FAMILIES OF HYMENOPTERAN PARASITOIDS IN ORGANIC COFFEE CULTIVATION IN SANTO ANTONIO DO AMPARO, MG, BRAZIL

Fabricio Zelesnikar Ferreira[1], Luís Cláudio Paterno Silveira[2],Marcelo Mendes Haro[3]

(Recebido: 27 de maio de 2010; aceito: 4 de junho de 2012)

ABSTRACT: The objective of this study was to understand the profiles of families of Hymenoptera parasitoids present in the organic coffee grown in Santo Antônio do Amparo, Brazil. Samples were collected monthly to calculate the accumulation curve, richness and abundance indices. 4817 parasitoids distributed in nine families and 26 superfamilies were collected. The superfamily Chalcidoidea had the highest abundance (28.34 %) and diversity (13 families). Families that have natural enemies to the coffee pests represented 42 % of arthropods collected. Samples were taken of Parasitoid families not related to coffee pests, indicating the importance of organic farming in the conservation of hymenoptera.

Index terms: Organic agriculture, conservative biological control, diversity.

FAMÍLIAS DE HIMENÓPTEROS PARASITOIDES EM CULTIVO ORGÂNICO DE CAFÉ EM SANTO ANTÔNIO DO AMPARO, MG, BRASIL

RESUMO: *Objetivou-se neste estudo compreender os perfis das famílias de himenópteros parasitoides presentes na cultura de café orgânico, no município de Santo Antônio do Amparo, MG. Foram realizadas amostragens mensais e posterior cálculo da curva de acumulação, riqueza e índices de abundância. Foram coletados 4.817 parasitoides, distribuídos em nove superfamílias e 26 famílias. A superfamília Chalcidoidea apresentou maiores abundância (28,34%) e diversidade (13 famílias). Famílias que possuem inimigos naturais de pragas do café representaram 42% dos artrópodes coletados. Foram amostradas famílias de parasitoides não relacionadas a pragas do cafeeiro, indicando a importância do cultivo orgânico na conservação da fauna de himenópteros.*

Termos para indexação: *Agricultura orgânica, controle biológico conservativo, diversidade.*

1 INTRODUCTION

Insect pest attack is responsible for significant oscillations in coffee production costs, grain yield and quality in Brazil (BENAVIDES et al., 2002). Among these phytophagous, the most important throughout the country are the coffee leaf miner *Leucoptera coffeella* (Guérin-Mèneville & Perrottet, 1842) (Lepidoptera: Lyonetiidae), and the coffee berry borer *Hypothenemus hampei* (Ferrari, 1867) (Coleoptera: Curculionidae), followed by a high number of secondary pests (GALLO et al., 2002).

In organic production system, due to the absence of pesticides, natural enemy community is responsible for insect pest regulation (ALTIERI; SILVA; NICHOLLS, 2003). Parasitoids from the order Hymenoptera stand out among these beneficial insects, performing as important role in the maintenance of ecological balance (PERIOTO et al., 2004). These individuals are studied aiming their use in biological control programs, with larger emphasis on the Chalcidoidea, Ichneumonoidea and Proctotrupoidea superfamilies (NICHOLLS; ALTIERI, 2007).

Regarding the control of coffee pests, the families Bethylidae, Eulophidae, Braconidae and Pteromalidae possess species responsible for the parasitism of *H. hampei* and *L. coffeella* (REIS; SOUZA; VENZON, 2002).

Families Braconidae, Chalcididae, Diapriidae, Figitidae, Monomachidae and Pteromalidae have high potential to control secondary coffee pests, such as the fruit fly *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), the caterpillar *Eacles imperialis*

[1] Universidade Federal de Lavras/UFLA - Departamento de Entomologia/DEN - Cx. P. 3037 - 37.200-000 - Lavras - MG -fzferreira@yahoo.com.br
[2] Universidade Federal de Lavras/UFLA - Departamento de Entomologia/DEN - Cx. P. 3037 - 37.200-000 - Lavras - MG - lcpsilveira@den.ufla.br
[3] Universidade Federal de Lavras/UFLA - Departamento de Entomologia/DEN - Cx. P. 3037 - 37.200-000 - Lavras - MG - marcelo_haro@hotmail.com

magnifica Walker, 1856 (Lepidoptera: Attacidae) and the root fly *Chiromyza vitata* Wiedemann (Diptera: Stratiomyidae) (HANSON; GAULD, 2006; REIS; SOUZA; VENZON, 2002).

