

Short Communication

**Preliminary studies on the reproductive biology of  
*Enterolobium contortisiliquum***

**Patricia Susana Hoc<sup>1\*</sup>, Carolina Flores<sup>2</sup>, Evangelina Lozano<sup>2</sup> and Alicia Zapater<sup>2</sup>**

<sup>1</sup>PROPLAME-PHRIDEP. CONICET, FACULTAD DE Ciencias Exactas y Naturales, U.B.A.  
Argentina

<sup>2</sup>Facultad de Ciencias Naturales, Universidad Nacional de Salta, Argentina

\*Corresponding author email : [patriciahoc@gmail.com](mailto:patriciahoc@gmail.com),

At present ten neotropical species of *Enterolobium* are known from Central to South America. Of them, only some aspects of the reproductive biology of *E. cyclocarpum*, a Mesoamerican species, are known at present. In Argentina grow *Enterolobium contortisiliquum* (Vell.) Morong. Its reproductive biology is still unknown, in order to elucidate this, morphologic studies on the flowers of several populations were analyzed. The flowers are disposed in pyramidal double racemes of heads. When anthesis occur two kind of flowers can be distinguished: 1) Perfect flowers with the anthers open exposing the polyads (till four in each theca), stigma receptive, ovary with ovules, an annular and a prominent nectary at the base of the staminal tube. 2) Staminate flowers with the anthers open exposing the polyads (till four in each theca), an annular nectary at the base of the staminal tube less prominent than in the perfect ones. The pollen is produced in pseudoacalymated polyads. The description of the species is here amended because of the two morphs that have been found. The specific description is modified. Two floral morphs can be recognized: perfect flowers (donor and receptor of pollen) and staminate flowers (donor of pollen). When the staminate flowers are present, constitutes in average the 14.57 % of the head (range 0-100%, n = 858). In consequence, not all the flowers can produce fruits, so the whole inflorescence, a double raceme of heads, act as a long - distance attraction unit to pollinators.

**Key words:** Andromonoecy, *Enterolobium*, floral morphs, Leguminosae, palynology.

The genus was founded by Martius in 1837. Bentham (1875) pointed out that *Enterolobium* only differs from *Pithecellobium* because its fruit is drupaceous and indehiscent, inferring that *Enterolobium* should be a Section of *Pithecellobium*. Nielsen (1981) included the genus in *Albizia* in the base of the anatomical, carpological and palynological characters. Barneby & Grimes (1996) recognized the generic status of

*Enterolobium* distributing the 10 species known at present in two Sections: *Enterolobium* and *Robrichia*, taking into account the foliar and floral characters. In this study the authors follow to Barneby & Grimes (1996). In Argentina only grow *E. contortisiliquum*. During the taxonomic and morphologic studies of the species (Hoc, 1987, 2005) it could be registered staminate flowers among the perfect ones described.

Some authors studied the morphology and the ultrastructure of the pollen in many *Ingeae* (Guinet, 1969; Niezgodá *et al.*, 1983), other studied the phenology and the pollen donor pool in *E. cyclocarpum* (Smouse *et al.*, 2013) and the dispersal and production of its seeds (Dorset and Trapnell, 2013). Although the wood of *E. contortisiliquum* has a high potential to produce furniture and constructions (Tortorelli, 1956), and the native races of Argentina widely use the wood and the fruits, its reproductive biology is still unknown in order to design afforestations. In order to know if the andromonoecy exist, as a previous analysis to the study of the reproductive biology of *E. contortisiliquum*, this study was carried out. A new and wide description of the species is provided considering the variability of the flowers.

#### Materials and Methods

The following material was studied: Argentina. Prov. Jujuy: Dpto. Ledesma, Ledesma, Pastrana 9212 (LIL); Dpto. General Belgrano, Cabrera *et al.* 31982 (SI); Dpto. San Pedro, Cabrera *et al.* 31026 (SI); Dpto. El Carmen, Cabrera *et al.* 21143 (LP, CTES). Prov. Salta: Dpto. Gral. J. de San Martín, Schreiter 3398 (LIL); Dpto. Gral. Güemes, Zapater *et al.* 3086e (MCNS); Dpto. Metán, Zapater *et al.* 3086c (MCNS); Dpto. Orán, Lorentz *et al.* Hieronymus 416 (CORD, SI, BAF). Prov. Tucumán: Dpto. Leales, Venturi 582 (SI, BA); Dpto. Trancas: Vipos, Zapater *et al.* 3090 (MCNS). Prov. Formosa: Dpto. Pirané, Rojas 12140 (LIL). Prov. Entre Ríos: Dpto. Concordia, Concordia, Troncoso *et al.* 2518 (SI).

