

RELATIONSHIPS BETWEEN INVERTEBRATES COMMUNITIES, LITTER QUALITY AND SOIL PROPERTIES UNDER DIFFERENT COCOA AGROFORESTRY SYSTEMS IN THE SOUTH OF BAHIA, BRAZIL



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INTRODUCTION

Cacao agroforestry systems adopted in southern region of Bahia, Brazil, have beneficial effects on the soil and litter faunal communities, and such systems can be considered as a conservation system for soil fauna (Moço et al., 2009).

Soil fauna are an important component of sustainability of agricultural systems, due to their functional role in some soil processes. Soil organisms vary according to climate, soil attributes, vegetation and to agriculture systems adopted.

This study aimed to evaluate the relationship between soil and litter attributes and faunal communities in cacao agroforestry systems in the south of Bahia, Brazil.

MATERIALS AND METHODS



Fig. 1: Study area. The study was conducted on the Research Station of MARS Center of Cocoa Science, Barro Preto located in southern Bahia, Brazil. The research farm is situated in a humid, tropical climate with an annual mean rainfall of 1500 mm which is well distributed throughout the year.



Fig. 2: Cacao agroforestry systems. Soil and litter samples were collected from five cacao agroforestry systems: renewed cacao (25-years-old) under *Erythrina* system (*Erythrina glauca*) (CRE); renewed cacao (25-years-old) under natural forest (Cabruca - CRF); an old cacao system (25-years-old) under *Erythrina* system (OCE); an old cacao system (70-years-old) under a natural forest system (Cabruca - OCF) and a cacao germoplasm (15-years-old) collection area (CGC) where plantations of cacao clones resistant to witch's broom (*Crinipellis perniciosus*) have been planted. Soil and litter samples were also collected from natural forest (NF) next to the agroforestry systems to serve as reference of faunal activities.

• The areas used for NF, CRE, CRF and OCF were on Oxisols whereas OCE and CGC were established on Inceptisols.



Fig. 3: Sampling. Soil (until the depth of 0,05 m) and litter (all plants residue on soil surface) were collected from a plot area of 0.25 m x 0.25 m.



Fig. 4: Extraction of soil fauna. Berlese-Tullgren apparatus.



Fig. 5: Identification and quantification of organisms. Fauna was counted under a binocular microscope.

• Density = individual m⁻²

• Fauna richness = number of fauna groups (higher taxonomic levels: class, order or family).

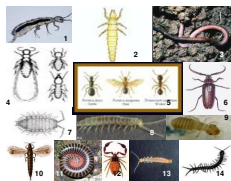


Fig. 6: Soil Fauna. 1 - Collembola; 2 - Protura; 3 - Oligochaeta; 4 - Isoptera; 5 - Hymenoptera; 6 - Coleoptera; 7 - Isopoda; 8 - Symphyla; 9 - Psocoptera; 10 - Thysanoptera; 11 - Diplopoda; 12 - Pseudoscorpionida; 13 - Diplura; 14 - Chilopoda.

• Physical and chemical analysis of soil and litter were determined in laboratory.

• Redundancy analysis (RDA) and Pearson correlation coefficients were used to evaluate the relationship between soil fauna groups and the soil and litter attributes.

Reference

MOÇO M. K. S.; GAMA-RODRIGUES E. F.; GAMA-RODRIGUES A. C.; MACHADO R. C. R. & BALIGAR V. C. Soil and litter fauna of cacao agroforestry systems in Bahia, Brazil. *Agroforestry Systems*, 76: 127-138, 2009.

