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Diversity of the Medico-Veterinary and Agricultural Interest Arthropods at Bia in the Sudanian Zone of Mali

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Abstract **Original Research Article**

Arthropods by their progressive evolution, occupyied the first place, either by the role of vectors of pathogenic organisms of some of its representatives, or by the nuisance for others. This study was conducted to document the diversity of the arthropods fauna at Bia in the Sudanian zone of Mali. A monthly inventory during a period from April 2021 to February 2022 was conducted. The collection were made with two types of traps (emergence and "T" traps). Arthropods collected were identified by observation with a magnifying glass using dichotomous identification keys for some and by PCR for mosquitoes. It allowed the inventory of 57 species divided into 2 classes, 10 orders and 50 families. Arthropods of agricultural interest are the most frequent group during the rainy and dry seasons. Among these different orders, the coleoptera are the most represented with a total of 16 families.

Keywords: Arthropods, inventory, seasonal variation, sudanian zone, Mali.

INTRODUCTION

Arthropods are a large phylum in the animal kingdom. They alone represent probably 4/5 of the species in the biosphere. The phylum arthropoda has the largest number of species in the living world with over 1.2 million extant species (Mineli *et al.,* 2013). Several new species of arthropods are described annually including arachnids, myriapods, crustaceans and insects.

Worldwide, there are over 70,000 species of arachnids and 11,885 species of myriapods that are described (Deflosse, 2015). For insects, these are nearly 1,200 new species recorded each year (Duvallet *et al.*, 2018).

Arthropods are a cosmopolitan group that have adapted in natural (deserts, forests, mountains) or anthropogenic (dwellings, oil wells) environments and are among the first animals to colonize land (Nabila and Ayad, 2017). They present an amazing diversity and abundance that can vary according to climatic and biogeographic conditions from one area to another (Fain, 1992). The economic and biological importance of the arthropod phylum suggests that they have a useful role in nature and in maintaining the balance of the ecosystem. Staphylinids are bioindicators of soils when it comes to developing a new agricultural area (Bohac, 1999).

Arthropods fauna occupies the world entomological news, because of its role in the transmission of viral and parasitic diseases that can affect humans, animals and plants (Chahed *et al.,* 2021). Some phytophage arthropods cause significant yield losses on farms. They are responsible for significant economic damage on a very large scale to crops (James *et al.,* 2010; Saethere *et al.,* 2011). Each year, arthropods destroy about 25% of the world's food crops (Abate *et al.,* 2000).

The allergic, stinging and venomous role for vertebrates of some insects has also been reported. They are also biological vectors for the transmission of pathogens in humans such as filariasis, trypanosomiasis,

dengue, Chaga disease, babesiosis (Rhodain & Perez, 1985). Ticks of the genus Hyalomma for example are responsible for Crimean-Congo hemorrhagic fever. In Mali, several species of crop pests have been recorded (Alain, 2007). About 20 species of Arthropods were identified in Mali in a recent study Assitoun *et al.*, (2019). This study was initiated to document the diversity of arthropods in the study area in order to identify potential disease vectors for humans, livestock and crops.

METHODOLOGY

Study Area

The village of Bia (longitude 10°,22' North and latitude 06°,05' West) is located in the Sudanian zone of Mali. It is a border village located less than 10 km from Côte d'Ivoire (Figure 1).

