Advantages of being a monoecious juniper

José Carlos Muñoz-Reinoso

Plant Biology and Ecology Department, University of Seville, P.O. Box 1095, 41080-Sevilla, Spain, email reinoso@us.es

ABSTRACT

This study represents the first report of a monoecious individual of *Juniperus oxycedrus* var. *badia* (a dioecious species), and the reproductive advantages that monoecy appears to confer to that individual in a small population. On the other hand, viable seeds (according to the tetrazolium test) were found in a second isolated female *badia* juniper; that individual should be pollinated by individuals of *J. macrocarpa* because there are no con-specific males in its neighborhood, that is, hybridization may have taken place. Published on-line www.phytologia.org *Phytologia 100(4): 205-207 (Dec 21, 2018).* ISSN 030319430.
KEY WORDS: *Juniperus oxycedrus* var. *badia*, monoecy, seed viability, sex expression

---

Lability of sexual expression has been reported in monoecious and dioecious juniper species (Vasek, 1966; Jordano, 1991; Adams and Thornburg, 2011), as well as in other gymnosperms such as *Taxus* (Allison, 1991). As Adams reported from *J. virginiana*, (and in most all *Juniperus* species) a few monoecious individuals may be found among thousands of dioecious individuals (Adams and Thornburg, 2011). Individuals that change sex may have some reproductive advantages in a population as Freeman et al. (1984) suggested in *Atriplex canescens*, although it has been little studied.

J. oxycedrus var. *badia* is a dioecious, wind-pollinated, long-lived tree up to 15 m, with a pyramidal crown, pendulous terminal branches, triverticillate prickly leaves up to 2 mm broad, and fleshy cones (galbuli) bigger than 1 cm. It produces pollen-bearing cones between November and January, and fleshy cones ripe in October of the second year. In the Iberian Peninsula it shows a continental distribution pattern, with a tendency to colonise the inner regions (Cano et al., 2007). According to Flora Ibérica (Franco, 1986), *Juniperus oxycedrus* var. *badia* is a component of sclerophyllous continental dry woodlands, in an altitude between 200-800 (1000) m. However, a small population has been recently re-discovered in El Rompido (Cartaya) on the coast of Huelva (SW Spain) (Muñoz-Reinoso and Sánchez-Gullón, 2016). Most of the trees are located on a coastal paleocliff (14 trees), four are located on sandy soils at the foot of the cliff sharing the habitat with *J. macrocarpa*, and the last one grows on sandy dunes several kilometers away in the understory of a pine plantation and close to individuals of *J. macrocarpa*. In January 2017, during the flowering season, it was noticed that one of the trees growing on the paleocliff was monoecious (Fig. 1, plant URB013).

The purpose of the present study was to examine the reproductive advantages that monoecy may confer to that individual in this small set of coastal individuals of *J. oxycedrus* var. *badia*.

MATERIALS AND METHODS

In October 2015, 50 female cones were collected from the trees which bore mature cones (10 individuals) near El Rompido, Spain (Fig. 1). Seeds were extracted from each cone, counted and measured with a digital caliper (height, length, width) in order to estimate their volumes by approximation to an ellipsoid (n= 50 seeds). Seed viability was assessed through the cutting method (to determine the percentage of empty seeds) and later, seeds with an embryo were subjected to the tetrazolium test. Juniper height and distance to the closest male juniper were measured.