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RESULTS

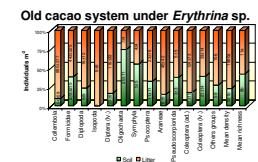
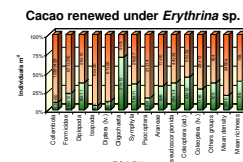
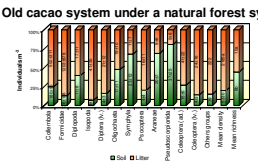
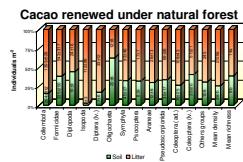
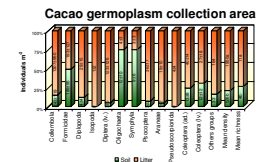
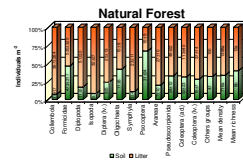


Fig. 7: Mean density of soil and litter fauna groups and mean richness. ± SE; Dates followed by the same letter are not significantly different at Duncan test $P = 0.05$

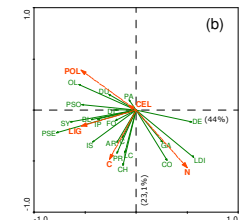
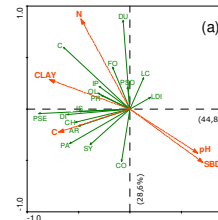


Fig. 8: Ordination (RDA) of soil fauna data and soil and litter attributes from cacao agroforestry systems and a natural forest. (a) Soil (b) Litter. CO, Collembola; SY, Symphyla; PA, Paupoda; AR, Araneae; CH, Chilopoda; DI, Diplopoda; PSE, Pseudoscorpionida; IS, Isopoda; PR, Protura; OL, Oligochaeta; IP, Isoptera; FO, Formicidae; PSO, Psocoptera; DU, Diplura; LC, larvae of Coleoptera; LDI, larvae of Diptera; BL, Blattodea; IP, Isoptera; C, Coleoptera; GA, Gastropoda; DE, Dermaptera; N, Nitrogen; C, Carbon; SBD, soil bulk density; POL, polyphenols; LIG, lignin; CEL, cellulose.

Tab. 1: Pearson correlation coefficients obtained between soil and litter attributes (columns) and fauna groups (rows).

	SOIL					LITTER				
	C	N	SBD	Clay	C	N	Lignin	Polyphenols	Cellulose	
Formicidae	0.124	0.894**	-0.647	-0.621	0.510	-0.449	-0.388	-0.064	0.257	-0.143
Collembola	0.091	-0.665	0.499	0.704	-0.426	0.398	0.313	0.319	-0.029	-0.829*
Coleoptera	0.273	0.911**	-0.810*	-0.786*	0.733*	0.038	0.310	-0.180	-0.290	0.657
Diplopoda	0.730*	0.330	-0.613	-0.462	0.701	0.598	-0.473	0.532	0.542	0.429
Isopoda	0.860**	0.274	-0.760*	-0.653	0.873**	0.334	-0.298	0.653	0.314	0.086
Diptera (larvae)	0.860**	0.369	0.335	0.030	-0.433	-0.034	0.724*	-0.509	-0.657	0.371
Psocoptera	0.180	0.816*	-0.704	-0.705	0.579	0.392	-0.483	0.626	0.203	0.296
Pseudoscorpionida	0.830*	0.239	-0.364	-0.612	0.744*	0.631	-0.333	0.767*	0.657	-0.143
Diplura	-0.161	0.893**	-0.454	-0.570	0.315	-0.616	-0.131	-0.377	0.247	-0.920**

*Significant at the 0.05 probability level; **Significant at the 0.01 probability level.

• In soil, Diplopoda and Pseudoscorpionida were positively correlated with organic carbon; Formicidae, Psocoptera and Diplura were positively related to total N; Isopoda was positively correlated with clay content, and Coleoptera was negatively correlated with soil bulk density.

• In litter, Oligochaeta was positively correlated with polyphenol content; Coleoptera larvae with organic carbon; Diptera larvae with total nitrogen, and Pseudoscorpionida with lignin content.

CONCLUSIONS

Soil and litter attributes in cacao agroforestry systems influence the composition of soil fauna community and, consequently, the ecosystem stability and functioning.

The attributes most closely related to the fauna groups in soil were organic carbon, total nitrogen and clay content (positively), and was bulk density (negatively). In litter, the attributes which had positive effect were carbon,