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Wasmannia spp. (Hym., Formicidae) and insect damages to cocoa in Brazilian farms

A. L. B. de Souza, J. H. C. Delabie and H. G. Fowler
Departamento de Ecologia, Instituto de Biociências, Universidade Estadual Paulista (UNESP), 13506-900 Rio Claro, SP, Brazil

Abstract: Diagnostic insect damage to cocoa tree leaves and fruits were compared in situations with and without the presence of the little fire ants, *Wasmannia auropunctata* and the closely related and sympatric *W.* cf *rochai*. No significant differences in thrips, lepidopteran, or chrysomelid beetle damage to fruits, or to young and old leaves, were associated with these ants. However, significant increases of pseudococcids *Planococcus citrii*, associated with areas dominated by *W. auropunctata*, and to a lesser degree with *W.* cf *rochai*, were present. *W. auropunctata* has been reported to be a canopy mosaic dominant in cocoa farms, but the lack of reduced herbivore incidences and its lack of spatial permanence do not support favoring its populations for the management of phytophagous insect control.

1 Introduction

A number of ant species have been considered to have potential management potential for the control of phytophagous insect pests of cocoa (*Theobroma cocoa* L.) in the cocoa-growing region of the state of Bahia, Brazil (13°00′ to 18°14′ S and from the Atlantic coast to 41°30′ W). Of these, *Wasmannia auropunctata* (Roger) and *W.* cf *rochai* Forel, are abundant and widespread (Delabie, 1988; Oliveira et al., 1997). *W. auropunctata* has been cited as a canopy dominant of cocoa tree farms (Majer, 1976; Majer and Delabie, 1994; Majer et al., 1994; Medeiros et al., 1995), although it was not considered as a canopy dominant by Leston (1978). Canopy-dominant species within the mosaic are spatially mutually exclusive, controlling large continuous areas of canopy (Leston, 1973). Each species of canopy-dominant ant has an associated fauna, being more pronounced in high dominant densities (Majer and Delabie, 1994). The removal of a dominant species results in its spatial replacement by another, and consequent changes in associated faunas (Leston, 1973; Majer, 1976).

W. auropunctata is a polydomous and polygynous species which has been introduced accidentally into a number of other regions of the world, where it has had an impact on the local fauna, such as in the Galapagos Islands (Lubin, 1984) and Florida (Spencer, 1941). In West Africa, *W. auropunctata* is considered a beneficial predator in cocoa farms (Bruneu de Miré, 1969). Using fogging techniques, Majer (1976) and Majer et al. (1994) found lower arthropod biomasses in areas dominated by *W. auropunctata*, and Majer and Delabie (1994) considered it as a potential species for manipulation. However, Medeiros et al. (1995) found that the spatial distribution *W. auropunctata* was not temporally stable, and questioned its management potential. Additionally, *W. auropunctata* has also been shown to be highly associated with fruit damages produced by pseudococcids (Delabie and Cazorla, 1991). As the biology and social organization of the sympatric *W.* cf *rochai* is similar to that of *W. auropunctata*, its ecological role is probably similar. In spite of low temporal site constancy, if the presence of these ants and associated lower arthropod biomasses are related to lower incidences of phytophagous insect pest damage, the management potential of these species would be greatly enhanced. Here, we examine the impact of *W. auropunctata* and *W.* cf *rochai* on the associated insect pest damage in cocoa farms in Bahia to evaluate their management potential.

2 Materials and methods

From November, 1993, through January, 1994, studies were conducted in 20-year-old experimental cocoa plantations in the Cocoa Research Institute in Itabuna, Bahia (14°45′ S, 39°13′ W). Cocoa trees were sampled such that 25% were of each species of *Wasmannia* and 50% were without. The occurrence of insect attack symptoms was recorded for randomly-sampled fruits and new and old leaves in each of the 208 cocoa trees sampled. Attack diagnosis for the principal insect pests (Bondar, 1939) follows Medeiros et al. (1997). Pest damages evaluated were caterpillars (Stenomidae and Noctuidae), beetles (Chrysomelidae), mirids (Miridae) and thrips (Thripidae), each being characteristics (Medeiros et al., 1997). Diagnostic damage incidences of each pest in trees dominated by *W. auropunctata* and *W.* cf *rochai* were compared with damages in trees in which these were not present, using contingency tables and the χ^2 statistic (Sokal and Rohlf, 1981).

