Main lepidopteran pest species from an eucalyptus plantation in Minas Gerais, Brazil

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Abstract. Lepidoptera species were monitored in a plantation of *Eucalyptus grandis* in the Municipality of Bom Despacho, State of Minas Gerais, Brazil from March 1987 to February 1992. A total of 547 species were collected and divided in: primary pests: 13; secondary pests: 20; species without defined importance to eucalyptus: 79; and non-identified species: 435. These four groups had a mean of 5231.29; 338.18; 438.16 and 2222.87 individuals with a total of 8229.87 individuals collected per trap. The number of species without defined importance to eucalyptus, and non-identified species, increased during the collecting period of five years while those of primary and secondary pests showed similar numbers in all years. The most collected primary pests *Thyrinteina arnobia* Stoll and *Stenalcidia* sp. (Geometridae) showed higher frequencies during the driest and coldest periods of the year, whereas *Psorocampa denticulata* Schaus (Notodontidae) was most frequent during periods of higher rainfall. Species of groups III and IV increased in diversity with eucalyptus age. This area has a high probability of outbreaks of eucalyptus defoliating caterpillars, especially *T. arnobia.* For this reason, lepidopteran pests should be monitored in this plantation during the driest and coldest periods of the year, when they can reach population peaks. Rev. Biol. Trop. 54(2): 553-560. Epub 2006 Jun 01.

Keywords: *Eucalyptus* sp., primary pests, *Thyrinteina arnobia,* diversity, conservation, Brazil.

Wood demand for energy and its increasing use for products and by-products which had been previously obtained from native forest have brought environmental consequences including reduction of forest cover in Brazil (Zanuncio *et al.* 1998a). Eucalyptus species which are native from Australia, Indonesia, Papua New Guinea and Philippines (Ohmart and Edwards 1991) are the main ones used in plantations for wood supply. This is because of their rapid growth, precocity and adaptation to many habitats (Iwakiri *et al*. 1999, Zanuncio *et al.* 2001) in monocultures (Zanuncio *et al.* 2000). Homogeneous plantations can favour more specialized insect pests because they are different from the original vegetation structure which determines spatial distribution of resources for herbivores (Zanuncio *et al.* 1998a). For this reason insects usually found at endemic levels on native plants of the Myrtaceae family are now damaging eucalyptus plantations in Brazil (Zanuncio *et al.* 2000). This has lead to the use of strategies of integrated management of these pests including the maintenance of strips of native vegetation which can increase heterogeneity and number of natural enemies of phytophagous species (Bragança *et al.* 1998a, 1998b, Zanuncio *et al.* 1998b).

Defoliating insects are the main pests of eucalyptus plantations in Brazil (Zanuncio *et al.* 1993a) especially leaf cutting ants, and Coleoptera and Lepidoptera defoliators (Zanuncio *et al.* 2000). This last group is assuming more importance due to the amount of damage they do. The brown caterpillar *Thyrinteina arnobia* Stoll (Lepidoptera: Geometridae) in the main Lepidoptera pest of eucalyptus in Brazil.

Studies about population fluctuation are essential to establish programs of integrated management of insect pests (Zanuncio *et al.* 1994) which have being monitored in eucalyptus plantations in Brazil (Pereira *et al.* 2001). Since the majority of Lepidoptera defoliators of eucalyptus are night active the use of light traps represents the main sampling method for these insects in eucalyptus plantations in Brazil (Busoli *et al.* 1981).

Population studies allow us to characterize communities but it is also necessary to know their tendencies, cycles, seasonal variation and relative numeric abundance over time (Morales *et al.* 2000) because a population can be characterized through faunistic indexes such as those of frequency and constancy. The lack of predictive/quantitative analyses represents the main limitation of monitoring studies due to their short period of time (Guedes *et al.* 2000). On the other hand some authors have been developing studies considering population dynamics during longer periods for faunistic analyses (Zanuncio *et al.* 1998b, 2001, Guedes *et al.* 2000, Pereira *et al.* 2001).

The objective of this study was to determine population dynamics of Lepidoptera pests in an eucalyptus plantation in the Municipality of Bom Despacho, State of Minas Gerais, Brazil over five years. Information about potential damage of Lepidoptera species associated with eucalyptus, besides faunistic and constancy indexes and population fluctuation of main Lepidoptera defoliator pests and species with higher numbers of individuals were obtained.

