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# FIRST HOST RECORD FOR THE ROOT PARASITE *Corynaea crassa* (BALANOPHORACEAE)

## Primer registro de la hemiparásita de raíz *Corynaea crassa* (Balanophoraceae)

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**ABSTRACT**

*Corynaea crassa* is a root hemiparasitc plant infrequent in nature. There is little information regarding their natural history, in particular their host range. In this study we dig 32 tubers and followed their parasitized roots to determine the species host. We found *Bocconia frutescens* (Papaveraceae), *Verbesina* sp. (Asteraceae), *Cayaponia* sp. (Cucurbitaceae) y *Palicourea* sp. (Rubiaceae) as natural hosts of *C. crassa*. This is the first host record available for *C. crassa* and provides some bases for its conservation in natural habitats.

**Key words:** Balanophoraceae, *Corynaea crassa*, Costa Rica, host plant, root parasitism.

**RESUMEN**

*Corynaea crassa* es una planta hemiparásita de raíz poco común y de la cual sabemos muy poco acerca de su historia natural y en particular sobre su rango de hospederos. En este estudio excavamos 32 tubérculos de dicha especie y seguimos las raíces que estaban parasitando para determinar su identidad. Encontramos *Bocconia frutescens* (Papaveraceae), *Verbesina* sp. (Asteraceae), *Cayaponia* sp. (Cucurbitaceae) y *Palicourea* sp. (Rubiaceae). Este es el primer registro de hospederos disponible para la especies y este tipo de información es de gran utilidad para las conservación de *C. crassa* en hábitats naturales.

**Palabras clave:** Balanophoraceae, *Corynaea crassa*, Costa Rica, Planta hospedera, parasitismo radical.

## INTRODUCTION

The Balanophoraceae is a nonphotosynthetic holoparasite flowering plant family distributed primarily throughout the tropics. They parasite roots of other plants and most of their life cycle occurs underground. The vegetative body of the Balanophoraceae consists of an irregular tissue known as haustorial tuber from which inflorescences develop (Hsiao *et ál.*, 1993).

Although 15 species in the family are found in America (Gómez, 1983), only one Amazonian species has been studied from the ecological point of view (Borchsenius and Olesen, 1990). Here we report observations on the parasitism *Corynaea crassa* Hook. f., a Neotropical species distributed from Costa Rica to all the Andean countries except Chile (W3 TROPICOS, 2007). Although several collections of this species exist, little is known about their host ranges and levels of specificity and there is no information about its conservation status. In order to provide key factors determining their distribution to search for new populations it is important to know their potential host species. In this study we ask the following questions: (1) which species are the most frequent hosts of *C. crassa?* and (2) Does it exist a relation between the size of the host's root and the size of the root parasite?

## MATERIAL AND METHODS

*Corynaea crassa* and the other members in the subfamily Helosidoideae, are characterized by their inflorescence in spadix which developed from subterranean globose to elongated tubers, large umbrella-like bracts enclosing the young spadix forming a tectum, a dense layer of nectar-hairs below the tectum, and male and/or female flowers scattered among the nectar-hairs in more or less distinct patterns (reviewed by Eberwein and Weber, 2004). Their inflorescences have been reporter to be visited by Hymenoptera and Diptera (Gómez, 1983) but no study of the pollination biology of the species has ever been published.

We carried out this study at Cuericí Biological Station (CBS) in Cordillera de Talamanca, Costa Rica. The CBS is located in San Jose Province, 5 km northeast of Pan-American Highway (9°33'30"N, 83°39'42"W) at 2400-2900 m altitude and occurs in Montane Wet Forest life zone (Moran, 2003). The sampling area was centered in a patch of secondary forest with organic-mater rich soils. For each individual of *C. crassa* the haustorial tuber diameter at the base of the tuber and the number of inflorescences were recorded. To identify the host plant, we excavated the tubers and followed the host plant root until we found its stem. The diameter of the host root where the haustorial tuber of the parasite is attached was measured.

