

OAK TREE HYBRIDS IN THE BEJAN FOREST - DEVA REACTUALISATION AND GENETIC PROSPECTIONS

VICTOR STĂNESCU,
NICOLAE ȘOFLETEA,
AUGUSTIN STANCIU

1. Hybrids identified. New hybrids

The Bejan Forest, located in the very neighbourhood of the Municipium of Deva, is well-known still since the last century as a unique biotope for existence of numerous hybrids of the indigenous oak-trees.

Among the oak hybrids in the Bejan Forest, literature cited:

x Q. Tabajdiana Simk. (*Q. frainetto* \times *Q. polycarpa*)

x Q. Tufae Simk. (*Q. frainetto* \times *Q. petraea*)

x Q. Dacica Borb. (*Q. polycarpa* \times *Q. pubescens*)

x Q. Haynaldiana Simk. (*Q. frainetto* \times *Q. robur*)

x Q. Kernerii Simk. (*Q. pubescens* \times *Q. robur*)

x Q. budensis Borb. (*Q. pubescens* \times *Q. virgiliana*)

Likewise, some varieties of the these hybrids are mentioned in the Bejan Forest and namely: *Q. x dacica* var. *Tiszae* (Simk et Fekete), *x Q. Haynaldiana* var. *Heuffelii* Simk., *x Q. Kernerii* var. *devensis* (Simk.) (fig. 1).

Our investigations performed in 1988, 1989 and 1990 revealed also a series of new hybrids and varieties not recorded in the Bejan Forest. This fact was expected, having in view occurrence of no less than 8 of the 9 indigenous oak tree species, in an area covering 200 ha, and broad interfertilisation possibilities offered by the local phytogeographical and physicogeographical frame.

Thus, were identified:

x Q. rosacea Bechst. Sylvan (*Q. robur* \times *Q. petraea*);

x Q. rosacea var. *petraeiformis* Beldie;

x Q. rosacea var. *Feketei* (Simk.);

x Q. rosacea var. *Jahnii* (Simk.);

x Q. pseudodalechampii Cretz. (*Q. robur* \times *Q. dalechampii*);

x Q. pseudodalechampii var. *Cretzoui* (Pașcovich);

x Q. Csatoi Borb. (*Q. robur* \times *Q. polycarpa*);

