Aliso: A Journal of Systematic and Evolutionary Botany

Volume 11 | Issue 1 Article 9

1985

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ALISO
11(1), 1985, pp. 115–119

ANTHOCYANINS OF BIGNONIACEAE. II. ADDITIONAL DATA AND CLADISTIC ANALYSIS

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ABSTRACT

Floral anthocyanins for 13 species of Bignoniaceae are reported, including the first report of the occurrence of acylated anthocyanins in this family. No additional occurrences of 3-desoxyanthocyanins were detected. The Hennigian cladogram based on floral pigments agrees poorly with phylogenetic affinities postulated on the basis of more general taxonomic characters.

Key words: Anthocyanins, Bignoniaceae, acylated anthocynanins, 3-desoxyanthocyanins, cladistic analysis.

INTRODUCTION

Scogin (1980) reported the results of a survey of floral anthocyanins among Bignoniaceae. The present report extends the survey base of Bignoniaceae floral anthocyanins, applies a cladistic analysis to that data set, and presents caveats regarding the application of cladistic analysis to limited floral-pigment data sets.

MATERIALS AND METHODS

Fresh floral materials were collected from specimens cultivated at the Los Angeles State and County Arboretum, Arcadia, California. Additional preserved, field-collected materials were provided and identified by Dr. A. Gentry of the Missouri Botanic Garden.

Anthocyanins were identified as described by Scogin (1980). Acylated anthocyanins were characterized using the methods of Scogin (1977).

Cladogram construction was performed using methods described by Richardson and Young (1982).

RESULTS AND DISCUSSION

Floral anthocyanins identified in the present study are shown in Table 1.

Occurrence of 3-Desoxyanthocyanins

The occurrence of the 3-desoxyanthocyanin pigment, carajurin, as a floral pigment in *Arrabidaea chica* (H. & B.) Varlot was confirmed earlier by Scogin, but carajurin was not detected in flowers of *A. brachypoda* Bur. (Scogin 1980). Four additional species of *Arrabidaea* were examined in the present survey (see Table 1) and carajurin could not be detected in any of them. Although these six *Arrabidaea* species constitute an inadequate sample of the 75 species of the genus, the present results support the earlier conclusion of Scogin (1980) that carajurin may occur uniquely in *A. chica,* a conclusion that would accord with the ethnobotanical use of only this species within the genus as a body paint by aboriginal groups (Gentry 1980).

Table 1. Floral anthocyanins of Bignoniaceae.

Tribe and species	Corolla pigments	
	Major	Minor or trace (tr)
Bignonieae		
Arrabidaea candicans (L. Rich) A. DC.		Cy 3-glu (tr)
A. mollissima (HBK.) Bur. & K. Schum.		Cy 3-glu
A. podopogon (DC.) A. Gentry		Cy 3-glu, Cy 3-rut
A. verrucosa (Standl.) A. Gentry		Cy 3-rut, Cy 3-glu (tr)
Clytostoma callistegioides Bur. & Schum.	Perillanin	Cy 3,5-diglu
Mansoa verrucifera (Schlecht.) A. Gentry	Perillanin, Cy 3,5-diglu	
M. alliaceum (Lam.) A. Gentry	Cy 3-rut	
Melloa quadrivalvis (Jacq.) A. Gentry	None detectable	
Paragonia pyramidata Bur.	Cy 3-rut	Cy 3-glu (tr)
Tecomeae		
Incarvillea delavayi Bur. & Franch.	Cy 3-rut	
I. olgae Regel	Cy 3-rut	Cy 3-glu (tr)
Podranea ricasoliana (Tanfani) Sprague	Cy 3-rut	
Eccremocarpeae		
Eccremocarpus scaber A. DC.	Cy 3-rut (Harborne 1967)	

Cy = cyanidin; glu = glucoside; rut = rutinoside.