All the terminology employed in the citation follows to Holmgren *et al.* (1990).

The dried specimens were hydrated in water and heated till boil begun, then was preserved in alcohol 70%. Part of the studied material was previously fixed in FAA (formaldehyde, alcohol, acetic acid, water) in

the laboratory was transferred to alcohol 70%. All the observations were made using a stereomicroscope (SM) Nikon SMZ-U.

The pollen was acetolysed following to Erdtman (1952). For the observations with optic microscope (OM) the pollen then was mounted in glasses with jelly - glycerin mix.

The dehiscence of the anthers was directly observed, the stigma receptivity was measured following Dafni (1992).

#### Results

##### *Enterolobium contortisiliquum* (Vell.) Mart.

Unarmed deciduous trees up to 30m tall. With simpodial grow. Stipules not persistent with glandular trichomes in its abaxial face. Leaves with 2 - 7- pairs of pinnae: pinnae with 5 - 21 leaflets, each one 0.4 - 2 cm long. X 0.15 - 0.5 cm lat., cultriform to asymmetrically cultriform, dark green in the adaxial face, glaucous in the abaxial face. Pyramidal and tomentous racemes of heads, the inferior half of the rachis with two or more heads in each node, with one head by node at the distal half; tomentose and deciduous bracts, the tectriz bracts of each head pinnate or lanceolate. Flowers perfect or imperfect and staminate. Calyx 2 - 4 mm long, tube pubescent to tomentose, with 4-6 sericeous teeth; corolla 4.5 - 8 mm long, with 4 - 7 teeth pubescent to sericeous, with glandular trichomes at their apex; androecium 10- 15 mm long., tube exerted or not, with a nectary at the base 0.7 - 0.8 mm long.; gynoecium with an ovary 1.3 - 2.2 mm long., oblong to reniform in shape, stigma patelliform. In the staminate flowers the nectary is 0.5 mm long, and a pistillode is present. Drupaceous loment 4.4 - 7.5 cm diameter X 2.4 - 4.2 cm lat., curvate and rolled 360°, woody epicarp resinous mesocarp, seeds biseriate. Figure 1, Table 1.

Pollen in polyads pseudoacalymated (existence of bridges of exine between monads), formed by 24-32 monads, 91-118 µm long. X 89-105 µm wide. X 48-72 µm thick.

Monads heteropolar, cubic, prismatic or truncate-pyramidal, in polar view rectangular, pentagonal or rhomboidal, in equatorial view rectangular or convex-pyramidal; pores, 4-8, 3.5-5.5  $\mu\text{m}$  in diameter, with annulus, disposed at the vertices of the proximal face and in the vertices of the equator, in sub-distal position, aperture membrane granulate; exine tectate in the distal face, tectum rugulate to fosulate in the central monads, fosulate or smooth in the peripheric ones. Figure 2.

### Floral morphology in relation with the function

During the development of the anthesis in each head it can be observed:

1. Stage 1. Buds with androecium and gynoecium not exposed, anthers not dehiscent, stigmas not receptive.

2. Stage 2. Open flowers:

2. a. Perfect flowers with the anthers open exposing the polyads (till four in each theca), stigma receptive, ovary with ovules, a prominent nectary at the base of the staminal tube and the gynoecium.

2. b. Staminate flowers with the anthers open exposing the polyads (till four in each theca), a nectary at the base of the staminal tube less prominent than in the perfect ones, often with a functionless gynoecium (pistillode).

In consequence two floral morphs can be recognized: perfect flowers (donor and receptor of pollen) and staminate flowers (donor of pollen). When the staminate flowers are present, constitutes in average the 14.57 % (range 0% - 100%) of each head (Table 2). The t test indicates that the differences are highly significant:  $t = 11.57$  ( $p = 95\%$ ).