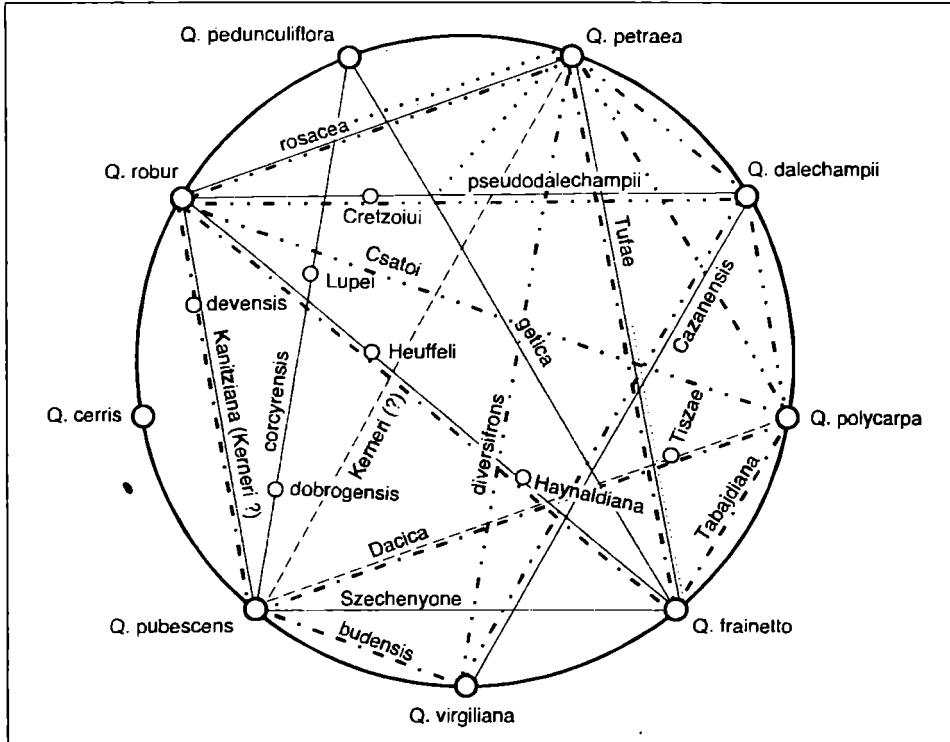


Fig. 1 - Diagram of *Quercus* genus hybrids (after C.C. Georgescu and I. Moraru) with data added from *Flora României* and our own investigations in the Bejan Forest)

LEGEND:

- Hybrids in flora of our country mentioned in „Monografia stejarilor din România”.
- - - - - Hybrids occurring in the Bejan Forest, after „Flora României”
- New hybrids in the Bejan Forest (already described in literature)
- New hybrids in the Romania's flora (for science?) identified in the Bejan Forest
- Multiple hybrid and introgressive hybrids identified in the Bejan Forest

x Q. diversifrons Borb. (*Q. petraea* \times *Q. virgiliana*);

x Q. cazanensis Paşcovschi (*Q. dalechampii* \times *Q. virgiliana*).

It is to mention that differences between these new hybrids have been established, in general, using the diagnosis criteria in *Flora României* and *Monografia stejarilor din România*. For hybrids between Sessiliflorae Series and *Q. virgiliana* diagnoses are original. For instance, in *Q. diversifrons* leaves are intermediate between the two parental forms, closer to *Q. petraea* (having not alternate characters); the shape of cupule scales also showing traits of *Q. petraea*, not only of *Q. virgiliana*, short peduncle (0,5 - 0,8 cms) no sessile cupules, etc. (table 1).

Comparative diagnoses of some of *Quercus* genus (after „Flora României” and the material originating from Bejan Forest)

Caracters regarding:					
Limb shape and lobation, mode	Shape of leaf base	Length of petiole	Leaf hairiness	Branches (hairiness, buds)	Cupes, achenes
0	1	2	3	4	5
1 x <i>Quercus cazanensis</i> Paşcovschi (<i>Q. dalechampii</i> x <i>Q. virgiliana</i>)					
a) After „Flora României”					
Most leaves as in <i>Q. virgiliana</i> , some as in <i>Q. dalechampii</i>			Leaves ± pubescent on lower face	Big buds as in <i>Q. virgiliana</i> Branches glabrous or glabrescent as in <i>Q. dalechampii</i>	Sessile acorns, with lower scales of cupes conglobate, large cups
b) After the material from Bejan Forest					
Leaves of intermediate shape (though closer to <i>Q. dalechampii</i>) Most leaves lobated as in <i>Q. dalechampii</i>	As in <i>Q. virgiliana</i>		Leaves ± pubescent on lower face	Pubescent branches	Scale shape and pubescence as in <i>Q. virgiliana</i> . Scale at de cupe base conglobate (as in <i>Q. dalechampii</i>).
2 x <i>Quercus diversifrons</i> Borb. (<i>Q. petraea</i> x <i>Q. virgiliana</i>)					
a) After „Flora României”					
Some leaves with shape as in <i>Q. virgiliana</i> (with nerves lateral basic conspicuously divergent), others on the same branch as in <i>Q. petraea</i> (evenly sinuate lobate).			Leaves pubescent on lower face, with fasciculated bristles, particularly on nerves, up to glabrescent	Large buds (as in <i>Q. virgiliana</i>). Branches glabrons (as in <i>Q. petraea</i>) up to slightly pubescent	Large cupes with prologed scales (similar to <i>Q. virgiliana</i>). Sessile acorns (similar to <i>Q. petraea</i>)
b) After the material from Bejan Forest					
Intermediate leaves between the two species, some somewhat closer to <i>Q. petraea</i> .	As in <i>Q. virgiliana</i>	10-20 mm	Lower face of leaves pubescent (as in <i>Q. virgiliana</i>)	Branches slightly hairy up to pubescent.	Cupes similar to <i>Q. virgiliana</i> ; scale shape also exhibits <i>Q. petraea</i> features. Peduncle short (5-8 mm).

