminology follow Hardin (1979) and Safou & al. (1988), respectively. These micro-characters observed have also been examined as regards their reliable taxonomical value and looking at their possible employ in addition to the macro-characters in the current taxonomical distinction practise;
- distribution and ecology of both the hybrids and concerned parents.

In addition to the above characters, the xylem micro-structure has been studied in *Q.* ×*fontanesii* and published separately (Schicchi & al. 2000).

The results of the reseach are presented here for each single nothotaxon including those concerning *Q.* ×*fontanesii* (Schicchi & al. 2000) that have consistently been considered as comparison terms. The SEM micro-morphological observations on each hybrid are presented in comparison with the parental ones and related to the macro-morphological characters which refer to both historical and current relevant literature and herbarium specimens studied (PAL) as well.

The data presented here are mostly provisional, and need substantial improvement. Nevertheless, they provide some interesting suggestions that, for each of the examined taxa, can be considered as an account to a comprehensive work, still in progress, which includes either xylem or leaf anatomy, seedling growth, etc.

## Results

***Quercus* ×*bivoniana* Guss. (*Q. pubescens* Willd. s. l. × *Q. suber* L.)**

Neglected (Pignatti 1982; Schwarz 1993) or included in *Q. suber* (Borzì 1911; Greuter & al. 1986), according to Bevilacqua (1996) this taxon is of specific rank. Nevertheless several characters suggest that *Q.* ×*bivoniana* is hybrid between *Q. suber* and a deciduous oak, probably *Q. pubescens* s. l., but not *Q. cerris* as assumed by Lojacono (1904) and later by Camus (1938). Notably, cork is similar to *Q. suber*, but the leaf shape even in a single branch of the same individual ranges within the putative parents.

In the abassial leaf surface, as in *Q. suber*, stomata and their rims (Fig. 2a) are elliptic; trichomes, 8-16 rayed, have a flattened base (Fig. 2b). The ray surface is more or less rough like in *Q. pubescens* s.l.

*Q.* ×*bivoniana* is endemic to Sicily, mainly occuring in the northern slopes on quartz-arenitic substrates between the sea level and 800 m altitude, in presence of *Q. suber* and *Q. pubescens* s.l., but not *Q. cerris* L.

***Quercus* ×*crenata* Lam. (*Q. pseudosuber* Santi, *Q. cerris* L. × *Q. suber* L.)**

Macro-morphologic characters range between those of the postulated parents, i.e., bark moderately corky and leaves more persistent than in *Q. cerris*. Fruits as in *Q. cerris*, reaching ripeness in two years. SEM micro-characters similar to *Q. cerris* are the raised and elliptical stomata (Fig. 2c), with elliptical rims; similar to *Q. suber* are the trichomes (Fig. 2d) with a common basis and 8-12 rays rather elonged and smooth on the surface.

*Q.* ×*crenata* occasionally occurs from Spain (Amaral Franco 1990) to S France, Italy, Yugoslavia and Greece (cfr. Jalas & Suominen 1976, Pignatti 1982, Greuter & al. 1984, Shwarz, 1993), that are the European regions where the parental taxa range. In Sicily, it is very occasionally found in the Nebrodi and Madonie Mountains, between 600 and 1300 m altitude. Its scarce frequency is to be referred to the Sicilian distribution of *Q. suber* and *Q cerris* that range from the coast upwards to 1000 m and above 1000 m altitude, respectively (cfr. Brullo & al. 1999). Therefore in the island hybridation may just occur in a restricted area where the two parents occur together. The above considerations are valid if *Q. gussonei* and *Q. cerris* are considered as independent species, according to the Brullo & al. (1999) treatment.

***Quercus* ×*morisii* Borzì (*Q. ilex* L. × *Q. suber* L.)**

SEM observation of leaf microstructures (only herbarium specimens) shows that the most relevant characters are: stomata (Fig. 2e) raised and elliptic in shape, with elliptical rims, close to *Q. suber* but clearly differing from the rounded rim and stomata of *Q. ilex*.

