Full Length Research Paper

Predominant melliferous plants of the western Sudano Guinean zone of Cameroon

Dongock Nguémo Delphine[1]*, Tchoumboue Joseph[2], Youmbi Emmanuel[3], Zapfack Louis[3], Mapongmentsem Pierre Marie[1] and Tchuenguem Fohouo Fernand-Nestor[1]

[1]Department of Biological Sciences, Faculty of Sciences, University of Ngaoundere, P.O. Box: 454 Ngaoundéré, Cameroon.
[2]Department of Zootechnology, Faculty of Sciences, University of Dschang, Cameroon.
[3]Department of plant biology, Faculty of Sciences, University Yaounde I, Cameroon.

Between September 2003 and March 2005, melissopalynological methods were used to access the predominant melliferous plants (PMP) in 104 honey samples collected from the Soudano Guinean highlands zone of west Cameroon. A total of 19 PMP from 11 families were identified, *Asteraceae* is the most represented. Trees and herbs were frequently exploited. Spontaneous PMP were more represented. Perennial PMP were highly visited by *Apis mellifera adansonii*. PMP with white colour flower are the most utilized by bees compared to other colours. When seasonal exploitation was considered, the proportion of PMP exploited in the rainy season was higher. *Eucalyptus saligna, Terminalia mantaly* and *Pterocarpus soyauxii* were frequently exploited.

Key words: *Apis mellifera adansonii*, melliferous plant, predominant, harvested.

INTRODUCTION

One of the goals of melissopalynology is to determine the floral sources utilized by honeybees in the production of honey (Barth, 2004; Von Der Ohe et al., 2004). Depending on the relative importance of the pollen of a specific melliferous plant (MP) represented in a honey sample (intensity of exploitation), MP are regrouped into predominant, accessory, secondary and rare pollen. Pollen composition of honey can be used as an indicator of the foraging behaviour of bees on different MP in a giving area and period. Apiculture is becoming an important socio-economic activity in some areas of Cameroon, (Tchuenguem et al., 2004) particularly in the Soudano-Guinean western highlands zone. Although an inventory and identification of MP have been carried out (Dongock et al., 2004, 2007) in this area, the level of their effective exploitation by bees is still to be determined. Thus the objective of the present study is to contribute to a better comprehension and knowledge of the factors affecting the exploitation of the PMP by *Apis mellifera*

adansonii through melissopalynology.

More precisely the spectrum and the frequency of exploitation of PMP of the Western Highlands of Cameroon will be accessed.

MATERIALS AND METHODS

Study area

The study was carried out in the Soudano Guinean highland zone of western Cameroon (Lat 5°21'. 45''–5° 35'.44'' and Long 10°04'.72''-10°26'.24''). Average altitude of 1500 m. Soils are of argilo lateritic and volcanic types. The climate is characterized by a raining season (March to November) with precipitation of 1500 to 2000 mm per year and a dry season (November to March), average relative humidity is 75%. Annual sunshine is 1874 h. Natural vegetation made up of shrub savannah with herbs which has been greatly modified by a dense population whose main activity is agriculture.

Collection and analysis and honey samples

A total of 104 honey samples, extracted by pressing, were obtained between September 2001 and March 2005 directly from 45 beekeepers. Qualitative and quantitative analysis of honey samples

---
*Corresponding author. E-mail: dndongock@yahoo.fr. Tel: 00 (237) 99 45 10 96/ 74 92 04 36.

Table 1. Repartition (%) of predominant of melliferous plants in function of families, botanical characteristics (MT: morphological types (A: trees, a: shrubs, ar: small trees, h: herbs); DD: degree of domestication (s: spontaneous, c: cultivated); LC: Live cycle (an: annuals, p: perennials); FC: flowers colours (W: white, Wt: whitish, Y: yellow, B: blue, P: pink) Season: DS: dry season; RS: rainy season seasons and frequency of exploitation; (+: present; -: absent).