Table 1. Measures of floral pieces

	Average length (mm)	Sample size
Calyx	2.7	20
Corolla	5.8	20
Androecium	11.6	17
Gynoecium (ovary)	1.8	20

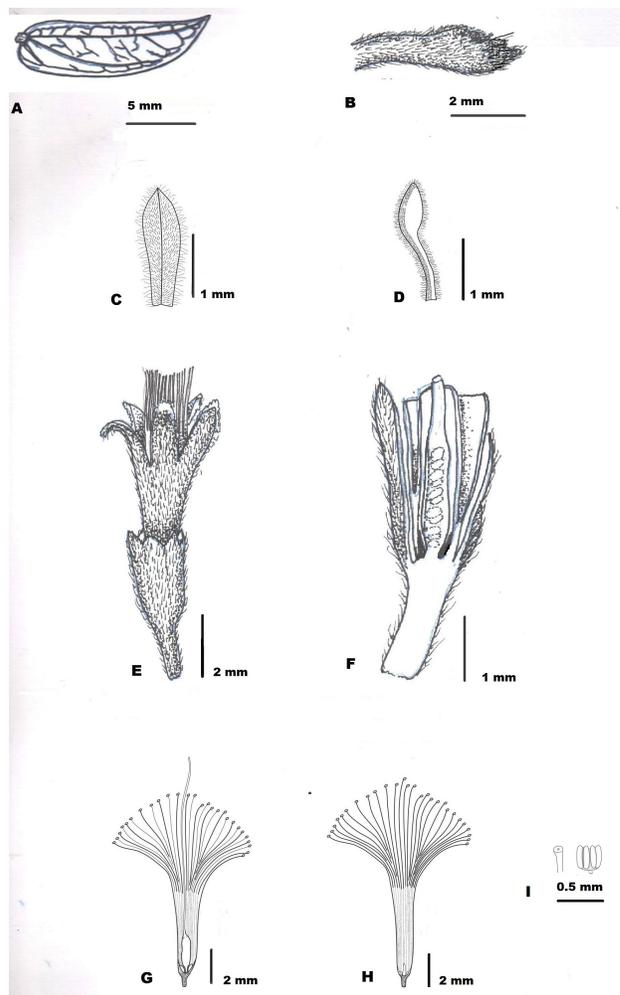


Figure 1. Flowers morphology. A, detail of a leaflet; B, basal tectrizbract; C, D, tectribract of the head; E, perfect flower; F, longitudinal section of a perfect flower; G, longitudinal section of a perfect flower, showing the nectary and the length of style and stamens; H, longitudinal section of a staminate flower showing the nectary and the pistillode. Drawings of the materials Venturi 582 (A); Rojas 12140 (B, C, D, E); Cabrera et al. 31026 (F); Zapater 3086c (G, H).

### Discussion and Conclusion

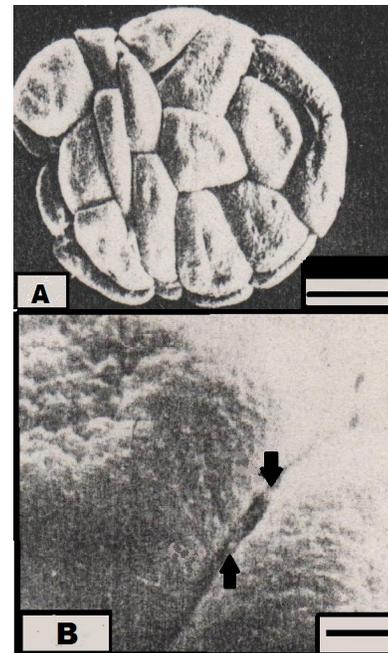
Among the authors that studied the taxonomy of the genus, only Barneby & Grimes (1996) superficially mention the existence of perfect and imperfect flowers.

Hoc (2005) briefly states that andromonoecy exist. In this work the andromonoecy is proved, because the staminate flowers, when are present, constitute the 0-100 % (average = 14.56%) of each head, in consequence, not all the flowers fructify.

**Table 2. Number of floral morphs in each head**

Sl No.	No. of Total flowers	No. of perfect flowers	No. of staminate flowers	Percentage of staminate flowers
1	12	0	12	100
2	23	23	0	0
3	24	24	0	0
4	22	22	0	0
5	21	21	0	0
6	13	13	0	0
7	20	1	19	95.00
8	20	20	0	0
9	28	14	14	50.00
10	24	14	10	41.66
11	16	8	8	50
12	17	17	0	0
13	9	8	1	11.1
14	34	9	25	73.50
15	15	15	0	0
16	21	21	0	0
17	9	9	0	0
18	12	12	0	0
19	9	9	0	0
20	15	15	0	0
21	7	7	0	0
22	18	15	0	0
23	18	17	0	0
24	11	11	0	0
25	11	11	0	0
26	18	18	0	0
27	15	15	0	0
28	16	16	0	0
29	17	17	0	0
30	10	10	0	0
31	9	9	0	0
32	19	19	0	0
33	14	1	13	92.8
34	13	11	2	15.38
35	12	12	0	0
36	15	15	0	0
37	16	16	0	0
38	5	4	1	20.00
39	13	13	0	0
40	14	14	0	0
41	16	16	0	0
42	27	26	1	3.7

43	23	23	0	0
44	10	10	0	0
45	25	25	0	0
46	15	13	2	13.33
47	15	15	0	0
48	25	25	0	0
49	8	8	0	0
50	20	20	0	0
51	39	22	17	43.58
52	858	729	125	14.56



**Figure 2. Pollen morphology.** A. polyad; B. tectum of a central monad, the arrows points the bridges of exine. (Troncoso et al. 1956).

