New Evidence of Pollination in *Gearum brasiliense* (Araceae—Spathicarpeae)

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ABSTRACT

New evidence is presented to suggest that the monotypic genus *Gearum* (Araceae) may be truly cantharophilous, not myophilous as suggested before. The credible pollinators in *Gearum brasiliense* are large scarab beetles of the species *Cyclocephala celata,* which were collected inside floral chambers of inflorescences between the female and the male phases. Along with the direct observations of insects within inflorescences, general floral morphology and construction are used as indirect evidences of a cantharophily pollination syndrome in this aroid genus.

KEY WORDS

Beetle pollination, Spathicarpeae, *Gearum,* cantharophily, *Cyclocephala*

INTRODUCTION

The monotypic aroid genus *Gearum* N.E.Br. belongs to the tribe Spathicarpeae and occurs in Central Brazil. It is the only genus that can be considered endemic to the Cerrado biome (Gonçalves, 2004) and it is rather common locally in southern Tocantins State.

The tribe Spathicarpeae traditionally comprises eight genera (Mayo *et al.,* 1997) but the genera *Dieffenbachia* Schott and *Bognera* Mayo & Nicolson, formerly considered as belonging to their own tribe Dieffenbachieae are now considered Spathicarpeae too (French *et al.,* 1995; Keating, 2004; Gonçalves *et al.,* in prep.). Very recently, two new genera (*Croatiella* E. G. Gonç. and *Incarum* E. G. Gonç.) were added to the tribe (Gonçalves, 2005).

Bogner & Gonçalves (1999) pointed out that the pollinators in *Gearum brasiliense* could be flies of the genus *Beebeomyia* (Richardiidae). These conclusions were based on Bogner's findings of larvae and pupae of these insects lying at the bottom of *Gearum* inflorescences. In fact, these flies are quite common in inflorescences of *Gearum* and other genera of Spathicarpeae such as *Taccarum* (Maia and collaborators, in prep.) and *Dieffenbachia* (Young, 1986), but they were never reputed as effective pollinators. The suggested fly pollination in *Gearum brasiliense* could be judged an idiosyncratic feature when considering the number of morphological similarities between the inflorescences of *Gearum* and other confirmed cantharophilous groups, such as *Dieffenbachia* (Young, 1986, Beath, 1999), *Xanthosoma* (García-Robledo *et al.,* 2004), *Montrichardia* (Gibernau *et al.,* 2003) and *Philodendron* (Gottsberger & Amaral, 1984; Gibernau *et al.,* 1999).

In November of 2005, the finding of a single *Cyclocephala* species in two inflorescences in the field reinforced the hy-

Fig. 1. Beetle captured inside the floral chamber of *Gearum brasiliense* in Tocantins state. (Photo: E. Gonçalves)

pothesis that the main pollinators in *G. brasiliense* could be scarab beetles and that the Richardiidae flies are only inflorescence predators. Arguments for this hypothesis are presented below.

Fig. 2. Inflorescence of *Gearum brasiliense* in the beginning of female phase. Note that the inflorescence arises singly from the peat. A second closed inflorescence can be seen behind.

Fig. 3. Detail of inflorescences in *Gearum brasiliense,* showing an intact inflorescences in full anthesis, female phase (left), an exposed spadix (middle) and an unopened inflorescence (right). In the exposed spadix, note the female flowers surrounded by white staminodes, the sterile male portion (middle) and the fertile male portion (apex).

NEW EVIDENCE

Between November 2nd and 3rd, 2005, two visits were conducted to the same site in the vicinity of the village of Arraias, southern Tocantins state, Central Brazil. The flowering population was located in an open area in a hyperseasonal savanna, moderately disturbed by cattle activity. There were at least 50 *Gearum brasiliense* inflorescences in different development stages. Only one individual had already unfurled (partially) its pedate leaf blade. Other cantharophilous species found at the same area were the aroid *Xanthosoma striatipes* (Kunth) Madison and the Annonaceae, *Annona warmingiana* Mello-Silva & Pirani.

A moderate thermogenesis (temperature not measured) was evidenced at early

dusk during the female phase, along with the emission of a camphor-like smell by the male flowers. Thermogenesis was not detected in male phase, but observations in male phase were restricted to the morning when heating is not usually observed in other cantharophilous species.