## RESULTS

We found 32 tubers of *C. crassa* parasitizing four host species: *Bocconia frutescens* (Papaveraceae), *Verbesina* sp. (Asteraceae), *Cayaponia* sp. (Cucurbitaceae) and *Palicourea* sp. (Rubiaceae) (Table 1). Although we found six additional tubers, we excluded them from the analysis since we could not follow the host roots they were parasitizing in order

to identify the host species. Most *C. crassa* tubers were parasitizing roots of *Bocconia frutescens* (Papaveraceae; Table 1). All parasitized roots of different host were concentrated on the top few centimeters of the soil (no more than 30 cm deep).

| Host plant | No. of Tubers of *C. crassa* | Percentage (%) |
|---|---|---|
| *Bocconia frutescens* (Papaveraceae) | 27 | 79.4 |
| *Cayaponia* sp. (Cucurbitaceae) | 3 | 8.8 |
| *Palicurea* sp. (Rubiaceae) | 2 | 5.9 |
| *Verbesina* sp (Asteraceae)- | 2 | 5.9 |
| Total | 34 | 100 |

Table 1. *Corynaea crassa* and its host, studied in a patch of secondary mature forest at Cuericí Biological Station.

There was no relationship between the diameter of the host root and the size of the tuber ($r^2 = 0.06$, $p = 0.12$). However, when we consider only the tubers parasitizing *B. frutescens* the correlation was significant ($r^2 = 0.28$, $p<0.005$, Fig.1). We also found a positive significant correlation between *C. crassa* tuber size and number of inflorescences ($r^2 = 0.46$, $p<0.0005$, Fig. 2).

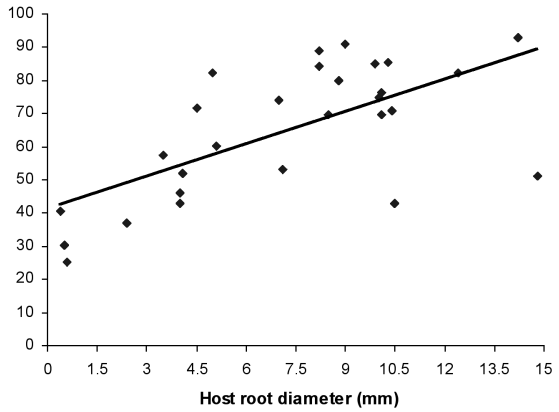


Figure 1. Host root diameter (*Boconia frutescens*) *vs.* haustorial tuber diameter of the parasitic plant (*Corynaea crassa*). The size of the haustorial tuber is correlated to the diameter of the host root (r2 = 0.28, p<0.005).

## DISCUSSION

Many aspects of the biology of *C. crassa* are poorly known, due largely to their underground life habit and the seasonal appearance of the inflorescence. The lack of knowledge, the entirely dependence of this species on other plants for its survival, as well as the conversion of many areas of cloud forest in to agriculture and pastures make the species vulnerable. Parasitic plants may also be limited by the additional suite of factors of host availability, host quality, host resistance to parasitism, and parasite preference (Marvier and Smith, 1996).

In this study we found out that *C. crassa* is parasitizing different host species, suggesting that this host parasite interaction could be shaping the local plant community. This

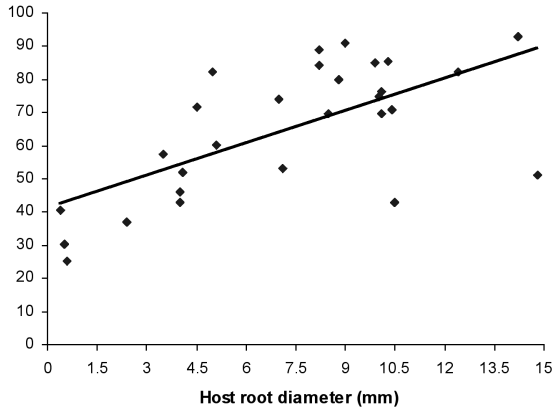


Figure 2. Haustorial tuber diameter of the parasitic plant *vs.* number of inflorescences. The number of inflorescences is correlated to the size of the haustorial tuber (r2 = 0.46, p<0.005).

could be true for other neotropical cloud forest where this parasite system occurs. Nevertheless, the fact that they were parasitizing other hosts from different families suggests not strict host specificity in *C. crassa* (Fig. 3). These results concur with Werth *et ál.*, 1979, who reported that most plant parasites are not specific to a single host.

