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Electrophoretic study of isozyme patterns in some wild populations of *Aubrieta columnae* Guss. (Cruciferae)

Giuliano Frizzi, Claudio Pantani, Antonella Bonfigli, Sabrina Colafarina, Patrizia Cesare, Osvaldo Zarivi, Michele Miranda*

Department of Life, Health & Environmental Sciences, University of L'Aquila, Via Vetoio, 67010 Coppito, L'Aquila, Italy

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ABSTRACT

Aubrieta columnae Guss. is currently divided into three subspecies: *A. columnae* subsp. *columnae*, *A. columnae* subsp. *italica*, both found as isolated and fragmented populations in rocky habitats of Central and Southern Apennines (Italy), and *A. columnae* subsp. *croatica* found in the Balkan region. In order to gain information about the degree of genetic variability and to clarify taxonomic relationships among these taxa, we studied the isozyme patterns at 8 marker loci of 376 individuals from 8 populations by means of starch gel electrophoresis. Data analysis by using Wright's F-statistics and UPGMA clustering method was performed. The results show: 1) a general deviation from Hardy–Weinberg equilibrium within each subspecies; 2) a lesser genetic variation in populations occurring in habitats characterized by milder climatic conditions and relatively small seasonal variations; 3) a relatively high degree of differentiation between the three subspecies; 4) the possible common transadriatic origin of *A. columnae* subsp. *italica* and *A. columnae* subsp. *croatica*; 5) the possible origin of *A. columnae* subsp. *columnae* from *A. columnae* subsp. *italica*; and 6) that the current taxonomic status of *A. columnae* may be substantially confirmed, even if the findings are from a limited number of loci explored.

1. Introduction

Aubrieta columnae Guss. is a perennial herb with hairy stems and leaves, with purple or violet flowers (Akeroyd and Ball, 1976). Plants of the genus *Aubrieta* are a common garden escape throughout Europe. Initially some Italian Authors (Bertoloni, 1833–1854; Cesati et al. 1884; Arcangeli, 1882) identified two species: *A. columnae* and *Aubrieta deltoidea* (L.) DC. The former was considered as a simple variety of *A. deltoidea* (Fiori and Paoletti, 1896–1909; Fiori, 1923–1929).

According to Mattfeld (1937) *A. columnae* may be at present subdivided into three subspecies: *A. columnae* subsp. *columnae*, *A. columnae* subsp. *italica* (Boiss) Mattf. and *A. columnae* subsp. *croatica* (Schott, Nyman, & Kotschy) Mattf. In Italy, the first one is found in higher rocky mountain habitats of the Central and Southern Apennines (Gran Sasso d'Italia, Maiella, Morrone, Sirente, Miletto, Pollino), and, at a lower altitude, also on the walls of old houses and castles in the Marsica region. The second one, *A. columnae* subsp. *italica*, is found in Monte S. Angelo (Gargano) and in a restricted area of the Basilicata region near, Madonna di Viggiano, as a small population that was incorrectly classified as *A. columnae* subsp. *italica* instead of *A. columnae* subsp. *columnae* by Pignatti (1982). The third one, *A. columnae* subsp. *croatica*, occurs in the Balkan region, near the coasts of Croatia and Albania, and in Romania (Akeroyd and Ball, 1976). The preferred habitats of these plants are calcareous rocks at an altitude between 800 m and 2300 m (Pignatti, 1982), which are generally fragmented and isolated.

* Corresponding author. Tel.: +39 862433264; fax: +39 862433273.
E-mail address: michele.miranda@univaq.it (M. Miranda).

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Morphological differences were seldom found also among populations belonging to the same subspecies, making problematic the identification.

The aim of the present work therefore is to get an insight into the current taxonomic status of *A. columnae*, by studying the effects of isolation and habitat characteristics on the genetic divergence and relationships among these populations. The experimental approach used here was the analysis of loci coding for enzymes by starch gel electrophoresis that is very useful for characterizing populations, because it is informative and technically simple and used also recently (Mitton, 1994; Sharma, 2001; Pastorino et al. 2004; Oostermeijer and De Knegt, 2004; Santos et al., 2011; Bakshi and Konnert,M. 2011). For each population eight enzymatic loci were investigated: *PGI-1* and *PGI-2* (phosfoglucose isomerase E.C. 5.3.1.9), *PGM-1* (phosphoglucomutase E.C. 2.5.7.1), *6PGDH-1* (6-phosphogluconate dehydrogenase E.C. 1.1.1.44), *MDH-2* and *MDH-3* (malate dehydrogenase E.C. 1.1.1.37), *GOT-1* (glutamate oxaloacetate transaminase E.C. 2.6.1.1) and *IDH-3* (isocitrate dehydrogenase E.C. 1.1.1.42), whose electrophoretic bands were clear and consistent. However, this work is preliminary to the investigation of a larger number of gene loci, by using DNA polymorphism (ITS, IGS, RAPD, RLFP, SNP); experiments are underwork in this direction.

2. Materials and methods

2.1. Plant material

As shown in Fig. 1, we studied: a) four populations of *A. columnae* subsp. *columnae*, 50 and 48 individuals from the gorges of Roio (ROI) (800 m) voucher AQUI 2011-55 and Celano (CEL) (700 m) voucher AQUI 2011-56 respectively, 60 and 50 individuals from the rocks of Ortucchio (ORT) (680 m) voucher AQUI 2011-57 and from the Santuario di Vallepietra (VAL) (800 m) voucher AQUI 2011-58 respectively; b) two populations of *A. columnae* subsp. *italica*, 56 and 50 individuals from the rocks of Monte S. Angelo (MSA) (800 m) AQUI 2011-59 on the Gargano headland, and near the Santuario di Madonna di Viggiano (VIG) (1700 m) AQUI 2011-60 respectively; and, c) two populations of *A. columnae* subsp. *croatica*, 40 and 56 individuals from Gračac (GRA) (500 m) AQUI 2011-61 near Velebit mountains and from Makarska (MAK) (at sea level) AQUI 2011-62 in

Fig. 1. Distribution of the sampled *Aubrieta* taxa: **1** Ortucchio (ORT); **2** Celano (CEL); **3** Roio (ROI); **4** Vallepietra (VAL); **5** Makarska (MAK); **6** Gračac (GRA); **7** Monte S. Angelo (MSA); **8** Madonna di Viggiano (VIG); **9** Monte Cucullo (MCU).