

Cordia alliodora with Theobroma cacao: a traditional  
agro-forestry combination in the humid tropics

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Introduction

The combination of Cordia alliodora with Theobroma cacao is a traditional agro-forestry practice that is common on the Atlantic coast of Costa Rica and Pacific coast of Colombia. One of the reasons for the wide-spread adoption of the system is that the growth of this timber tree species is probably at its maximum in the well drained, cultivated T. cacao plantations which are situated on the continuously humid coastal plains (altitudes 0-300m). However, many farmers claim that C. alliodora is not the best shade tree species, from the point of view of cacao production because its root system competes strongly with the underlying crop. They prefer C. alliodora because of the value of the wood but pure stands of this species in the T. cacao plantations are rare. A mixture of shade trees, with C. alliodora dominating, is far more common. Thus any study of the effect of C. alliodora on understory crop yields, or other parameters, is a difficult task in the existing examples.

All future research on cacao in the Atlantic coastal area of Costa Rica will be complicated by the recent appearance of "Monilia" pod rot (Monilia roreri). Effective economically feasible control techniques have yet to be demonstrated and since the disease has spread during a period when cacao prices have nearly halved many farmers have abandoned their plantations. Lack of income has prompted those farmers, whose property contains valuable timber species, to harvest the merchantable trees. This sequence of events is a classic demonstration of the importance of agricultural diversification, and thus of one of the benefits of agro-forestry combinations, which is that the mature timber trees represent a financial reserve which can be realized whenever necessary. The widespread harvesting of the C. alliodora in the infected area has provided an opportunity to determine the actual wood yields and gross income which are obtained with the existing harvesting techniques.

A summary of the results obtained from such a study\*, which was carried out on two adjacent farms 5 km east of Cahuita, is given in the appendix.

Damage to the cacao, resulting from the tree felling, and the regeneration of the timber component have also been studied at the same sites (see appendix). The tree volume measurements were used to calculate a merchantable volume form factor for mature C. alliodora in this area. This factor was subsequently used to estimate merchantable volume growth for 4 other permanent demonstration plots that are being measured annually (see table 1).

\* A large part of the field work was carried out by E. Escalante (United Nations University fellow) who was attached to the PRNR, CATIE for 4 months in 1980.

Table 1. Growth of *Cordia alliodora* in association with *Theobroma cacao* and pasture.

Site	Density (trees/ha)		Diameter at breast height		Heights "h" (m)		Basal area (m <sup>2</sup> /ha)		Commercial Volume V (m <sup>3</sup> /ha)		Δ V <sup>②</sup> (m <sup>3</sup> /ha/yr.) 1979-80 1979-80					
	1977	1980	1977	1979	1977	1979	1977	1979	1977	1980	1977	1980				
Madre de Dios (cacao)	180	167	34.5	36.0	35.6 <sup>4</sup>	35.9	35.8	17.6	17.8	17.7	17.7	160	169.5	168.7	0.6	5.8
Patino (cacao)							32.0								9.9	85.0
Home Creek 3,5 (cacao)	120	100	41.1	43.1	-	34.0	35.2	16.0	14.6	-	14.1	134				
Cahuíta Plot 1 (pasture)	150	150	30.4	31.3	26.6	26.5		11.4	12.1		81.9	86.1			0.65	4.23
Cahuíta Plot 2 (pasture)	208	208	36.7	37.5	33.0	33.8		22.5	23.5		195.6	206.4			0.94	10.8

1. Values affected by exploitation and natural mortality.

2. Calculations based only on measurements of trees still standing in 1980.

3. Rosero, P. y Gwald, N. Growth of Laurel (*Cordia alliodora*) in coffee and cacao plantations, and pastures, in the Atlantic region of Costa Rica. In De las Salas, G., ed. Proceedings of the Workshop Agro-forestry Systems in Latin America. Turrialba, Costa Rica, CATIE. 1979. pp. 205-208.

4. Based on a diameter-baigt regression curve obtained from the 1979 measurements.

5. Remeasurements not taken as, after exploitation, only 6 *C. alliodora* remain in 1980.

Appendix. Harvest and regeneration study of Cordia alliodora in Theobroma cacao plantations.

Data from the farms of Srs. Mora y Buchanan, Cahuita<sup>(1)</sup>.

A. Average and range of the dimensions of the felled trees.

- a) Utilized underbark volume<sup>(2)</sup> - 7.27 (315 - 1697) pulgadas ticas (p.t.)  
- 2.64 (1.12 - 6.06) m<sup>3</sup>
- b) Roadside value<sup>(2)</sup> (1 p.t. = Ø1.1) - Ø800 (347 - 1867)
- c) Age<sup>(3)</sup> (assuming growth rings are annual) - 25 (16-26) years.
- d) D.B.H.<sup>(2)</sup> (Breast height diameter but above buttresses when necessary)  
- 58 (42-84) cm
- e) Total height<sup>(2)</sup> (h) - 36 (25-43) m
- f) Rates of growth<sup>(3)</sup> (assuming growth rings are annual) - 2.2 cm/yr  
1.3 m/yr  
0.09 m<sup>3</sup>/tree/yr.
- g) Commercial volume form factor<sup>(2)</sup> - 0.255
- h) Commercial volume<sup>(2)</sup> (p.t.) = 55.48 d.a.p.<sup>2</sup> (cm<sup>2</sup>) x h (m) - 16.61 (r<sup>2</sup> = 0.89)

B. Average and range of dimensions of the logs

- a) Log lengths - 3, 4, 5 or 6 varas (v) equivalent to 2.5, 3.3, 4.2 or 5 meters (m) (76% are 4 v)<sup>(4)</sup>
- b) Small end diameter - 47.3 (28.5-80) cm
- c) Utilized stem length - 13.9 (4.1 - 20.6) m (equivalent to 40% of total height)
- d) Stump height (includes where appropriate a disc which was rejected from the first log) - 1.4 (0.25 - 2.2)m.
- e) Nose cones - 0.061 m<sup>3</sup> (8% of commercial volume)

C. Regeneration of Cordia alliodora

- a) Stumps which coppice<sup>(2)</sup> - 84% (Average height at 4 months is 1.25 m)
- b) Natural regeneration and immature trees in the cut over plots (0.75 ha; April 1980)
- Heights 0 - 2 meters : 60/ha  
Heights 2 - 25 meters : 48/ha  
Coppiced stumps : 18/ha (4 without sprouts in this plot)  
total : 126/ha

- 1) Beer, J.W. and Escalante, E. Unpublished data.  
2) For 46 trees.  
3) Derived from a study of 14 discs.  
4) For 180 logs.

D. Cacao data

- a) Density - 400/ha (5 x 5 m)
- b) Average number affected by the felling of one C. alliodora<sup>(5)</sup> - 3.1
- c) Average number destroyed by the felling of one C. alliodora<sup>(5)</sup> - 1.8
- d) Age - 30 years (very variable)
- e) Harvest prior to the arrival of the fungus "Monilia" - 135 "boxes"/ha/yr.<sup>(6)</sup>
- f) Present harvest (plantations not yet completely abandoned) - 18 "boxes/ha/yr."<sup>(6)</sup>

(5) Average of data from 22 cacao shrubs.

(6) Owners estimates, 1 box gives approximately 15 kg of dried cacao.

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