MATERIALS AND METHODS

This study was developed in a plantation of *Eucalyptus grandis* in the Municipality of Bom Despacho, State of Minas Gerais, Brazil from March 1987 to February 1992. Lepidoptera species were collected biweekly with five light traps with black light (powered by 12 volt batteries) installed at 2 m height. A plastic bag with pieces of paper and a glass with ethyl acetate was fixed to the funnel of each trap with the aim of reducing morphological damage to insects collected (Zanuncio *et al.* 1998a).

Insects collected were conditioned in entomological blankets labeled with place, date of collection and they were sent to the laboratory of Forest Entomology at the "Universidade Federal de Viçosa (UFV)" where they were separated, counted, classified and, those in good conditions, mounted. The identification of these insects was based on the literature and by comparison with entomological collections of the UFV, "Universidade Federal do Paraná (UFPr)" and "Escola Superior de Agriculture 'Luiz of Queiroz' (ESALQ / USP)".

Lepidoptera collected were divided in four groups according to their importance to eucalyptus plantations (Zanuncio *et al.* 1993a). Group I includes species considered primary pests; group II, species considered secondary pests because they have been occurring in limited outbreaks, associated or not to primary pests; group III, identified species without defined importance to eucalyptus culture and group IV, non identified species.

Frequency index (IF) for each primary pest specie was obtained with the formula: IF= N x 100/T, where: IF= frequency index (%); N= number of individuals per pest species; T= total number of primary Lepidoptera pests (Bodenheimer 1955, Dajoz 1973, Silveira Neto *et al*. 1976, Gallo *et al*. 2002).

Constancy of each primary pest species was determined with the formula: C= P x 100/

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T, where C= constancy index; P= total number of collections with a specific pest species; N= total number of collections. Pest species were classified in the following categories based on constancy indexes (Bodenheimer 1955, Silveira Neto *et al*. 1976, Gallo *et al*. 2002): constant species (X)= present in more than 50% of collections; accessory species (Y)= present in 25% to 50% of collections and accidental species (Z)= present in less than 25% of collections.

Faunistic analysis of Lepidoptera species was made with frequency and constancy indexes (Bodenheimer 1955, Silveira Neto *et al*. 1976, Gallo *et al*. 2002). Biweekly average of number of individuals of Lepidoptera primary and secondary pest species and of those with higher number of individuals, *T. arnobia, Stenalcidia* sp. (Geometridae) and *Psorocampa denticulata* Schaus (Notodontidae) was plotted on a logarithmic scale for the five years of collection.

RESULTS

A total of 547 Lepidoptera species were collected during these five years of monitoring, being (I) 13 primary pests, (II) 20 secondary pests, (III) 79 without defined importance to the eucalyptus culture and (IV) 435 non identified species (Table 1). These four groups presented 5231.29; 338.18; 438.16 and 2222.87 individuals, respectively, with a total of 8229.87 Lepidoptera individuals collected per trap during five years (Table 1). The pattern of total number of individuals collected was similar to that of primary pests (Fig. 1).

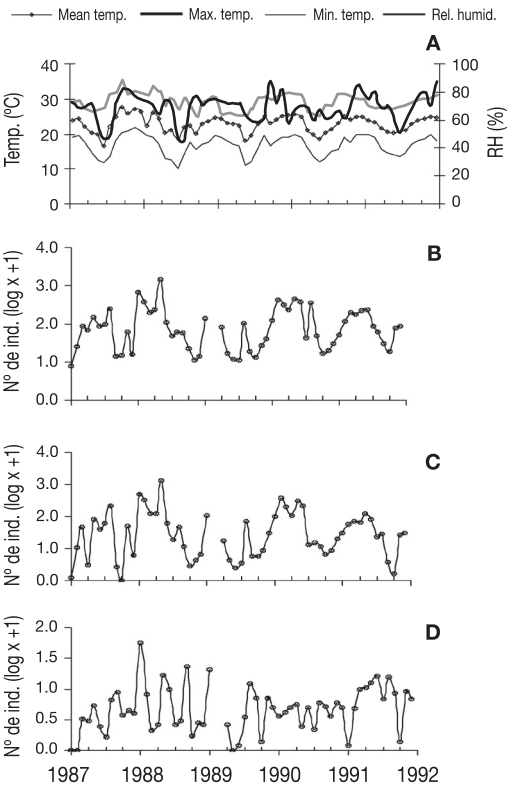

Fig. 1. Mean, maximum and minimum temperatures, relative humidity (A) and total number of individuals of Lepidoptera (B), of primary (C) and secondary (D) pests collected in the Municipality of Bom Despacho, State of Minas Gerais, Brazil. March 1987 to February 1992. Discontinued lines indicated that collections were not made in these dates.