Given to the economical importance of coffee cultivation in Minas Gerais and the essential role of parasitoids as pest regulator, the objective of this study was to understand the family profiles of hymenopteran parasitoids present in the coffee plant culture, cultivated under organic system in Santo Antônio do Amparo, MG.

2 MATERIAL AND METHODS

Study area

The experiment was conducted on Fazenda Cachoeira, in the municipality of Santo Antônio do Amparo, west region of Minas Gerais (20°53'51,55"S/44°56'32,11"W). Two areas of coffee were used for the development of this research: one with the Catuaí Amarelo cultivar, with an area of 3.1 hectares, and the other with 4.2 hectares of the Acaiá cultivar. Both cultivations were approximately five years old.

Period and sampling method

The parasitoid diversity survey was carried out monthly from February to June of 2009, aiming for the period of highest population of coffee pests (REIS; SOUZA; VENZON, 2002; SOUZA; REIS; RIGITANO, 1998). For the collections yellow plastic traps (Moericke) with 15cm of diameter were used, suspended 50 cm from the soil in bamboo stakes, fastened in the soil. A saturated solution of sodium chloride (30 g per litre of water) added to drops of detergent was used to conserve the insects collected.

Traps were distributed in five transects for each area, with 20m between traps and 40m between each transcect. In the smaller plot four traps were installed in each transect (total of 20), while in the larger area five were used in each (total of 25). The traps remained in the field for 72 hours per collection. The hymenopteran parasitoids collected were maintained in 70% alcohol and identified at family level.

Data analysis

The information was organized in a database. Family richness (total number of families collected) and abundance index (total number of individuals in each family collected) were determinate using the software Biodiversity Pro (MCALEECE et al., 1997). Diversity index (H') and species accumulation curves, used to verify the sufficiency of sampling period, were calculated using the software EstimateS© (COLWELL, 2006).

3 RESULTS AND DISCUSSION

The total of 4,817 parasitoid individuals from 26 families and nine superfamilies were collected (Table 1). Perioto et al. (2004), using of the same methodology in conventional coffee cultivations found only 21 families. Therefore, based on the collection curve (data not shown), the methodology used in this work was enough to sample most of the parasitoid families that potentially could be found in the areas.

Chalcidoidea was the superfamily with the highest number of families registered (Table I), result that agrees with the observations of Perioto et al. (2004). Possibly, the high number of hosts in the area, present in organic coffee plants and weeds (e.g. *Bidens pilosa* L., *Parthenium hysterophorous* L. and *Amaranthus* spp.), were the reasons for this result (GIBSON; HUBER; WOOLLEY, 1997; HANSON; GAULD, 2006).

The family Encyrtidae was the most abundant in this study. The wide number of potential hosts and the capacity to produce a large number of descendants, due to poliembryonic development, can explain the abundance observed (GIBSON; HUBER; WOOLLEY, 1997).

Eight families with importance for biological control of coffee pests were found: Bethylidae, Braconidae, Chalcididae, Diapriidae, Eulophidae, Figitidae, Monomachidae and Pteromalidae. These families represented 42.60% of the collected parasitoids, a proportion higher than the results in conventional cultivation, where Perioto et al. (2004) registered 24.72% and Santos (2007) 28.38%.

TABLE 1 – Superfamilies of Hymenoptera parasitoids collected; abundance, and percentage of families observed in organic coffee, in Santo Antônio do Amparo, MG, February to June/2009.