Occurrence of Acylated Anthocyanins

Acylated anthocyanins were undetected in the previous survey of Bignoniaceae floral pigments (Scogin 1980). In the present survey perillanin [cyanidin 3-(p-coumaryl-glucoside)-5-glucoside] was identified from two genera of the tribe Bignonieae. This is the first report of the occurrence of acylated anthocyanins in

Table 2. Character states of anthocyanin features of Bignoniaceae.

Character	Character state	
	Primitive	Advanced (derived)
1. Cyanidin (only) occurrence	present	absent
2. Delphinidin occurrence	absent	present
3. Pelargonidin occurrence	absent	present
4. Sugar other than simple glucose	absent	present
5. 5-0 glucosylation	absent	present
6. Acylation	absent	present
7. 3-desoxyanthocyanins	absent	present
8. 0-methylation	absent	present

Table 3. Data matrix of occurrence of advanced anthocyanin features among the tribes of Bignoniaceae.

Taxon	Character number*							
	1	2	3	4	5	6	7	8
Bignonieae	+	−	+	+	+	+	+	−
Tecomeae	+	+	+	+	+	−	−	+
Coleeae	−	−	−	+	−	−	−	−
Crescentieae	−	−	−	+	−	−	−	−
Eccremocarpeae	−	−	−	+	−	−	−	−

* See Table 2; + = present, − = absent.

Bignoniaceae and their occurrence increases the phytochemical similarity between Bignoniaceae and closely related Scrophulariaceae, from which acylated anthocyanins have also been reported (Timberlake and Bridle 1975).

Occurrence of 5-Glucosylation

Glucosylation at the 5 position is uncommon among Bignoniaceae. It has previously been found only in *Jacaranda* (delphinidin 3,5-diglucoside) and a horticultural hybrid of *Distictis* (cyanidin 3,5-diglucoside). During the present survey, *Clytostoma callistegiodes* and *Mansoa verrucifera* were found to share an anthocyanin constitution consisting of cyanidin 3,5-diglucoside and its acylated form, perillanin. The shared occurrence of these uncommon (among Bignoniaceae) pigments suggests a possible close alliance between these two genera. Interestingly,

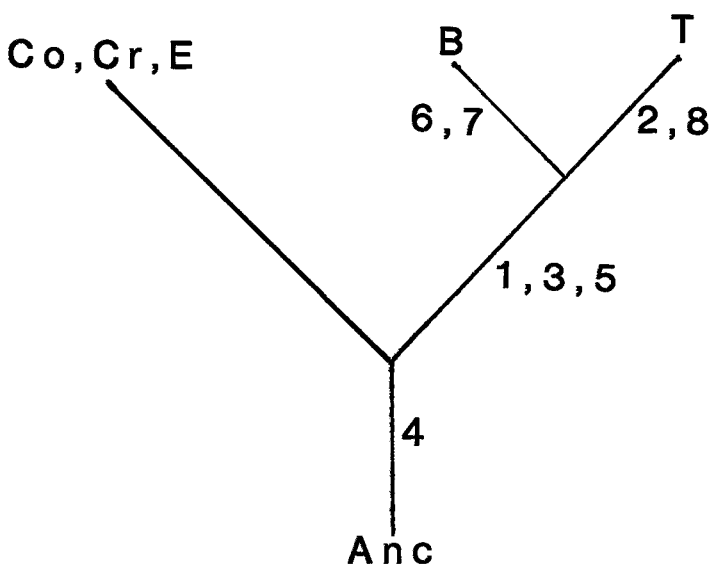

Fig. 1. Cladogram showing relationships among tribes of Bignoniaceae based on floral anthocyanin features. Numerals indicate lineage position where advanced character state first occurs. Key: Co = Coleeae, Cr = Crescentieae, E = Eccremocarpeae, T = Tecomeae, B = Bignonieae, Anc = Ancestral stock.

Mansoa verrucifera also exhibits an unusual, spiny fruit similar to that of *Clytostoma* (A. Gentry, pers. comm.).