TABLE 1

Mean number of species, individuals per trap and individuals per trap per species of Lepidoptera collected in the Municipality of Bom Despacho, State of Minas Gerais, Brazil. March 1987 to February 1992

Groups	Species	Individuals/ trap	Individuals/ trap/ species
(I) Primary pests	13	5231.29	402.41
(II) Secondary Pests	20	338.18	16.91
(III) Species without defined importance	79	438.16	5.55
(IV) Unidentified species	435	2222.87	5.11
Total	547	8229.87	15.05

Group I presented highest number of individuals per trap per species (402.41), followed by groups II, III and IV with, respectively, 16.91; 5.55 and 5.11 individuals per trap per species (Table 1).

Groups III and IV represented 32.33% of total number of individuals collected with lowest number per trap per species. A low increment on number of species of groups I and II was found during these five years of collection in a different manner to that observed for groups III and IV mainly for this last one (Table 2).

T. arnobia, Stenalcidia sp. and *P. denticulata* were the most collected pest species with 2,324.78, 1,901.35 and 216.85 individuals per trap, respectively (Table 3). These three species represented 84.94% of the total number of individuals of primary pests. Out of 13 primary pests, *T. arnobia*, *Stenalcidia* sp., *Oxydia vesulia* Cramer (Geometridae), *Sarsina violascens* Herrich-Schaeffer (Lymantriidae) and *Dirphia rosacordis* Walker (Saturniidae) were constant species; *Blera varana* Schaus (Notodontidae), *Eupseudosoma aberrans* Schaus, *Eupseudosoma involuta* Sepp

TABLE 2

Number of Lepidoptera species of groups I, II, III e IV collected per year with light traps in the Municipality of Bom Despacho, State of Minas Gerais, Brazil. March 1987 to February 1992

Groups	Species				
	87-88	88-89	89-90	90-91	91-92
I	10	12	10	11	13
II	10	16	15	14	15
III	40	54	33	43	62
IV	178	210	129	133	255

TABLE 3

Species, families and individuals per trap (Ind.) and frequency (Freq.) and constancy (Const.) indexes for Lepidoptera primary pests collected with light traps in the Municipality of Bom Despacho, State of Minas Gerais, Brazil. March 1987 to February 1992

Species	Family	Ind.	Freq. (%)	Const.
Thyrinteina arnobia Stoll	Geometridae	2324.78	44.44	X
Stenalcidia sp.	Geometridae	1901.35	36.35	X
Psorocampa denticulata Schaus	Notodontidae	216.85	4.15	Y
Oxydia vesulia Cramer	Geometridae	173.58	3.31	X
Dirphia rosacordis Walker	Saturniidae	165.74	3.17	X
Sarsina violascens Herrich-Schaeffer	Lymantriidae	143.75	2.75	X
Eupseudosoma aberrans Schaus	Arctiidae	114.08	2.18	Y
Eupseudosoma involuta Sepp	Arctiidae	105.16	2.01	Y
Blera varana Schaus	Notodontidae	38.25	0.73	Y
Apatelodes sericea Schaus	Eupterotidae	37.95	0.73	Z
Nystalea nyseus Cramer	Notodontidae	4.60	0.08	Z
Misogada blerura Schaus	Notodontidae	4.40	0.08	Z
Sabulodes caberata Guenée	Geometridae	0.80	0.02	Z
Total		5231.29	100.00	

(Arctiidae) and *P. denticulata* were accessories; and the other ones were accidentals (Table 3).

T. arnobia presented higher population peaks during coldest and driest periods of the year with higher population between March and July (Fig. 2). This species represented higher number of individuals during the second, fourth and fifth years of collections. *Stenalcidia* sp. also represented higher proportion of the catch during the driest and coldest periods of the year and population peaks occurred between May and September (Fig. 2) but with a more regular pattern than that found for *T. arnobia* with lower number of individuals also in the third year. *P. denticulata* presented higher abundance of individuals during periods of higher temperature and relative humidity (Fig. 2) in a opposite way to that observed for *T. arnobia* and *Stenalcidia* sp.