| Scientifics names | Botanical characteristics | | | | Seasons | | Frequency (%) |
	MT	DD	LC	FC	DS	RS	
Eucalyptus saligna	A	c	p	Wl	+	+	79.0
Terminalia mantaly	A	c	p	W	+	+	63.2
Pterocarpus soyauxii	A	c	p	Y	+	+	42.1
Tithonia diversifolia	ar	s	p	Y	-	+	36.8
Cassia mimosoides	a	s	p	-	+	-	31.6
Weinmannia sp	-	s	-	-	+	-	21.1
Bidens pilosa	h	s	an	W	+	+	15.8
Elaeis guineensis	A	c	p	Wt	+	+	10.5
Coffea arabica	a	c	p	W	-	+	10.5
Ageratum hostonianum	h	s	an	B	-	+	5.3
Phoenix reclinata	A	c	p	Wt	+	+	5.3
Caesalpinia bonduc	a	s	p	-	-	+	5.3
Buchholzia tholloniana	-	s	-	-	-	+	5.3
Combretum nigricans	A	s	p	Y	-	+	5.3
Leucas oligocephala	h	c	p	W	-	+	5.3
Mimosa invisa	h	s	an	P	-	+	5.3
Myrianthus arboreus	a	s	-	-	-	+	5.3
Syzygium aromaticum	a	c	p	P	-	+	5.3
Gnidia bambutana	ar	s	p	-	+	-	5.3

were carried out according to the methods of melissopalynology by Von Der Ohe et al. (2004) using Zander classes derived for this technique. MP are classified into predominant pollen (>45%), accessory (16 to 45%), secondary (3 to 16%) and rare (<3%) (Louveaux et al., 1978). Only predominant pollen plants are considered in the present study. The frequency of exploitation of a specific PMP was determined as percent of the 69 honey samples with predominant pollens. The frequency of exploitation of PMP was then regrouped into three categories: Frequently, averagely and less frequently PMP with their pollens grains present in respectively > 60, 60 to 30% and < 30% of the 69 honey samples considered.

Statistical analysis

Descriptive statistics was used for frequency distribution and Chi-square test (P≤0, 05) to compared percentages.

RESULTS

Botanical characteristics of PMP

Botanical characteristics of PMP foraged are summarized in Table 1. Out of the 104 honey samples analysed, the pollen of 142 MP were identified of which only 19 (13, 4%) are predominant. The PMP belong to eleven families (Table 1). The most represented is *Asteraceae*. PMP exploited by *A. mellifera adansonii* in the study area are from four biological types as showed in Figure 1, trees, shrubs, herbs and small trees. Trees are the most represented (35.3%) followed by shrubs (29.4%), herbs (23.5%), and small trees (11.8%) but the differences were not significant (P≥ 0, 05). Distribution according to the level of domestication shows that spontaneous species represent nearly two third (57.9%) of PMP compared to cultivated (42.1%) however no significant difference was found between these two categories. When life cycle is considered perennial plants (81.3%) are highly represented but no significant difference compared to annual species (18.8%) was observed. White flowers colours of PMP were significant (P≤0.05) and frequent (38.5%) as shown in Figure 2 compared to other colours, followed by whitish (23.0%), yellow and pink colours (15.4% each), and blue (7.7%).