Four beetles were found inside the floral chamber of one inflorescence during the male phase. Another smaller inflorescence at the same phase was also found with two beetles of the same species. The beetles were all identified as *Cyclocephala celata* Dechambre 1980 (Scarabaeidae, Dynastinae, Cyclocephalini), a common species in Brazil (Maia and collaborators, ined. data). In both inflorescences, the beetles ate all the staminodes, including those in synandrodia, produced between fertile male flowers and female flowers. No damage was observed in female flowers but the fertile male flowers were occasionally chewed.

DISCUSSION

No controlled test was conducted in order to confirm positively if *Cyclocephala celata* is in fact the main pollinator of *Gearum brasiliense*. However, considering the sum of morphological aspects, the cantharophily involving large scarab beetles can be easily detected by the following "syndromic features" as suggested by many authors (e.g. Gottsberger, 1999)

1. Large pollination chamber—Scarab Dynastinae beetles are usually robust and commonly remain for at least 24 hours within the inflorescences, so a large pollination chamber (spathe tube) is generally required.

2. Massive quantities of feeding material—It is widely known that Dynastinae are eager beetles and eat many floral parts during their stay in the inflorescences (Gotsberger, 1999; Gibernau *et al.*, 1999). Providing edible parts that could feed the beetles and avoid damage to the female flowers or fertile male flowers is a vital strategy.

3. Easily detected thermogenesis—Plants pollinated by large scarab beetles are usually strongly thermogenic (Gottsberger & Amaral, 1984; Gottsberger, 1990). Thermogenesis is usually known to occur at dusk in these species.

4. Strong odor emission—Crepuscular/nocturnal emission of odoriferous volatiles are known for all large scarab pollination syndromes and seems to be the key attraction mechanism for these beetles (Gottsberger & Amaral, 1984; Gottsberger, 1990; Gottsberger & Silberbauer -Gottsberger, 1991). These scents are usually associated with the female phase of anthesis, when they are volatilized at higher spadix temperatures (Gibernau & Barabé, 2002).

5. Nocturnal anthesis (or more precisely crepuscular anthesis)—Flowering in species adapted to be pollinated by Dynastinae beetles has to be coordinated with the time when the beetles are mostly active (Gottsberger, 1999). Pollen release and thermogenic peaks are usually known to occur at dusk in these species.

The only aspect to be considered as lacking in the previously described *Gearum brasiliense* system is that the spathe is not white or whitish green in all individuals, as is common to other large scarab pollination systems. Most specimens have a spathe that is white with dark stripes. The inverse also occurs commonly, i.e. dark spathes with whitish stripes. The same patterns are also shared with other species known to be truly cantharophilous such as *Taccarum caudatum* Rusby (G. Gerlach, pers. observ.) and *Taccarum ulei* Engl. & K. Krause (Maia and collaborators, in prep.).

In the tribe Spathicarpeae, only the genus *Dieffenbachia* is well studied regarding its pollination (Young, 1986; Beath, 1999), and long known to be essentially visited by scarab beetles of the subfamily Dynastinae (*Cyclocephala* and *Erioscelis*). Probable pollinators were also observed in the field for the monospecific genus *Bognera* and they proved to be a still unidentified Dynastinae (E. Gonçalves, pers. observ.). Within the core geophytic Spathicarpeae, only *Taccarum* is well known concerning its pollination (Maia and collaborators, in prep.). Visitation of Droso-

phyllidae flies were observed in *Spathicarpa* and *Spathantheum,* in the field for the former and in the cultivation for the latter (E. Gonçalves, pers. observ.). Moreover it is not expected that pollination in the genus *Asterostigma* or in the recently described *Croatiella* or *Incarum* (Gonçalves, 2005) should be performed by large scarab beetles, because the floral chamber (spathe tube) is too slender in these genera.

Gearum is considered basal to a lineage within the tribe Spathicarpeae (Gonçalves *et al.,* in prep.). This new evidence reinforce the hypothesis of Gonçalves (2002) that the pollination in basal members of the tribe Spathicarpeae may be performed mainly by Dynastinae beetles and that the use of different strategies of pollinations in modern lineages probably evolved in response to the adaptive radiation to more seasonal/subtropical environments.

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