For pseudococcids, fruits associated with each ant species and fruits in which these were not present were compared. Density classes of pseudococcids (*Planococcus citri* Risso) were recorded in the classes of 1–4, 5–10, 11–20, 21–50, 51–150, and more than 150 individuals per colony. These data were compared with the contingency coefficient, C (Siegel, 1956), a non-parametric correlation measure, and its sig-

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***Table** Frequency of diagnostic phytophagous pest damage to cocoa fruits and new and old leaves in the presence of* Wasmannia *species, and their relation to pseudococcid populations on fruits in cocoa farms in southern Bahia, Brazil. The z statistics test whether proportionally more damages are associated with ants and differences between species of* Wasmannia. *Positive values indicate first choice larger, negative for second choice. Significant differences ($P < 0.05$) are marked with asterisks*

Damage by	Without ants	*W. auropunctata*	*W.* cf *rochai*	Without = with ants *z*	*W. auropunctata* = *W.* cf *rochai z*
	New leaves ($N = 765$)				
Thrips	254	156	92	0.268	8.750*
Lepidoptera	182	108	63	0.586	3.468*
Chrysomelidae	321	228	119	−1.007	5.987*
χ^2 overall	1.982				
	Old leaves ($N = 1787$)				
Thrips	705	334	327	1.191	0.272
Lepidoptera	279	147	133	−0.042	0.837
Chrysomelidae	802	415	427	−0.408	−0.414
χ^2 overall	3.298				
	Fruits ($N = 1337$)				
Thrips	505	243	266	−0.126	−1.020
Mirid	124	66	92	−2.028*	−2.072*
Chrysomelidae	546	241	271	1.046	−1.327
χ^2 overall	7.170				
	Pseudococcid populations ($N = 791$)				
1–4	66	22	43	0.087	2.616*
5–10	7	5	7	−1.148	−0.577
11–20	4	3	1	0.00	−1.001
21–50	9	8	6	−1.043	0.535
51–150	2	10	3	−2.855*	−1.946*
> 150	0	3	0	−1.735*	1.735*
Totals	88	51	60	−1.533	−0.855
χ^2 overall	30.596				

nificance tested with the χ^2 statistic (SIEGEL, 1956). Additionally, mean population values for each pseudococcid density class were summed, and then divided by the number of fruits infested in each of the three situations to estimate mean minimum pseudococcid populations on fruits associated with these ants and in their absence.

3 Results and discussion

For thrips, caterpillar, and chrysomelid beetle damages, frequencies were not significantly different in areas without either species of *Wasmannia* than in their presence (table). All χ^2 tests were non-significant for fruit and new and old leaf damages (table). However, herbivore damage incidences were considerable for all of these pests (table). These results provide no direct evidence of lack of control of species of *Wasmannia* by these pests, due to their low spatial permanence (MEDEIROS et al., 1995). The lack of even subtle differences provides no evidence for their usefulness in management situations. MAJER et al. (1994), however, reported lower arthropod biomass; this was not consistent with diagnostic pest damage in trees occupied by these ants, unlike that found for the other canopy dominants in this area, *Azteca chartifex spiriti* (Forel) (MEDEIROS et al., 1997), and *Ectatomma tuberculatum* (Oliver) (FOWLER et al., 1996).

A significant association was evidenced between populations of pseudococcids and ants ($C = 0.556$) ($\chi^2 = 39.11$, $P < 0.05$). Pseudococcid populations were estimated at approximately 8.1 per fruit in the absence of *Wasmannia*, 32.1 per fruit with *W. auropunctata*, and 10.0 per fruit when associated with *W.* cf *rochai* (table). These data confirm previous studies (DELABIE and CAZORLA, 1991) that *W. auropunctata* is associated with higher populations of *P. citri*. However, *W.* cf *rochai* was associated with a 20% increase of pseudococcid populations, which may be economically significant, although much less than the 4-fold increase found in fruits within the territories of *W. auropunctata*.

In the study area, *W. auropunctata* occupied approximately 11% of the cocoa trees, and *W.* cf *rochai* less than 3% (MEDEIROS et al., 1996; OLIVEIRA et al., 1997). This implies that the presence of these ants resulted in a significant increase of pseudococcid populations. As we found no direct evidence of the reduction of insect herbivore damage in presence of these species, and as these ants reduce overall ant species diversity (SOUZA et al., 1997), in spite of having a higher number of associated ant species per tree (MAJER et al., 1994; SOUZA et al., 1997), at the present time we cannot recommend that this ant be favored for phytophagous pest control in Bahian cocoa farms. In fact, their annoying interference with fruit harvest (DELABIE, 1988) adds further support to efforts to favor other canopy-dominant ant species in this cropping system.

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Authors' addresses: Dr HAROLD G. FOWLER (corresponding author), Departamento de Ecologia, Instituto de Biociências, Universidade Estadual Paulista (UNESP), 13506-900 Rio Claro, SP, Brazil; ANA LUCIA B. DE SOUZA and JACQUES H. C. DELABIE, CEPEC, CEPLAC, 45906-700 Itabuna, BA, Brazil