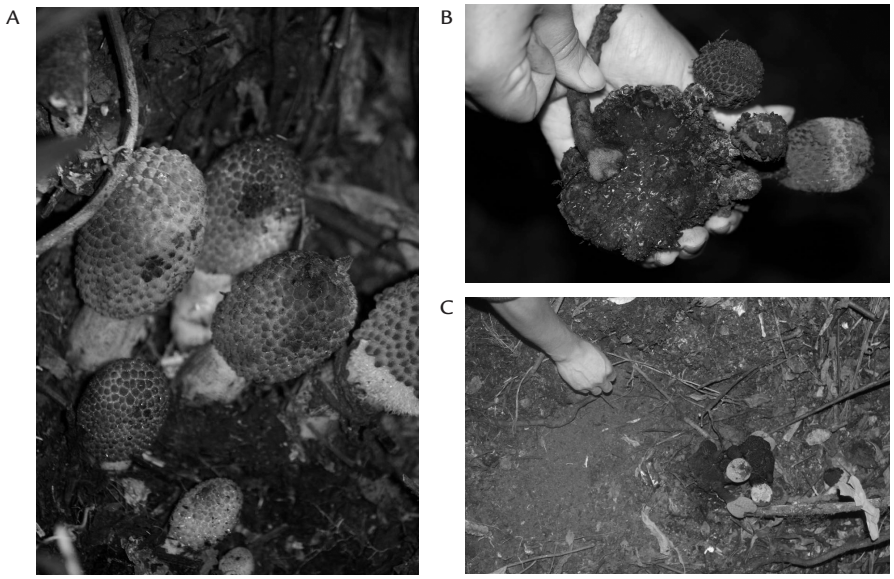


Figura 3. *Corynaea crassa*. A. Inflorescences. B. Haustorial tuber with inflorescences and the host root. *C. Root* of *Bocconia frutescence* intercepted by *C. crassa*.

Similarly, *Thesium chinensis* (Santalaceae) parasitized 38 plant species in Japan (Suetsugu *et ál.*, 2008). The reduction in host specificity in tropical compared to temperate areas is considered a consequence of the lower relative abundance of individual host species (Hawkins *et ál.*, 1992; Norton and De Lange, 1999). The relative broad host range in

*C. crassa* at CBS can be advantageous as it allows the parasites to grow successfully in different potential hosts encountered. This suggests that plants with superficial or shallow roots will be more susceptible of being parasitized. On the other hand, the factors associated to a higher frequency of parasitism in *Bocconia frutescens* are not known yet. The fact that *B. frutescence* had long roots (up to 7 m) could increase the probability of been parasitized. Another possible explanation is related to the high abundance of *B. frutescence* at the study site. The relative abundance of host species is a key factor determining the degree of host specificity in a parasite (Norton and Carpenter, 1998). If further studies prove that *C. crassa* shows preferences for certain host species, (e.g. *Bocconia frutescens*) then conservation efforts should be also addressed to the management of selected host populations.

A better understanding of this plant-plant interaction and the ecological role that *C. crassa* is playing in the ecosystem is necessary in order to have stronger bases for their successful conservation and restoration. Assuming that bigger tubers are older than smaller ones, those results suggest that *C. crassa* starts its life cycle parasitizing small diameter roots getting thicker as they age together with the host root. We also founded a positive significant correlation between *C. crassa* tuber size and number of inflorescences ($r^2 = 0.46$, $p<0.0005$, Fig. 2) suggesting that bigger plants can invest more energy in reproduction and presumably also present higher fitness. Since the haustorial tuber diameter is correlated to the host root diameter and the number of inflorescences is determined by the size of the tuber, we could infer that the host diameter is also a good predictor of the number of inflorescences. More studies with larger sample size are required taking into account the frequency of all potential host plants in a given area to determine if high frequency of parasitism reflects indeed host preference in *C. crassa*.

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