Stomata are almost covered with a rich waxy framework, varying in size and shape and affecting to some extent observation. Stellate trichomes (Fig. 2f) are exserted and tickened, 8–14 rayed from the base. According to Lojacono (1904), macro-morphologic characters suggest the prevailing influence of *Q. ilex*.

*Q.* ×*morisii* occasionally occurs in Spain (Amaral Franco 1990), Sardinia (Borzì 1911) and other regions where the parents are found. In Siciliy it has been recorded in the Ficuzza wood, Lipari (Borzì 1911) and the Madonie Mountains (Lojacono 1904).

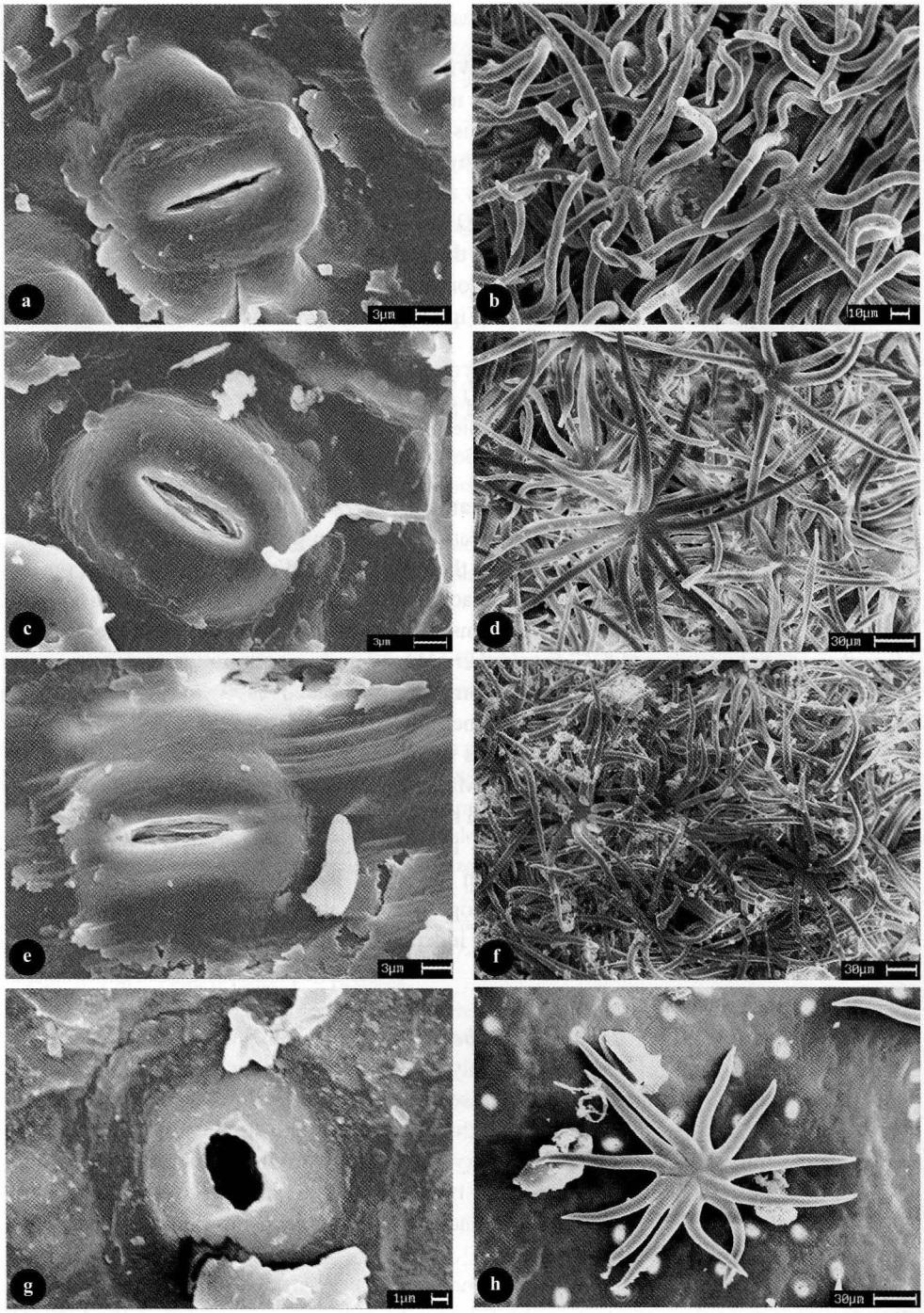


Fig. 2. Stomata and trichomes: (a-b) *Q.* ×*bivoniana*; (c-d) *Q.* ×*crenata*; (e-f) *Q.* ×*morisii*; (g-h) *Q.* ×*soluntina*.