Distribution of the PMP by season of exploitation summarised in Table 1 shows that a high proportion (84.2%) are foraged in the rainy season (*Ageratum hostonianum, Bidens pilosa, Elaeis guineensis* etc...) against only 47.4% to those of dry season (*Cassia mimosoides, Coffea arabica, Gnidia bambutana* etc...), whereas one third (31.6%) are foraged by *A. melliferous adansonii* in both seasons (*Elaeis guineensis, Phoenix reclinata, Bidens pilosa,* etc). No significant difference (P≥ 0, 05) was observed in the spectrum of PMP between the two seasons.
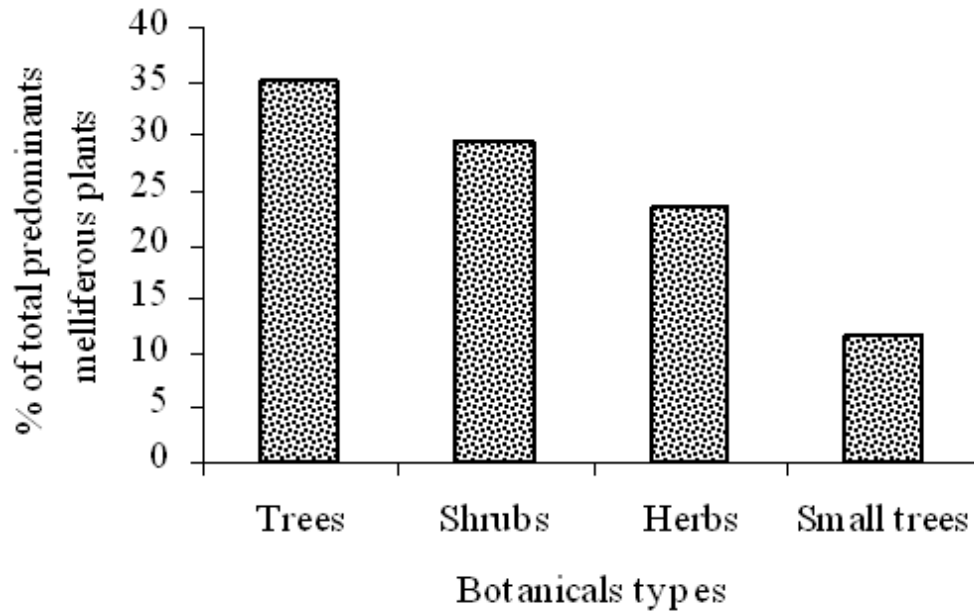
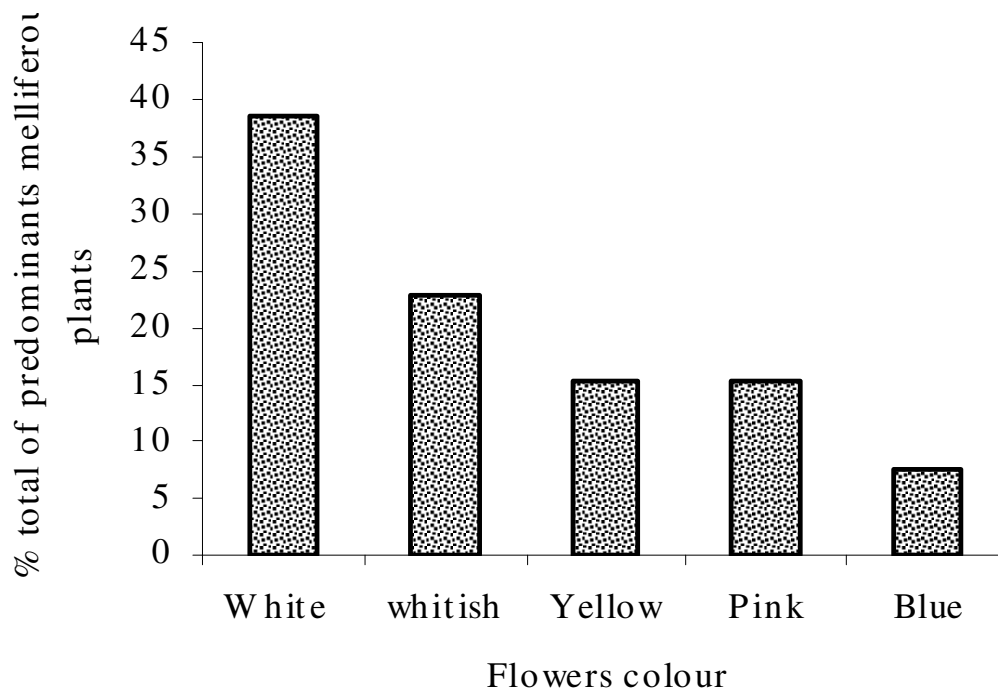**Figure 1.** The Distribution of PMP as a function of botanical source.

Figure 2. The distribution of PMP in function of flowers colours.

Frequency of exploitation of PMP

Concerning the frequency of exploitation (Figure 3), 66.3% (69) out of the 104 honey samples analysed contained PMP pollen. *Eucalyptus saligna* and *Terminalia mantaly* were frequently exploited with their pollen found respectively in 79.0 and 63.2% of the honey samples with