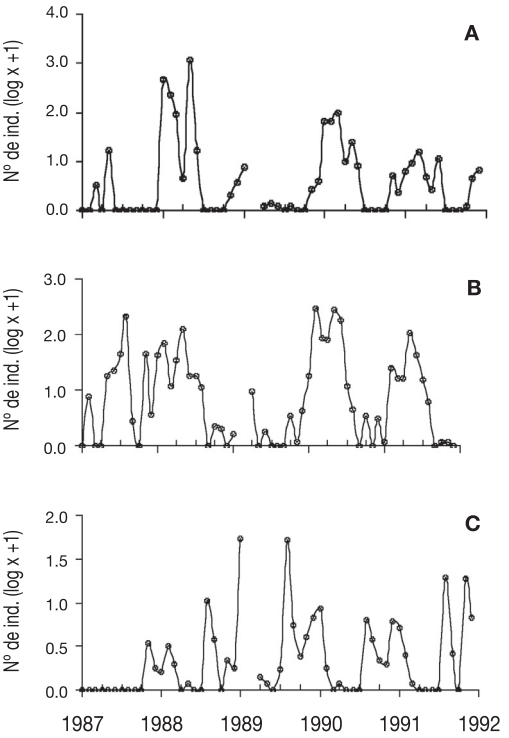

Fig. 2. Population fluctuation of *Thyrinteina arnobia* (Geometridae) (A), *Stenalcidia* sp. (Geometridae) (B) and *Psorocampa denticulata* (Notodontidae) (C) in the Municipality of Bom Despacho, State of Minas Gerais, Brazil. March 1987 to February 1992. Discontinued lines indicated that collections were not made in these dates.

DISCUSSION

Species of primary (group I) and secondary (group II) pests of eucalyptus represented 67.67% of total number of individuals collected. This shows the high adaptability and coexistence of these Lepidoptera pests with eucalyptus plantations in the region of Bom Despacho.

Number of individuals per species of groups I and II especially of group I and diversity of Lepidoptera species in this region showed lower values than that found by Zanuncio *et al.* (1998b, 2001), Guedes *et al.* (2000). This shows a lower recovery on the Lepidoptera fauna in eucalyptus crops in this region. More specialized herbivores are favored by higher quantity of food in these crops which associated to reduced pressure of natural enemies (Andrewartha and Birth 1984, Price 1984) can increase their damage to these plants. On the other hand these herbivores have more difficulties to find and to colonize their host plants in more heterogeneous environment where food is more scarce and survival and persistence of natural enemies are higher (Bragança *et al.* 1998a, 1998b, Zanuncio *et al.* 1998a).

The high number of individuals and of individuals per species of groups I and II suggests higher possibilities of outbreaks of these species in the region of Bom Despacho. However food supply do not represent the only factor responsible for outbreaks of Lepidoptera pests because unfavourable environmental conditions to plants can also favour population peaks of pest species (Elton 1975, Wallner 1987). Temporary distribution of species of groups I and II showed higher number of individuals during periods of lower temperature and relative humidity (Fig. 1) when plants can present stress mainly due to water deficit. This can reduce their defense mechanisms which can facilitate survival and concentration of pests in eucalyptus plantations during this time of the

year. Besides, processes of plant defense and presence of digestibility reducers and of toxins to herbivores and alelochemical liberation for attraction of natural enemies are reduced in these conditions (Cavalcanti 1995).

Low number of individuals and of individuals per trap per species of groups III and IV indicates that these species do not feed on eucalyptus plants but they are associated to understorey plants or to those present on remaining strips or reserves of native vegetation (Zanuncio *et al.* 1998a, Pereira *et al.* 2001).

Low increment on number of species of groups I and II and higher numbers of those of groups III and IV during the five years of collection can be due to a progressive recovery of the ecosystem especially of the vegetation under eucalyptus plants. This can occur because cultural treatments are reduced with age increase of the plantation what might allow diversity of vegetation and Lepidoptera fauna to recover (Zanuncio *et al.* 1998a, 1998b, Pereira *et al.* 2001). This shows that silvicultural practices which preserve vegetation are important for maintenance of heterogeneity of Lepidoptera species and of their natural enemies (Bragança *et al.* 1998a, 1998b).