Cladistic Analysis

Phytochemists have recently been urged to perform a cladistic analysis on data sets (even though limited in extent) and to present the results as a Hennigian cladogram in order to extract the maximum amount of phylogenetic information present (Richardson 1982). I have performed such an analysis on the floral anthocyanin data set for 52 species of Bignoniaceae by examining the distribution of eight pigment characters at the tribal level. In the absence of a suitable outgroup for character polarity assignment, the generally accepted postulates as to primitive and derived states for flavonoid features were used (Harborne 1977) as indicated in Table 2. The data matrix upon which the cladogram was constructed is shown in Table 3 and is based upon the present results and those presented by Scogin (1980). Among the characters analyzed, a question remains regarding the occurrence of 0-methylation among Bignoniaceae. Peonidin 3-rutinoside was reported by Pomilio and Sproviero (1971) from the flowers of *Tabebuia ipe* (Mart.) Standl. and *T. avellanedae* (Lorentz) Griesb. Scogin (1980) was unable to detect the presence of peonidin glycosides in these species or in additional species of this genus. The cladogram presented in Fig. 1 is unaltered with the inclusion or omission of this character (indicated as #8).

The cladogram in Fig. 1 contrasts strikingly with the phylogenetic affinities suggested for Bignoniaceae by Gentry (1980) in a partial monograph of the family which was based on numerous taxonomic characters. Gentry suggests an isolated position for the tribe Eccremocarpeae within Bignoniaceae. He further notes that the similarity between Crescentieae and Coleeae represents convergence rather than common origin and that these tribes evolved from different Tecomeae stocks. The phylogenetic results based on a cladistic analysis of floral pigments are clearly not congruent with Gentry's broadly based evolutionary conclusions. The phytochemical analysis is the weaker due to its inadequate number of characters, their restricted nature, and the limited taxonomic sample. Floral pigments are probably an especially poor choice as taxonomic characters for cladistic analysis because of strong selection upon them as pollinator attractants (Harborne and Smith 1978). A phytochemically based cladogram which included additional classes of floral or foliar flavonoids might have greater credibility. Selective pressures affecting other classes of flavonoid compounds are poorly understood at present, but are probably weaker than pressures acting on floral anthocyanins. Clearly, great caution must be exercised in applying cladistic analysis (or any other taxonomic interpretation) to a limited data set consisting solely of phytochemical characters, especially floral pigments.

ACKNOWLEDGMENTS

I am grateful to Dr. A. Gentry for providing floral material and identifications for some taxa used in this study.

LITERATURE CITED

Gentry, A. 1980. Bignoniaceae—Part I. Flora Neotropica, Monograph 25. New York Botanic Garden, New York. 130 p.

Harborne, J. B. 1967. Comparative biochemistry of the flavonoids. Academic Press, New York. 383 p.
———. 1977. Flavonoids and the evolution of angiosperms. Biochem. Syst. Ecol. 5:7–22.
———, and D. M. Smith. 1978. Correlations between anthocyanin chemistry and pollinator ecology in the Polemoniaceae. Biochem. Syst. Ecol. 6:127–130.
Pomilio, A. B., and J. F. Sproviero. 1971. Anthocyanins from Argentine *Tabebuia* species. Phytochemistry 10:1399–1400.
Richardson, P. M. 1982. Anthocyanins of the Sterculiaceae: Flavonoid scores and Hennigian phylogenetic systematics. Biochem. Syst. Ecol. 10:197–199.
———, and D. A. Young. 1982. The phylogenetic content of flavonoid point scores. Biochem. Syst. Ecol. 10:251–255.
Scogin, R. 1977. Anthocyanins of the Fouquieriaceae. Biochem. Syst. Ecol. 5:265–267.
———. 1980. Anthocyanins of the Bignoniaceae. Biochem. Syst. Ecol. 8:273–276.
Timberlake, C. F., and P. Bridle. 1975. The anthocyanins, pp. 214–266. *In* J. B. Harborne, T. J. Mabry, and H. Mabry [eds.], The flavonoids. Academic Press, New York.