PMP. Followed by *P. soyauxii* (42.1%) and *Tithonia diversifolia* (36.8%). The other PMP were less exploited with their pollen present in less than 36.0% of honey samples. In the dry season, E. *saligna* and *T. mantaly* were also the most harvested with 72.3% each, whereas in raining season it is *E. saligna* and *P. soyauxii* with their pollen present in 59.1 and 47.5% of honey samples.
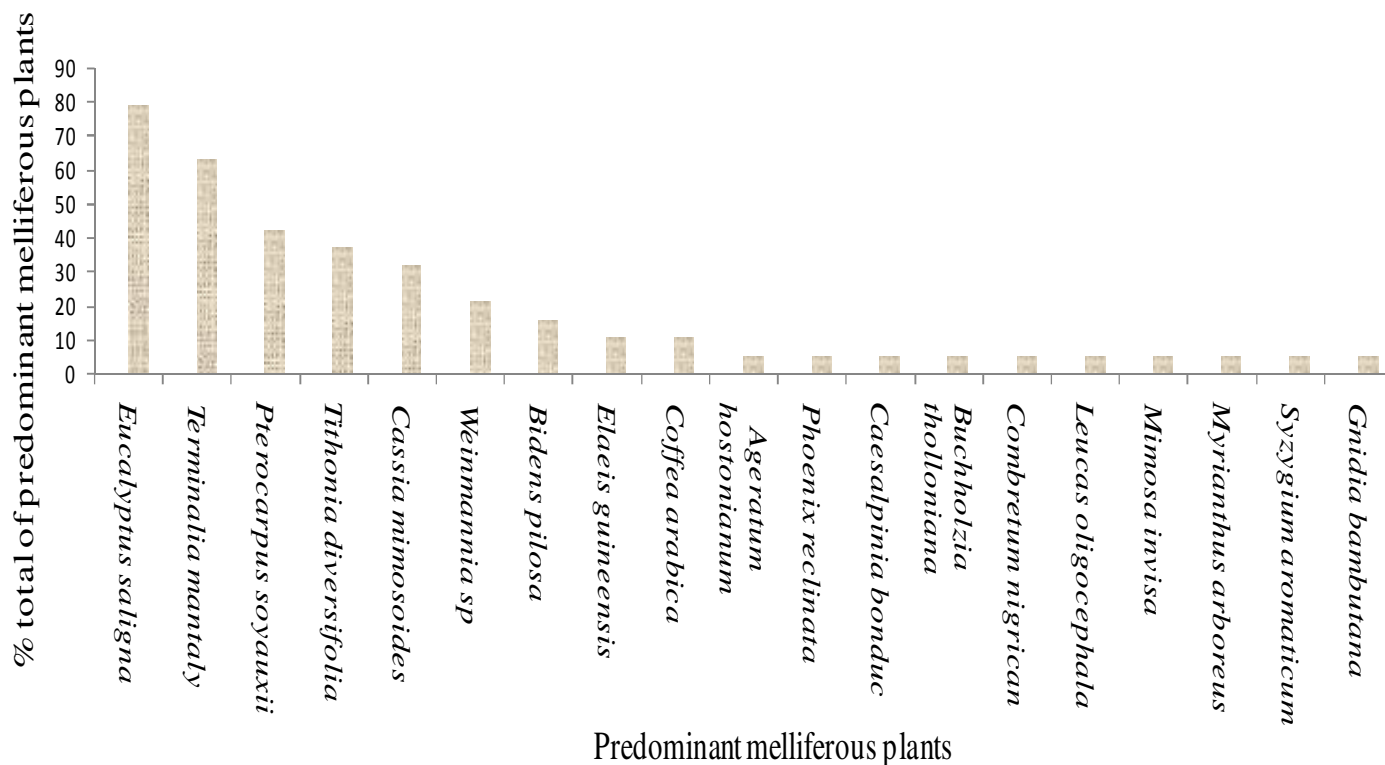
Figure 3. Distribution of PMP in function of the frequency of exploitation.

DISCUSSION

From the present study it appears that the spectrum of PMP exploited by *A. mellifera adansonii* is less diversified compared to the total number of MP identified in the area (Dongock et al., 2004). A similar low proportion of PMP out the total of MP was also reported in other areas like Senegal by Ricciardelli and Compagnucci (1991), in Somalia (Papoff et al., 1988; Ricciardelli, 1986), in Zambia and Somalia (Persano et al., 1988). In our zone *Asteraceae* family is the most represented as opposed to *Mimosaceae* in the meridian zone of Chad (Gadbin, 1980) and *Combretaceae* in Senegal (Ricciardelli and Compagnucci, 1991). From our result *Terminalia, Elaeis* and *Combretum* were also identified in Senegal as PMP (Ricciardelli and Compagnucci, 1991). Some of the PMP identified in our study zone have also been reported in other areas but not as predominant plants. This is the case of *Eucalyptus* in Senegal (Ricciardelli and Compagnucci, 1991), *Eucalyptus* and *Terminalia* in Somalia (Ricciardelli and Monaco, 1986), *Bidens* in Zambia (Persano et al., 1988), *Mimosa*, and *Combretum* and *Terminalia* in Somalia (Ricciardelli and Monaco, 1986).

On the contrary, *Ageratum hostonianum*, *T. diversifolia*, *Phoenix reclinata*, *Caesalpinia bonduc*, *Buchholzia tholloniana*, *Weinmannia sp*, *Pterocarpus soyauxii*, *Leucas oligocephala, Myrianthus arboreus, Gnidia*

bambutana) are not mentioned elsewhere from the literature. If this is proven to be the case, then these MP could be considered like characteristics of honey of our region and could be used for their identification purpose.