The high frequency of *T. arnobia*, *Stenalcidia* sp. and *P. denticulata* indicates that the region of Bom Despacho presents favourable ecological and climatic conditions for reproduction and establishment of these species. *T. arnobia* is considered the main Lepidoptera pest species of eucalyptus in Brazil and it presents irregular occurrence pattern. Lower number of individuals of this species was found during the first year in a similar way as recorded by Pereira *et al.* (2001) in the region of Três Marias, State of Minas Gerais, Brazil what can indicate that this species prefers older eucalyptus plants. Lowest number of individuals of *T. arnobia* and *Stenalcidia* sp. in the third year can be due to the impact of natural enemies especially predatory bugs because these organisms, naturally, increase their population in areas where pests have higher number of individuals and they can maintain this number at low levels for the next period (Barcelos *et al.* 1991). This shows the importance of management of populations of natural enemies including their rearing and liberation aiming to maintain pest populations below economic damage and to avoid the use of insecticides because pest species can develop resistance to constant applications of chemical products (Zanuncio *et al.* 1994, 1996, 1996-1997).

T. arnobia is considered the main defoliator Lepidoptera of eucalyptus in Brazil with economic damage to these plants (Zanuncio 1993) but *S. grosica* also present high voracity in plants of eucalypt. This shows the importance of monitoring both species aiming to reduce damage to these plants (Santos *et al*. 1998). *T. arnobia* and *S. grosica* were found during the whole period.

Largest abundance of *P. denticulata* during periods of higher temperature and relative humidity is the opposite to that observed for *T. arnobia* and *Stenalcidia* sp. This can be explained by the biology of this pest which pupates in the soil where it needs humidity for adult emergency (Zanuncio *et al.* 1993b). Caterpillars of *P. denticulata* also have high voracity on eucalyptus plants and this species has been reported at epidemic levels in several Municipalities of the State of Minas Gerais, Brazil. This has led to the development of programs to control and to monitor this pest and to reduce its damage (Zanuncio 1993). Caterpillars of this species were found defoliating eucalyptus plants specially in periods before and after its population peaks.

High abundance of *T. arnobia*, *Stenalcidia* sp. and *P. denticulata* shows the necessity of studying their population dynamics. It is important to determine their periods of higher abundance and to reduce costs with monitoring besides facilitating control decision and introduction of natural enemies. Such activities can maintain populations of these pest species below economic level and to reduce the use of curative measures in case of outbreaks.

This area presents risks of population outbreaks of Lepidoptera pests of eucalyptus especially *T. arnobia*, *Stenalcidia* sp. and *P. denticulata* due to a high number of individuals

and species of groups I and II and to the low diversity of the Lepidoptera fauna in this region. Also the increment on number of species of groups III and IV indicates that the diversity of Lepidoptera species can increase with diversity of vegetation under eucalyptus trees and around such plantations.

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RESUMEN

De marzo de 1987 a febrero de 1992 se realizó un monitoreo con trampas luminosas en plantaciones de *Eucalyptus grandis* en Bom Despacho, Minas Gerais, Brasil. Se recolectaron 547 especies del orden Lepidoptera: plagas primarias: 13; plagas secundarias: 20; especies sin importancia definida para el cultivo de eucalipto: 79; y especies no identificadas: 435. Estos cuatro grupos tuvieron medias de 5231.29; 338,18; 438.16 y 2222.87 individuos por trampa respectivamente, para un total de 8229.87 lepidopteros recolectados por trampa. Durante los cinco años hubo un aumento del número de especies de los grupos III y IV. Las plagas primarias con mayor número de individuos fueron *Thyrinteina arnobia* Stoll y *Stenalcidia* sp. (Geometridae), con las mayores frecuencias para los meses más secos y fríos del año. *Psorocampa denticulata* Schaus (Notodontidae) fue más abundante en los periodos más lluviosos. La probabilidad de brotes de larvas desfoliadoras de eucalipto, principalmente *T. arnobia,* es alta en la región. Se recomienda hacer el monitoreo de lepidópteros plaga en los periodos más secos y fríos del año, cuando pueden presentar picos poblacionales.

Palabras clave: *Eucalyptus* sp., plagas primarias, *Thyrinteina arnobia,* diversidad, conservación, Brasil.

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