SCIENTIFIC NOTE

Floral Visitors of *Chamaecrista debilis* (Vogel) Irwin & Barneby (Fabaceae - Caesalpinioideae) at Cerrado of Estação Ecológica de Jataí, São Paulo State, Brazil

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Visitantes Florais de *Chamaecrista debilis* (Vogel) Irwin & Barneby (Fabaceae - Caesalpinioideae) no Cerrado da Estação Ecológica de Jataí, SP

RESUMO - Embora plantas do gênero *Chamaecrista* Moench representem importante fonte de pólen para abelhas do cerrado, essas relações são ainda pouco conhecidas. Entre os visitantes florais de *Ch. debilis*, os himenópteros (Apidae) são os mais abundantes, mas também são encontrados coleópteros (Buprestidae) e lepidópteros (Noctuidae). Abelhas de grande porte parecem ser os polinizadores efetivos dos Cassiinae no cerrado. Assim, das dezessete espécies visitantes florais de *Ch. debilis*, são indicadas apenas cinco espécies como potencialmente polinizadoras, dais quais quatro não foram registradas em outros estudos.

PALAVRAS-CHAVE: Polinização, abelha, Cassiinae, Apidae

ABSTRACT - Although *Chamaecrista* Moench genus is a very important source of pollen to bees in the Cerrado, this relationship is almost unknown. Within flower visitors of *Ch. debilis*, we found hymenopterans (Apidae) as the most abundants, but Coleoptera (Buprestidae) and Lepidoptera (Noctuidae) were also collected. Bees of great size are pointed out as effective pollinators of Cassiinae. Only five out of seventeen species of floral visitors of *Ch. debilis* sampled in cerrado, are indicated as possible pollinators, from which four species were not previously indicated in other papers.

KEY WORDS: Pollination, bee, Cassiinae, Apidae

The *Chamaecrista* Moench genus is widely distributed in the cerrado vegetation, were there are more than 130 species (Mendonça *et al.* 1998), of *ca.* 232 species from Brazil (Irwin & Barneby 1982). These plants are a very important source of pollen to bees from cerrado, despite the poor knowledge of their reproductive biology (*e.g.* Carvalho & Oliveira 2003). Westerkamp (2004) observed that in Cassiinae (*Cassia*, *Senna* and *Chamaecrista*), the stamens show great diversity of forms and functions, and the anthers show a special type of secondary pollen presentation: the ricochet. This phenomenon was observed first by Todd (1882, *apud* Westerkamp 2004) in *Ch. fasciculata*. Bees of relative great size, like *Xylocopa* are involved in this kind of pollination; Westerkamp (2004) describes that the pollen destined to pollination in *Cassia fistula* L. remains for a long period in the back of bee's body, without removal by self-grooming.

Many species of *Chamaecrista* have extrafloral nectaries (EFNs), which are nectar secreting glands not involved directly in pollination (Fiala & Maschwitz 1991). Recent studies have already showed the evolutionary and functional aspects of EFNs related to protection against herbivory, *i.e.*, the extrafloral nectar is a food source mainly to ants that reduce the damage level caused by herbivores to plants (*e.g.* Fuente & Marquis 1999, Heil & McKey 2003). However, these EFNs can attract ants and many other insects that can also occasionally visit the flowers of EFN-bearing plants (Del-Claro 2004). *Chamaecrista debilis* (Vogel) Irwin & Barneby is a common species from cerrados of northeast region of São Paulo state, specially at Gleba Pé-de-Gigante, Parque Estadual de Vassununga, (Batalha & Mantovani 2000) and Estação Ecológica de Jataí (Toppa 2004), adjacent Conservation Units. This Caesalpinioideae has EFNs and associated ants that reduce herbivory at significant levels (Nascimento 2006). Due to *Chamaecrista* abundance in the field and the poor knowledge of their floral visitors in Brazil, the present study had the main objective to identify the floral visitors of *Ch. debilis* in a cerrado area, establishing a comparison with what has been described to the family and genus.