Superfamily/Family		Coffee variety		Total	Average	%
		Acaiá	Catuaí			
1. Ceraphronoidea						
1. Ceraphronidae		174	345	**519**	2.471	10,77%
	Total	**174**	**345**	**519**	**2.471**	**10,77%**
2. Chalcidoidea						
2. Aphelinidae		54	78	**132**	0.629	2.74%
3. Chalcididae		14	21	**35**	0.167	0.73%
4. Encyrtidae		403	282	**685**	3.262	14.22%
5. Eucharitidae		1	2	**3**	0.014	0.06%
6. Eulophidae		25	56	**81**	0.386	1.68%
7. Eupelmidae		7	6	**13**	0.062	0.27%
8. Eurytomidae		4	3	**7**	0.033	0.15%
9. Mymaridae		101	184	**285**	1.357	5.92%
10. Perilampidae		1	0	**1**	0.005	0.02%
11. Pteromalidae		20	36	**56**	0.267	1.16%
12. Signiphoridae		26	15	**41**	0.195	0.85%
13. Torymidae		1	1	**2**	0.010	0.04%
14. Trichogrammatidae		14	10	**24**	0.114	0.50%
	Total	**671**	**694**	**1365**	**6.500**	**28.34%**
3. Chrysidoidea						
15. Bethylidae		14	57	**71**	0.338	1,47%
16. Dryinidae		11	54	**65**	0.310	1.35%
	Total	**25**	**111**	**136**	**0.648**	**2.82%**
4. Cynipoidea						
17. Figitidae		212	207	**419**	1.995	8.70%
	Total	**212**	**207**	**419**	**1.995**	**8.70%**
5. Evanioidea						
18. Evaniidae		0	1	**1**	0.005	0.02%
	Total	**0**	**1**	**1**	**0.005**	**0.02%**
6. Ichneumonoidea						
19. Braconidae		200	227	427	2.033	8.86%
20. Ichneumonidae		43	61	104	0.495	2.16%
	Total	**243**	**288**	**531**	**2.529**	**11.02%**

Continues...

TABLE 1 – Continuation...

7. Platygastroidea					
21. Platygastridae	294	185	479	2.281	9.94%
22. Scelionidae	209	170	379	1.805	7.87%
Total	**503**	**355**	**858**	**4.086**	**17.81%**
8. Proctotrupoidea					
23. Diapriidae	317	335	652	3.105	13.54%
24. Monomachidae	169	142	311	1.481	6.46%
25. Proctotrupidae	3	2	5	0.024	0.10%
Total	**489**	**479**	**968**	**4.610**	**20.10%**
9. Vespoidea					
26. Tiphiidae	15	5	20	0.095	0.42%
Total	**15**	**5**	**20**	**0.095**	**0.42%**
Total parasitoids	**2332**	**2140**	**4817**	**22.938**	**100.00%**

Bethylidae family represented 1.47% of the individuals collected. This is a very important family, above all in function of the African species *Cephalonomia stephanoderis* Betrem and *Prorops nasuta* Waterston. These species participate in the natural control of the coffee berry borer, and they were introduced in Brazil in the decade of the 30's and 80's respectively, today being commonly found in surveys of parasitoids of that pest (REIS; SOUZA; VENZON, 2002).

The family Eulophidae also had low abundance (1.68% of the specimens collected in the organic coffee plantation), and they usually attack several miners and gall formers (GIBSON; HUBER; WOOLLEY, 1997). This family, however, possesses species that act controling the coffee berry borer, like the species *Phymastichus coffea* La Salle, as well as coffee leaf miner, of which about 10 species are registered in Brazil (REIS; SOUZA; VENZON, 2002).

Braconidae reached 8.86% of the collected parasitoids in the present study. Neotropical braconids occupy practically all terrestrial habitats, and they mostly attack larvae of the orders Lepidoptera, Coleoptera and Diptera (HANSON; GAULD, 2006). According to Reis, Souza e Venzon (2002) eight species of Braconidae have been reported parasitizing *L. coffeella* caterpillars in Brazil, whereby *Calastes letifer* (Mann) and *Mirax* sp. are considered the main braconids responsible for the population control of this pest.