Perhaps the whole inflorescence should function as a long distance unit of attraction to pollinators (Faegri and Van der Pijl, 1971), as medium sized bees. It can be inferred that the species is self-compatible because the trees that grow isolated from the con-specific ones produce fruits. With the exception of *Calliandra*, the majority of the genus in the tribe *Ingeae*, to which *Enterolobium* species belong, have acalymated polyads (Guinet, 1969; Hoc, 1987), so during the translation to the stigmas the monads of each polyad are dispersed and

the arrival to the con-specific stigmas is not ensured, the existence of exine bridges between monads brings coherence to the polyads and ensures a more effective transfer. The description of the species is here amended because of the two morphs that have been found.

### Acknowledgements

This work was financed with the grant CIUNSA N° 2099 from Universidad Nacional de Salta. P. S. Hoc and A. Zapater are Professors, respectively, of the Faculty of Exact and Natural Sciences, University of Buenos Aires and the Faculty of Natural Sciences, University of Salta; P. S. Hoc is researcher of the CONICET; E. Lozano and C. Flores are teachers of the Faculty of Natural Sciences, University of Salta.

### References

- Bentham, G (1875). Revision of the Suborder Mimoseae. *Trans. Linn. Soc. London*. 30: 537 - 650.
- Barneby R C, Grimes, J W (1996). Silk Tree, Guanacaste, Monkey's Earring. A generic System for the Synandrous Mimosaceae of the Americas. Part I, *Abarema*, *Albizia* and Allies. *Mem. New York Bot. Gard.* 74 (1): 1 - 292.
- Dafni, A (1992). Pollination ecology. A practical approach. Oxford University, Oxford.
- Dorset, W, Trapnell, D (2013). Long-term patterns of fruit production of *Enterolobium cyclocarpum* among years and landscapes. 50<sup>th</sup> Anniversary Meeting Association for Tropical Biology and Conservation & Organization for Tropical Studies. San José de Costa Rica, Costa Rica.
- Erdtman, G (1952). Pollen morphology and plant taxonomy. Angiosperms. Almqvist & Wicksell, Stockholm.
- Faegri, K, Van der Pijl, L (1971). The Principles of Pollination Ecology. 2<sup>nd</sup> ed. Pergamon Press, Oxford.
- Guinet, Ph (1969). Les Mimosacees. Etude de Palynologie fondamentale. Correlations, evolution. *Trav. Sect. Scient. Et Techn. Inst. Francais Pondichery*: 9: 1 - 293; 20 l.
- Hoc, P S (1987). Tribu Ingeae en la Argentina, estudio taxonómico y palinológico. 237 p., 46 f., 5 t. Tesis Doctoral. Universidad de Buenos Aires.
- Hoc, P S (2005). Flora Fanerogámica Argentina. 128. Fabaceae, parte 14. Subfam. Mimosoideae, parte 5. Tribu VIII. *Ingeae*. Programa PROFLORA.CONICET. Fasc. 93: 1-25.
- Holmgren, P K, Holmgren, NH, Barnett, L C (1990). Index Herbariorum. Part I: The Herbaria of the world. 8° ed. *Regnum Veg.* 120: 1 - 693.
- Nielsen, I (1981). *Tribe Ingeae*. In R. M. Polhill & P. H. Raven (eds.), *Advances in Legume Systematics* 1: 173 - 190. Bot. Garden. Kew; Crown Co., England.
- Niezwoda, C J, Feuer, S M, Nevling, L I (1983). Pollen ultrastructure of the tribe Ingeae (Mimosoideae: Leguminosae). *Amer. J. Bot.* 70 (5) : 650 - 670.
- Smouse, P E, Gonzales E B, Robledo-Arnuncio, J J (2013). Comparative analyses of the pollen donor pool of *Enterolobium cyclocarpum* among years and landscapes. 50<sup>th</sup> Anniversary Meeting Association for Tropical Biology and Conservation & Organization for Tropical Studies. San José de Costa Rica, Costa Rica.
- Tortorelli, L A (1956). Maderas y Bosques Argentinos. Acme, Buenos Aires.