The floral visitors were collected in the cerrado at Estação Ecológica de Jataí, that is a Conservation Unit with 9.010.70 ha, (Santos *et al.* 2005) at Luiz Antônio city (21º 36' 54" S e 47º 48' 02" W), São Paulo state. In the same area all other data were took, and experiments and direct observations of *Ch. debilis* were performed.

The studied plants were mostly at the margins of internal roads of the study site where the physiognomy "cerradão" prevail, being considered by Toppa (2004) a range of cerrado *sensu stricto*, *i.e.*, *Ch. debilis* seems to have preference for opened areas. These plants are shrub-arboreal and can reach *ca.* 2.5 m tall. The flowers are yellow, with pentamere calyx and corolla, typical characteristic of the family, according to Tucker (1996) that, additionally, also comments on the singular morphology of flower of *Chamaecrista* species.

About 40 plants were examined *ca.* ten minutes each one, at 15-day periods, and the floral visitors were collected with insect net. This was done in two periods: from 11-VIII to 23-XI-2004 and from 03-VIII to 26-IX-2005. The observations were done when the pollen was already available, pulverulent, from 9 a.m. to 3 p.m.. Pinheiro *et al.* (1988) report that anthesis of *Ch. ramosa* occurs at about 5 a.m., with peak of floral visitation from 6 a.m. to 7 a.m.. To *Ch. neesiana*, the anthesis occurs at dawn, and the pollen is available at 8:30 a.m. (A.C.B. Sodré personal communication). To other Cassiinae, as *Cassia spectabilis*, *Senna sylvestris* and *S. corymbosa*, the anthesis occurs between 5 a.m. to 7 a.m., and the pollen become available along of morning, generally some hours after anthesis (Manente-Balestieri & Machado 1999, Carvalho & Oliveira 2003, Laporta 2005).

According to Batalha & Mantovani (2000), the flowering of *Ch. debilis* occurs from November to July and fruiting from January to December. Although, in the study area, *Ch. debilis* started flowering in August (in 2004) and September (in 2005), years with similar meteorological conditions (Nascimento 2006). Short climatic variations can inflict significant impact on final results of ecological interactions, even indirectly, when it affects the phenology of individuals (Marquis & Braker 1994, Del-Claro & Oliveira 2000).

A total of 17 insect species were recorded visiting *Ch. debilis* flowers, they were essentially hymenopterans, mainly Apidae, but also Halictidae, Colletidae and Vespidae (Table 1). Some species of Apidae and Halictidae can vibrate during flower visitation, *i.e.*, since *Ch. debilis* has poricidal anthers, the vibration was necessary to pollen eject (Buchmann & Hurley 1978). The majority of poricidal anther flowers – as in great majority of Cassiinae (Laporta 2005) – do not produce nectar as reward to pollinators (Buchmann & Hurley 1978), also observed to *Ch. debilis*. Tiny bees, like Halictidae, Colletidae and some Apidae generally are not effective pollinators, because they do not reach the reproductive structures (*e.g.* Michener 1979), so they are considered as parasites or pollen thieves.

Two buprestid beetle species, *Agrilus* sp. (Fig. 1A) and *Tetragonoschema* sp., were observed feeding on petals of *Ch.*

Table 1. Flower-visiting insects of *Ch. debilis* at cerrado of Estação Ecológica de Jataí, SP. (* = probable role of floral visitors)

		Taxon	Visitor status*
Hymenoptera	Apidae	*Bombus morio* Swederus	Pollinator
	Apidae	*Centris* (*Melacentris*) sp.	Pollinator
	Apidae	*Centris tarsata* Smith	Pollinator
	Apidae	*Eulaema nigrita* Lepeletier	Pollinator
	Apidae	*Paratrigona lineata* (Lepeletier)	Pollen thief
	Apidae	*Trigona hyalinata* (Lepeletier)	Pollen thief
	Apidae	*Tetragona clavipes* (Fabr.)	Pollen thief
	Apidae	*Xylocopa muscaria* (Fabr.)	Pollinator
	Colletidae	*Hylaeus* sp.	Pollen thief
	Halictidae	*Pseudaugochlora* sp.	Pollen thief
	Halictidae	*Pseudaugochlora graminea* (Fabr.)	Pollen thief
	Vespidae	*Polybia paulista* Ihering	Pollen thief
Coleoptera	Buprestidae	*Agrilus* sp.	Herbivore
	Buprestidae	*Agrilus* cf. *octopunctatus* Gory	Herbivore
	Buprestidae	*Tetragonoschema* sp.	Herbivore
Lepidoptera	Noctuidae	sp.1, sp.2	Herbivore