***Quercus* ×*soluntina* Tineo ex Lojac. (*Q. calliprinos* Webb. × *Q. ilex* L.)**

In his description, Lojacono (1904) stressed the great polymorphic character of this nothotaxon especially as regards the leaf shape even in a single branch. Micro-structure shows this same gradient variation, ranging between the extreme individuals quite similar to *Q. calliprinos* and *Q. ilex.* SEM shows scarce pubescent hairs on the lower leaf blades (as in *Q. calliprinos*); stomata (Fig. 2g) are elliptic and barely raised with rounded rims similarly in both *Q. ilex* and *Q. calliprinos*. Trichomes (Fig. 2h), with more rays (7-14) than in the parents, are short, swollen at the bottom and irregularly spread on the whole surface.
*Q.* ×*soluntina*, is endemic to a single locality extending about 10 ha, on the slopes of the Monte Catalfano, close to Palermo, on sandy soil laying on limestone substrate (Marcenò & Raimondo 1972). It ranges between 30 and 100 m a.s.l., within a strongly disturbed shrubby vegetation. In the Catalfano area *Q. ilex* occurs too. *Q.* ×*soluntina* can probably be assumed as resulting from introgression between an isolated original population of *Q. calliprinos* and *Q. ilex*. As regards other Sicilian localities where *Q.* ×*soluntina* possibly occurs, these could be deduced from Lojacono (1904) who, on the other hand, distinghuished the Sicilian hybrids from *Q.* ×*auzandrii* Gren. & Godron (*Q. coccifera* L. × *Q. ilex* subsp. *ballota* (Desf. Samp.) which occurs in Spain.

***Quercus* ×*fontanesii* Guss. (*Q. gussonei* (Borzì) *Brullo* × *Q. suber* L.)**

As reported by Schicchi & al. (2000), the leaves vary considerably in size and shape between the parents. In the same population both almost evergreen and deciduous individuals occur. SEM characters show abundant waxes and several protective trichomes on the abassial surface similar in shape and ray number to *Q. suber* (8-14). Stomata, clearly raised, are very similar to the parents as shape and elliptical rim are concerned. In addition, hybridity is confirmed by the wood anatomy. In fact, xylem of *Q.* ×*fontanesii* clearly appear intermediate between both the parents. In particular, the transverse sections on earlywood and latewood show that the structure and distribution of the vessel in *Q.* ×*fontanesii* is intermediate between the diffuse porous wood relating to *Q. suber*, and the ring porous wood like in *Q. gussonei.*
*Q.* ×*fontanesii* is endemic to N Sicily, in Ficuzza wood, Madonie and Nebrodi Mountains, between 300 and 900 m altitude. As concerns taxonomy, with respect to the rank of *Q. gussonei* and its hybrids, Schicchi & al. (2000) appear to clarify adequately the relationships between *Q. gussonei* and *Q. cerris*.

## Conclusion

In the genus *Quercus,* the basical use of macro-morphological characters, as such, often appears inadequate to taxonomical distinction at specific or lower ranks. This, especially as regards hybrids.
Their morphology is so variable and includes so many transitional terms that, in many cases, distinction between nothotaxa and parental species is quite difficult, even impossible. On the contrary, a better knowledge of the hybrids can greatly help in the taxonomical understanding of the parents. In the above cases, the analysis of leaf micro-structures, and xylem anatomy as well, shows several features of particular interest in taxonomical

distinction of both hybrids and their parents occurring in Sicily. Therefore, further studies dealing with superficial microstuctures and wood anatomy, as shown for *Q* ×*fontanesii* (Schicchi & al. 2000), could be encouraged in future as additional techniques to traditional taxonomy.

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