Presence in a direct contact of typical oak forms (*Q. petraea*, *Q. dalechampii*, *Q. polycarpa*), their diagnosis reliability and incontestable morphological stability emerging from a pronounced reproductive isolation, lead to conclusion of their taxonomical value as true species and not subspecies or varieties was sometimes decribed.

In this sense plaids existence of hybrids between these species, identified and described through investigation in the Bejan Forest, as new units for the flora of our country (for science?).

Thus the following hybrids have been provisionally described:
***Q. petraea* x *Q. dalechampii*;**

Q. petraea x *Q. polycarpa*;

Q. dalechampii x *Q. polycarpa*.

Characters of these hybrids for leaves rank between the paternal genitors (leaf shape, lobation form etc.) or belong to one of them (coriacity and shininess), the same case being with fruits (cupes with partially flat and partially globular) (table 2).

We mention that for all these hybrids diagnoses are provisional, these having to be supplemented and confirmed by subsequent investigations on material derived from other trees.

A special place in the Bejan Forest is detained by hybrids resulted from repeated interfecondation (introgressive hybrids – backcross), and the double or multiple hybrids, this confirming the very remarkable hybridogenous potential of mixed populations of local oak trees.

From this series it is mention the hybrids between *Q. petraea* and *Q. rosacea*, between *Q. Tufae* and *Q. frainetto* (introgressive) and between *Q. petraea* and *Q. x pseudodalechampii* (multiple hybrid).

There is no doubt series of repeated hybrids and that of multiple in the Bejan Forest are broader, requiring further studies.

Nevertheless, we have to mention that in our field research and in the material available till present (leaves and fruits harvested by Mr. Augustin Staniciu from the Forest District Inspectorate Hunedoara), we tailed to tind the following hybrids cited in the Bejan Forest:

x Q. Tabajdiana Simk. (*Q. frainetto* x *Q. polycarpa*);

x Q. Haynaldiana Simk. (*Q. frainetto* x *Q. robur*);

x Q. Haynaldiana var. *Heuffellii* Simk.;

x Q. Kernerii Simk. (*Q. pubescens* x *Q. robur*);

x Q. Kernerii var. *devensis* (Simk);

x Q. dacicavar. Tiszae (Simk. et Fekete) (*Q. polycarpa* x *Q. pubescens*);

x Q. Szechenyana Borb. (*Q. frainetto* x *Q. pubescens*), cited by Al.

Săvulescu (unpublished).

An other problem risen by hybridization of oak trees in the Bejan Forest are combinations with genitors from the *Lanuginosae* series (*Q. pubescens* and *Q. virgiliana*), as far as these species possess a broad polymorphism, the intermediate forms *Q. pubescens* x *Q. virgiliana* being neither excluded, this introducing a shade of incertitude in diagnoses in the sphere of *Q. x dacica*, *Q. x Szechnyana*, *Q. x cazanensis*, *Q. x Kernerii* (*Q. pubescens* x *Q. petraea*), *Q. x Kanitziana*.

At the of this point we stress that for trees used to determine the hybridogenous origin these have been individualized by imprinting numbers and encircling, by Augustin Staniciu.

2. Genetic prospection of oak tree hybridogenous populations

From data collected in the field and from literature, we can conclude that between various indigenous oak tree species, except for *Q. cerris*, there

Table 2.