Fig. 1. Buprestidae beetles visiting *Ch. debilis* flowers: A. couple of *Agrilus* sp. mating while female forrages. B. *Agrilus* cf. *octopunctatus* in the flower.

debilis flowers. Another species, *Agrilus* cf. o*ctopunctatus* Gory, was observed in the flowers (Fig. 1B). All these beetles copulate on flowers, having the potential to be accidental pollinator species, since they touched stigmas and stamens. A.C.B. Sodré (personal communication) also observed a beetle like *Agrilus* cf. *octopunctatus* in *Ch. neesiana* flowers. Thomisidae spiders seem to be common floral visitors to *Chamaecrista*. *Polybia paulista* Ihering (Vespidae) was observed being predated by *Misumenops* sp. (Thomisidae), which presents similar coloration to flower. Other individuals of Thomisidae (aff. *Misumenops*) were seen on *Chamaecrista* flowers waiting for prey (A.C.B. Sodré personal communication). Another important observation was the presence of two caterpillar morphospecies of Noctuidae (Lepidoptera) feeding on buds and flowers. Our personal observations suggested that if they infest the plant in great number, the reproduction of *Ch. debilis* can be negatively affected.

Silberbauer-Gottsberger & Gottsberger (1988) reported that 79.4% of zoophilous species that have exclusive pollinators show bees as pollinator agents, and in 45.4% of the plants that have bees as pollinator agents can be exclusive, main or additional. Analyzing floral visiting bees in the cerrado, Pedro (1992) at Cajuru city, SP; Carvalho & Bego (1996) at Uberlândia, MG; Mateus (1998) at Estação Ecológica de Jataí, Luiz Antônio, SP; Rêgo (1998) at Chapadinha, MA; and Araújo *et al.* (2006) at Ouro Branco, MG, reported that the Apidae (including Anthophoridae) show the major number of bee species that visit flowers in the cerrado, followed by Megachilidae and Halictidae. These data corroborate what was observed, in minor scale, to *Ch. debilis*. The bee species that visit *Chamaecrista* in cerrado vegetation, observed by many authors, are listed in Table 2. In Uberlândia, MG, A.C.B. Sodré (personal communication) observed *Bombus* sp., *Centris* sp., *Trigona* sp. and one species of Augochlorini flowers of *Ch. neesiana*.

Carvalho & Bego (1997) found from one to three bee species visiting flowers of Caesalpinioideae in Uberlândia,

Table 2. Floral visitor bees recorded to *Chamaecrista* species in cerrado areas, in Cajuru, SP (Pedro 1992), Luiz Antônio, SP (Mateus 1998, Nascimento 2006), Chapadinha, MA (Rêgo 1998), Uberlândia, MG (Sodré 2002) and Ouro Branco, MG (Araújo *et al.* 2006); [1- *Chamaecrista* sp1 - (probably *Ch. debilis*); 2- *Chamaecrista* sp2; 3- *Ch. debilis;* 4- *Ch. desvauxii* (Collad.) Killip; 5- *Ch. diphylla*; 6- *Ch. flexuosa* (L.) Greene; 7- *Ch. nictitans* (L.) Moench]; 8- *Ch. ochnacea* (Vogel) Irwin & Barneby.

Family/bee species	Visited plant	Reference work
Apidae		
Bombus attratus Franklin	2	Araújo *et al.* (2006)
Bombus morio Swederus	1,3	Mateus (1998), Nascimento (2006)
Centris bicolor Lepeletier	9	Araújo *et al.* (2006)
Centris tarsata Smith	3	Nascimento (2006)
Centris (*Melacentris*) sp.	3	Nascimento (2006)

Continue

Table 2. Continuation.