Organic coffee areas also showed potential to conserve general parasitoid fauna, which was proved by the presence of Eucharitidae and Perilampidae, considered rare in faunistic surveys (HANSON; GAULD, 2006), followed by Mymaridae, Aphelinidae, Ichneumonidae and Dryinidae.

4 CONCLUSIONS

The high richness and abundance of parasitoids families observed in this study leads to the conclusion that organic management can contribute with coffee pest regulation. Presence of rare families also demonstrated the capacity of coffee ecosystem to preserve parasitoid diversity. Functional importance of high richness and abundance of parasitoid families observed in this work should be investigated in future papers.

5 ACKNOWLEDGMENTS

We thank the staff of Fazenda Cachoeira, Mr. Fernando Paiva and Mr. Helson Aguiar, for permission to use the areas and logistical support for sampling, and FAPEMIG, CNPq and CAPES for providing scholarships and financial support to carry out this work.

6 REFERENCES

ALTIERI, M. A.; SILVA, E. N.; NICHOLLS, C. I. **O papel da biodiversidade no manejo de pragas**. Ribeirão Preto: Holos, 2003. 226 p.

BENAVIDES, P. et al. Evaluación de los métodos de control cultural, químico y biológico en el manejo integrado de la broca del café. **Revista Colombiana de Entomología**, Cali, v. 28, p. 247-253, 2002.

COLWELL, R. K. **EstimateS:** statistical estimation of species richness and shared species from samples. Version 8. Baltimore, 2006. Available on: <http://viceroy.eeb.uconn.edu/EstimateS>. Access in: 10 Aug. 2009.

GALLO, D. et al. **Manual de entomologia agrícola**. São Paulo: Agronômica Ceres, 2002. 649 p.

GIBSON, G. A. P.; HUBER, J. T.; WOOLLEY, J. B. **Annotated keys to the general of Nearctic Chalcidoidea (Hymenoptera)**. Ottawa: NRC Research, 1997. 794 p.

HANSON, P. E.; GAULD, L. D. **Hymenoptera de la región neotropical**. Davis: The American Entomological Institute, 2006. 994 p.

MCALEECE, N. et al. **Biodiversity Pro:** free statistics software for ecology. Oban: The Natural History Museum; The Scottish Association for Marine Science, 1997.

NICHOLLS, C. I.; ALTIERI, M. A. Projeção e implantação de uma estratégia de manejo de habitats para melhorar o manejo de pragas em agroecossistemas. In: ALTIERI, M. A.; NICHOLLS, C. I.; PONTI, L. (Ed.). **Controle biológico de pragas através do manejo de agroecossistemas**. Brasília: MDA, 2007. p. 2-16.

PERIOTO, N. W. et al. Himenópteros parasitoides (Insecta: Hymenoptera) coletados em cultura de café *Coffea arábica* L. (Rubiaceae) em Ribeirão Preto, SP, Brasil. **Arquivos do Instituto Biológico**, São Paulo, v. 71, n. 1, p. 41-44, jan./mar. 2004.

REIS, P. R.; SOUZA, J. C.; VENZON, M. Manejo ecológico das principais pragas do cafeeiro. **Informe Agropecuário**, Belo Horizonte, v. 23, n. 214/215, p. 83-99, jan./abr. 2002.

SANTOS, P. S. **Diversidade de himenópteros parasitoides em áreas de mata-de-cipó e cafezais em Vitória da Conquista, BA**. 2007. 72 p. Dissertação (Mestrado em Fitotecnia) - Universidade Estadual do Sudoeste da Bahia, Vitória da Conquista, 2007.

SOUZA, J. C.; REIS, P. R.; RIGITANO, R. L. O. **Bicho mineiro do cafeeiro:** biologia, danos e manejo integrado. 2. ed. Belo Horizonte: EPAMIG, 1998. 48 p.