Provisional diagnoses for hybrids from *Sessilifore* series

Characters for:				
Shape of leaf limb and lobation pattern	Shape of leaf base	Leaf hairiness	Buds	Cupes, achenes
1. <i>Q. petraea</i> (Matt.) Libel x <i>Q. dalechampii</i> Ten.				
Leaves intermediate between the two species, often with <i>Q. petraea</i> lobation on the upper part and <i>Q. dalechampii</i> in the lower part.	As in <i>Q. dalechampii</i>	—	Large buds (as in <i>Q. dalechampii</i>)	Intermediate cupes with basal scales partially plane and partially conglobate.
2. <i>Q. petraea</i> (Matt.) Libel x <i>Q. polycarpa</i> Schur.				
Leaves intermediate in shape between the two species, however coriaceous and shining on upper face (as in <i>Q. polycarpa</i>).	Most leaves with base as in <i>Q. polycarpa</i>	Leaves glabrous or slightly pubescent on lower face, especially at nerves crossings (as in <i>Q. polycarpa</i>)	—	Cupes with walls ± thick and basal scales ± conglobate
2. <i>Q. dalechampii</i> Ten. x <i>Q. polycarpa</i> Schur.				
Leaves with characters intermediate between the two parental forms, some on them obviously lobate as in <i>Q. dalechampii</i> , however coriaceous and shining on upper face (as in <i>Q. polycarpa</i>)	—	—	—	—

is a full genetic compatibility for interhybridization. Therefore it is also expected to identify other hybrids out of those described in literature, or of those described by us.

In fact, we can speak in the case of oak trees of actual hybridization series, within which various forms can be distinguished, closer of one or other genitor, without the hybrid lose its discontinuital character.

The hybridization phenomenon in oak trees in the Bejan Forest is also complicated by certain possibilities of introgressive hybridizations and double or multiple hybridizations. It is the case already mentioned of the hybrid between *Q. x pseudodalechampii* and *Q. petraea*.

It should not result from the above facts that in the Bejan Forest would not exist limits for interfertilization. However, data show hybrids congregate around their genitors, thus true interfertilization circles can be distinguished, circumscribed by the reduced distances of moving of most pollen granules.

This problem of dimensions of interfertilization circles remains still opened, needing special investigations.

In this sense it would be important to determine the ecologic component in the process of natural selection of hybrids of various orders.

The study of hybridogenous populations in the Bejan Forest offered valuable data on establishing relations between genes in descendants, as

related to genitors, as well as in relation with nature of genetic control some characters.

Thus, by extrapolating relationships between allele genes from intraspecific hybrids to interspecific ones, in the case of oak trees the following types of relationships can be distinguished:

- *Dominance*, manifested by a typical character or nearly typical of one of the two genitors in descendants. It is the case with the shape of common oak leaf in the hybrid *Q. x rosacea*, with the base of oak leaf in the same hybrid, with the hairness of leaves and stems of most hybrids having *Q. pubescens* or *Q. virgiliana* as one parent, coriacity and shiness of the upper surface of limb in hybrids with *Q. polycarpa*, a.s.o.

- *Semidominance*, represented by intermediary characters between genitors, like in *Q. x rosacea* var. *Cretzoui*, *Q. x Csatoj*, with pedunculated short acorn, i.e. with intermediate character between sessiliflore and pedunculated oaks, the case of leaf shape in hybrids identified and described by us among common oak etc. Semidominance is also present in *x Q. dacica* and *Q. dacica* var. *Tizsae* as leaf and stem pubescence – up to disperse pubescent – though in other cases, as in was shown, pilosity remains a dominant character.

- *Codominance*, manifesting the characters of both genitors in the same organ, as in hybrids between common oak, with lobate leaves of *Q. petraea* in the upper part and *Q. dalechampii* in the lower one, or in the *x Q. cazanensis* hybrid with *Q. virgiliana* scales in the upper part of cup (flat, lanceolate) and *Q. dalechampii* scales (globular) in the lower part.

- *Alternate codominance*, revealing a relation between characters unrecorded as yet. This is apparition, rather frequent, in oak hybrids, of character of both genitors in the same organ but on different branches, as in the common oak and *Q. robur* case in *Q. x rosacea* var. *Jahnii*, in *Q. frainetto* and *Q. transylvanica* in *Q. x Tufae* etc.