Family/bee species	Visited plant	Reference work
Eulaema nigrita Lepeletier	3	Nascimento (2006)
Epicharis flava (Friese)	1	Mateus (1998)
Epicharis minima Friese	1	Mateus (1998)
Epicharis schrottky Friese	1,2	Mateus (1998), Araújo *et al.* (2006)
Epicharis spp.	2	Araújo *et al.* (2006)
Exomalopsis fulvofasciata Smith	4,8	Pedro (1992), Mateus (1998)
Monoeca sp.	2	Araújo *et al.* (2006)
Paratetrapedia sp1.	1	Mateus (1998)
Paratetrapedia sp2.	2	Araújo *et al.* (2006)
Paratrigona lineata (Lepeletier)	3	Nascimento (2006)
Tetragona clavipes (Fabr.)	3,8	Pedro (1992), Nascimento (2006)
Tetrapedia spp.	2	Araújo *et al.* (2006)
Trigona fulviventris Guérin	5	Rêgo (1998)
Trigona fuscipennis Friese	5	Rêgo (1998)
Trigona hyalinata (Lepeletier)	2,3	Araújo *et al.* (2006), Nascimento (2006)
Trigona pallens (Fabr.)	5	Rêgo (1998)
Trigona spinipes (Fabr.)	8	Pedro (1992)
Thygater sp.	2	Araújo *et al.* (2006)
Xylocopa muscaria (Fabr.)	3	Nascimento (2006)
Xylocopa suspecta Moure & Camargo	1	Mateus (1998)
Colletidae		
Hylaeus sp.	3	Nascimento (2006)
Ptiloglossa aenigmatica Moure	6	Pedro (1992)
Halictidae		
Augochlora chapadea (Cockerrel)	4	Mateus (1998)
Augochloropsis pandrosos (Schrottky)	1	Mateus (1998)
Augochloropsis sparsilis (Vachal)	1	Mateus (1998)
Caenohalictus incertus Schrottky	1	Mateus (1998)
Pseudaugochlora sp.	3	Nascimento (2006)
Pseudaugochlora graminea (Fabr.)	3,4	Mateus (1998), Nascimento (2006)
Megachilidae		
Anthidium sertanicola Moure & Urban	8	Pedro (1992)

MG. Many genera found in *Ch. debilis* also were registred by Carvalho (1990) visiting *Cassia* sp. flowers, like *Paratrigona* (*P. lineata*) and *Trigona* (Apidae); and by Balestieri & Machado (1998) visiting *Caesalpinia peltophoroides* flowers, like *Bombus*, *Xylocopa* and *Trigona* (Apidae) and *Polybia* (Vespidae). Andena *et al.* (2005) found *Centris*, *Xylocopa* and *Trigona* species, among other genera, visiting other Caesalpiniaceae.

Centris species found visiting *Ch. debilis,* also are important floral visitors of other *Chamaecrista* species, according to Aguiar *et al.* (2003), in different biomes, like in caatinga (*Ch. belemii*, *Ch. nictitans*, and *Ch. pascuorum*), in campos rupestres (*Ch. cipoana* and *Ch. papillata*) and in restingas(*Ch. racemosa*). According to Pinheiro *et al.* (1988), *Xylocopa brasilianorum* L. is the effective pollinator of *Ch. ramosa* var. *ramosa*, a common species in restingas.

Comparisons between herbivore fauna and floral visitors of the same vegetal taxon can be important tools to a better understanding of the importance and how wide-ranging can be the trophic relationships established from a single primary

producer (Thompson 2005). The study of these relationships is an important instrument to identify the set of ecological systems that can afford the determination of certain area, as priority or not, to conservationist matters (see Oliveira & Del-Claro 2005 and citations therein). In this sense, we suggest that other species of *Chamaecrista* should be studied and compared about the floral visitors, as regarding to its omnipresence in the cerrado vegetation; this genera can be an important bioindicator on determination of preservation areas.

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