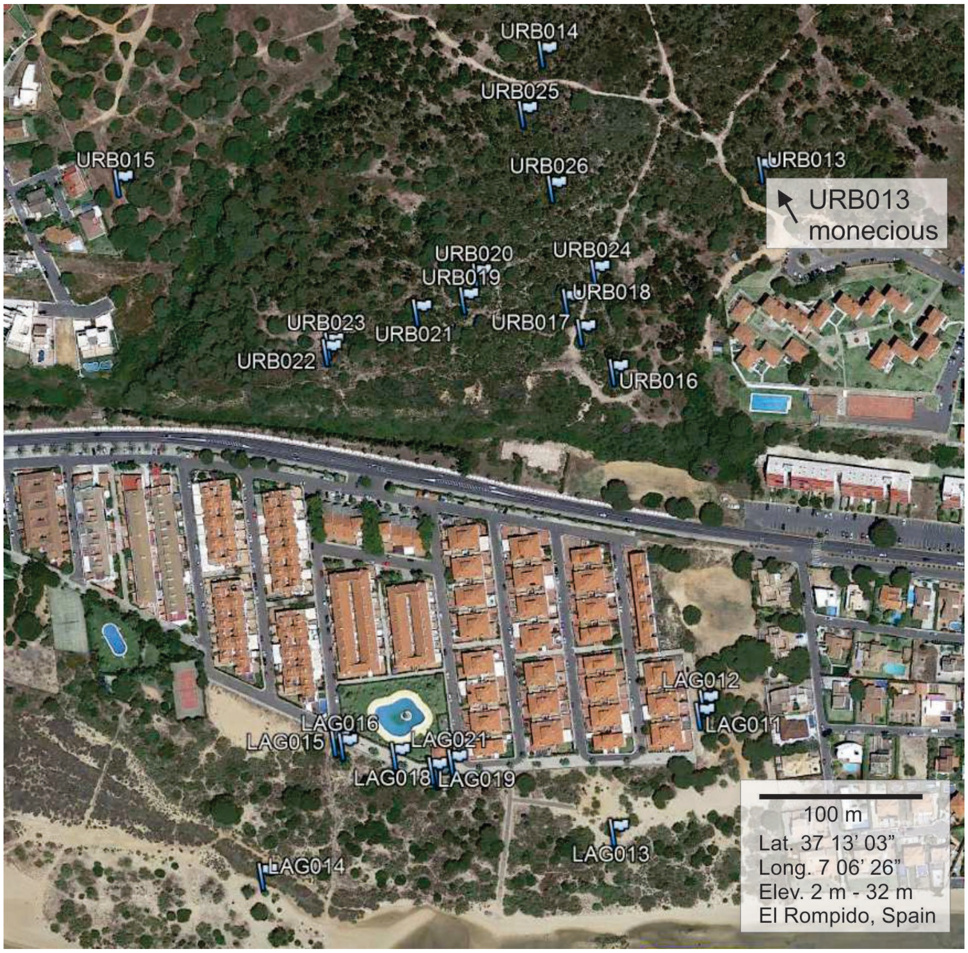

Figure 1. Map showing study area. Note locations of trees sampled. The monecious tree (URB013) is in the upper -right corner. Map modified from Google Earth as per universal agreement for scientific use only and no commercial use.

RESULTS AND DISCUSSION

Mean number of seeds/cone was 1.95+0.15 (mean+s.e.). Except for the monoecious tree (Fig. 1, plant URB013), all junipers growing on the cliff had less than two seeds/cone (mean distance to a con-specific male 72.4+19.8 m), while the three others had among 2.2 and 2.5 seeds/cone. Mean volume of seeds was 72.0+4.5 mm^3, showing the junipers on sandy soils the lowest sizes (42.1-67.3 mm^3) and the junipers on the cliff the highest (69.0-93.7 mm^3). Mean percentage of filled seeds was 50.7+5.7%, while the percentage of aborted embryos was 30.7+2.9%, and the percentage of empty seeds 18.7+4.7%. Finally, the percentage of viable seeds was 26.3+4.1%.

Two things should be highlighted. First, in the monoecious tree (Fig. 1, plant URB013) the proportion of male structures was clearly higher than the proportion of female ones. Monoecy seems to confer to this individual the highest number of seeds/cone (2.78+0.12), the lowest proportion of aborted embryos (16.7%), a very low proportion of empty seeds (6.7%), and the highest seed viability (50.0%) in spite of being to a distance of 120m from a con-specific male.

Secondly, one of the individuals bearing fleshy cones should be pollinated by individuals of *J. macrocarpa* because there are no con-specific males in its neighborhood, that is, hybridization may have taken place, and a high proportion of viable seeds (totally stained) have been produced (33.3%). Hybridization in junipers has been reported by Adams and Wingate (2008) and Adams (2015).

In spite of a lack of germination tests, these preliminary results show advantages that monoecious junipers may have, and the possibility for hybridization between close junipers (Adams, 2000).

ACKNOWLEDGEMENTS

This research was self-financed. I thank Dr P. Jordano for his comments and Dr. R. P. Adams for their suggestions on a previous version of the manuscript.

LITERATURE CITED

Adams, R.P. 2000. Systematics of *Juniperus* section *Juniperus* based on leaf essential oils and random amplified polymorphic DNAs (RAPDs). Biochem. Syst. Ecol.28: 515–528.

Adams, R.P. 2015. Allopatric hybridization and introgression between *Juniperus maritime* R.P.Adams and *Juniperus scopulorum* Sarg.: Evidence from nuclear cpDNA and leaf terpenoids. Phytologia 97: 55-66.

Adams, R.P. and D. Wingate. 2008. Hybridization between *Juniperus bermudiana* and *J. virginiana* in Bermuda. Phytologia 90: 123-133.

Adams, R.P. and D. Thornburg. 2011. Sexual change in *Juniperus arizonica*: facultative monecious? Phytologia 93: 43-50.

Allison, T.D. 1991. Variation in sex expression in Canada yew (*Taxus canadensis*). Am. J. Bot. 78: 569-578.

Cano, E., A. Rodríguez-Torres, C. Pinto Gomes, A. García-Fuentest, J.A. Torres, C. Salazar, L. Ruíz-Valenzuela, A. Cano-Ortíz and R. J. Montilla. 2007. Analysis of the *Juniperus oxycedrus* L. communities in the centre and south of the Iberian Peninsula (Spain and Portugal). Acta Bot. Gallica 154: 79-99.

Franco, J.A. 1986. *Juniperus* L. *In*: Flora Ibérica I, S.Castroviejo, M. Laínz, G. López González, P. Montserrat, F. Muñoz Garmendia, J. Paiva and L. Villar,eds., C.S.I.C., Madrid.

Freeman, D.C., E.D. McArthur and K.T. Harper. 1984. The adaptative significance of sexual lability in plants using *Atriplex canescens* as a principal example. Ann. Missouri Bot. Gard. 71: 265-277.

Jordano, P. 1991. Gender variation and expression of monoecy in *Juniperus phoenicea* L. (Cupressaceae). Bot. Gaz. 152: 476-485.

Muñoz-Reinoso, J.C. and E. Sánchez-Gullón. 2016. *Juniperus oxycedrus* var. *badia* novedad para el litoral de Huelva (España). Acta Bot. Malacitana 41: 291-294.

Vasek, F. C. 1966. The distribution and taxonomy of three western junipers. Brittonia 18: 350-372.