As for the genetic control of characters one can consider, of course under the reserve of some special investigations, that it is independent for characters such as: leaf shape and lobation – on one hand, and shape and lobation of leaf versus glabrum character or pilosity of leaf surface, on the other hand. This would mean that control genes of these characters are located either at large distances on the same chromosome, i.e. devoid of possibilities of linkage or with reduced possibilities, or are located on different chromosomes.

Another situation is revealed by a series of characters tending to be transmitted in association, such as shape and lobation of leaf shape, lobation and lenght of petiole, coriacity and shiness of leaf pilosity and shape of scales

of cupes etc. These characters could be controlled by linkage or even by supergenes.

However, linkage or crossing over relations are hidden in hybrids by the relations between genes derived from both parents, so that in this direction use of some direct methods of investigation is required.

CONCLUSIONS

Oak hybridization in the Bejan Forest, almost devoid of genetical interspecific constraints, is a remarkable phenomenon, whose study remains open in multiple plans: taxonomical, ecological, physiological, and of course, from genetical standpoint.

The bioecological circumstances allowing interfecondation of oaks in the Bejan Forest constitute a problem per se, nevertheless on the account of frequency of local hybridizations, one can reach the conclusion that the hybrids are fertile at least partially.

– Besides the phytogeographical factor of species interference in the same site, in the case examined some essential circumstances of phenological order would have intervention, related to reduction of delays in starting vegetation, flowering, pollination and fertilization, whose attentive study can make the object of a separate investigation.

– Interfecondation of oak trees in the Bejan Forest cannot be, of course, recent, being possible that along the time hybrids of various orders would have appeared here, which partially did not survive, the natural selection preserving selectively the most balances heterozygotes.

– The hybridogenous populations in the Bejan Forest offer a possibility to establish some relationships between the allele genes from descendants (dominance, semidominance, codominance, alternate codominance). Nevertheless, on the other hand, the study of *Quercus* hybrids does not offer sufficient conclusive data on the linkage and crossing-over relationships, hidden in hybrids by the relationships between the allele genes derived from the two genitors.

The valuable germplasm fund existing in the Bejan Forest imposes establishing a special preservation and conservation regime of genofund and local ecosystems, as well as performing in an organized frame, of new investigations able to provide other data related to Knowledge local vegetation and biotopes.

HIBRIDII DE STEJARI DIN PĂDUREA BEJAN – DEVA. REACTUALIZARE ȘI PROSPECTIUNI GENETICE

REZUMAT

Articolul oferă date noi cu privire la hibridii genul lui *Quercus* din pădurea Bejan – Deva.

În cercetările efectuate în ecosistemele locale a reieșit că amploarea hibridizării a depășit limitele obișnuite, s-au identificat noi hibridi pentru Pădurea Bejan (*x Q. rosacea* Bechts. *Sylva*, *x Q. rosacea* var. *petraeiformis* Beldie, *x Q. rosacea* var. *Fekete* (Simk.), *x Q. rosacea* var. *Jahnii* (Simk.), *x Q. pseudodalechampii* Cretz., *x Q. pseudodalechampii* var. *Cretzoui* Pascovschi, *x Q. Csato* Borb., *x Q. diversifrons* Borb., *x Q. cazanensis* Pascovschi), hibridi introgresivi și multipli (*Q. x rosacea x Q. petraea*, *Q. Tufae x Q. frainetto* și *Q. x pseudodalechampii x Q. petraea*), ca și hibridi noi pentru flora României (pentru știință?). Între speciile seriei *Sessiliflorae* (*Q. petraea x Q. dalechampii*, *Q. petraea x Q. polycarpa* și *Q. dalechampii x Q. polycarpa*).

În plus, cercetările genetice ale hibridilor de stejari de Pădurea Bejan au permis identificarea unor rapoarte de segregare între genele allele (dominantă, semi dominantă, codominantă și un nou tip codominantă – „codominantă alternativă”), ca și între genele situate pe aceiași cromozomi.

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VICTOR STĂNESCU Universitatea Brașov
NICOLAE SOFLETEA Universitatea Brașov
AUGUSTIN STANCIU Romsilva S.A. – Deva