In our study, trees are the most exploited compared to herbs, shrubs and small trees; this corresponds with the findings in Somalia (Ricciardelli and Monaco, 1986) and in Senegal (Ricciardelli and Compagnucci, 1991). But, in the Mediterranean zone (Ricciardelli, 1998), Zambia and Malawi zone (Persano et al., 1988), herbs were more frequent. Exploitation of cultivated and spontaneous MP as PMP was reported in Western Africa (Lobreau-Callen and Damblon, 1994) and in the Mediterranean zones (Ricciardelli, 1998). As in our results, a high proportion of spontaneous PMP was also mentioned by the same authors in these areas. Perennial plants are also exploited as PMP in Senegal (Ricciardelli and Compagnucci, 1991), Somalia (Ricciardelli and Monaco, 1986), Zambia and in Malawi (Persano et al., 1988). However, in the Mediterranean zone (Ricciardelli, 1998); the annual plants compared to perennial were the most foraged by bees.

From our results as also reported in Zambia and Malawi (Persano et al., 1988), white colour flowers plants were the most exploited, but observation in the equatorial zone shows that plants with yellow colour flower were the most harvested by bees (Tchuenguem et al., 2000). The differences between our observation and those of the

literature could be attributed to variation in vegetation, bees species and their foraging behaviour.

Conclusion

Out of the total number of the 142 families harvested by *A. mellifera adansonii*, a few proportion, less than 15% are predominant, *Asteraceae* being the most represented of the eleven families identified as PMP identified in honey samples, only 13.4% are predominant. A higher proportion of PMP are harvested in raining season as compared with the dry season. Trees were more frequently visited by *A. mellifera adansonii* than shrubs, herbs and small trees respectively. Spontaneous PMP compared to cultivated were more visited by bees. This was also the case of perennials PMP compared to annuals. In addition, white colours flowers PMP is represented most compared to others colours. *E. saligna* and *T. mantaly* were the most frequently exploited species in dry season whereas it is *E. saligna* and *P. soyauxii* in raining season. Some of the predominant melliferous plants were also reported elsewhere in tropical African area (*Eucalyptus*) but others (*A. hostonianum, T. diversifolia)* seem to be specific to our study zone.

REFERENCES

Barth OM (2004). Melissopalynologie in Brazil: a review of pollen analysis of honeys, propolis and pollen loads of bees, Sci. Agric., 61(3): 342 - 350.
Dongock ND, Foko J, Pinta JY, Ngouo LV, Tchoumboue J, Zango P (2004). Inventory and identification of melliferous plants of the Sudano-Guinean highlands of West Cameroon. Tropicultura, 22(3): 139 -145.
Dongock Nguemo D, Tchoumboue J, Ricciardelli D'Albore G, Youmbi E and Pinta YJ (2007). Spectrum of melliferous plants used by *Apis mellifera adansonii* in the Sudano-Guinean western highlands of Cameroon, Grana, 46(2): 123 -128.
Gadbin C (1980). Plants harvested by bees in Southern chad, Apidologie, 11(3): 217-254.
Lobreau-Callen D, Damblon F (1994). Pollinic spectrum of honey from *Apis mellifera* L. (Hymenoptere, Apidae) and vegetation zone of Tropical West and Mediterranean, Grana, 33: 245-253.
Papoff CM, Campus Raffaele L, Cicu Maria F I, Farris Antonio G, Ignazio Flroris et Ricciardelli D'Albore G (1988). Physico-chemical, microbiology and pollinic characteristics of Somalian honey, Apicultura, 4: 147–172.
Persano Oddo L, Krell R et Ricciardelli D'Albore G (1988). Contribution to the identification of the geographical and botanical origin of honeys produced in Zambia and Malawi. Apicultura, 4: 113-138.
Ricciardelli D'Albore G, Compagnucci R (1991). Pollinic spectrum of Somalian honey, Apicoltura, 7: 33-49.
Ricciardelli D'Albore G, Monaco R (1986). Apiculture and pollinic spectrum of Senegal honey. Apicoltura, 2: 1-24.
Ricciardelli D'Albore G. (1998). Mediterranean melissopalynolgy, University of Perugia, Faculty of Agriculture, Institute of Agricultural Entomol., 198 p.
Tchenguem Fohouo F-N, Messi J et Nkongmeneck BA (2000). Exploitation of some plants flower by insect in Campo (South Cameroon) Sci. Technol. Dev., 7: 12–7.
Tchenguem Fohouo F-N, Messi J, Brückner D, Bouba B, Mbofung G, Hentchoya HJ (2004). Foraging and pollination behaviour of the African honey bee (*Apis mellifera adansonii*) on *Callistemon rigidus* flowers at Ngaoundere (Cameroon), J. Cameroon Acad. Sci., 4(2): 133-140.
Von D-OW, Persano Oddo L, Piana M L, Morlot M and Martin P (2004). Harmonized methods of melissopalynology, Apidologie, 35: 18 -25.