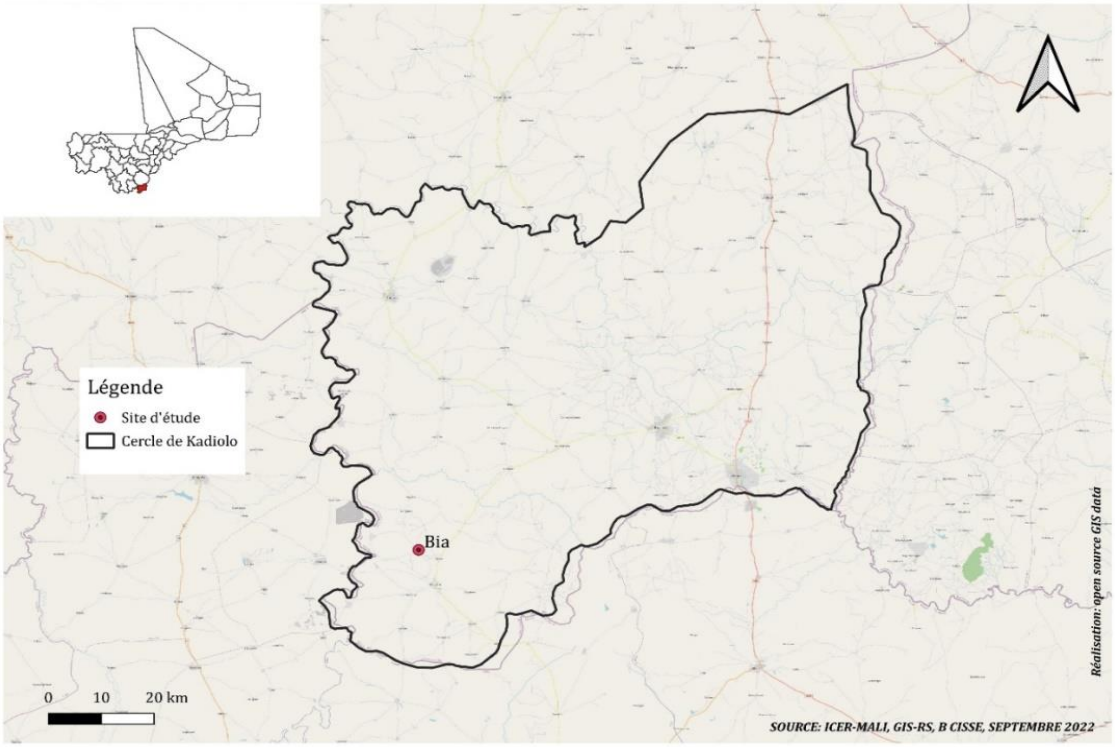

Figure 1: Location of the study area

Material

The animal material consisted of the residual arthropod fauna of the village of Bia. The consumable material consisted of dissection forceps, eppendorf tubes, Falcon tubes of 15 and 50 ml, trinocular magnifying glass, mosquito netting, unimpregnated mosquito netting, iron stake, small flashlight, absolute ethanol, adhesive glue, latex gloves, flexible forceps, petri dishes.

Method

Monthly sampling was done between 2021 and 2022. The captures were made with two types of traps. Each month during the first 5 days, arthropods were collected on both types of traps.

T trap collection

It was based on the collection of arthropods using two pieces of mosquito netting previously induced with adhesive glue this allows the immobilization of arthropods captured by contact with the trap. The "T" trap is made of mosquito netting 1 meter wide x 3 meters long. The face of each mosquito netting is soaked with adhesive glue. The "T" shaped trap collects several arthropod because of the angles created at the intersection. A light source was placed behind to the trap to attract arthropods at night (Assitoun *et al.*, 2021). The collected and counted arthropods are placed in Falcon tubes containing 80% ethanol. Each Falcon tube is labeled with the following information: date collected, trap type, number of arthropods collected.

Emergence trap

This is a method of trapping arthropods that emerge from the water. It consists of installing a rectangular or square mosquito net not impregnated with insecticide free mosquito net at larvae breeding site. The net is attached to metal poles to secure it. Emerged arthropods are collected with forceps or a mouth aspirator. Each day the trapped arthropods are collected, counted and put in the Falcon tube indicating the date, the type of trap and the number of arthropods collected. Figure 2 shows an illustration of the two types of traps used in this study.

Figure 2a: Image of the "T" shaped trap

Figure 2b: Image of the emergence trap

Identification

Individual morphological identification of arthropod specimens was performed using a trinocular magnifier. Several identification keys and general taxonomic determination books based on morphological criteria were used. Species were determined using several documents such as the practical identification manual for the main locusts of the Sahel and West Africa (Launois-Luong & Lecoq, 1988; Launois, 1978; Greathead *et al.,* 1994; Popov, 1989; Mestre, 1988). Other geographically specific keys were used, namely the determination key for the major insect families of Europe (Mignon *et al.,* 2016). The polymerase chain reaction technique has been used for the determination of some mosquito species of the Anopheles gambiae complex (Favia *et al.,* 1997; Fanello *et al.,* 2002).

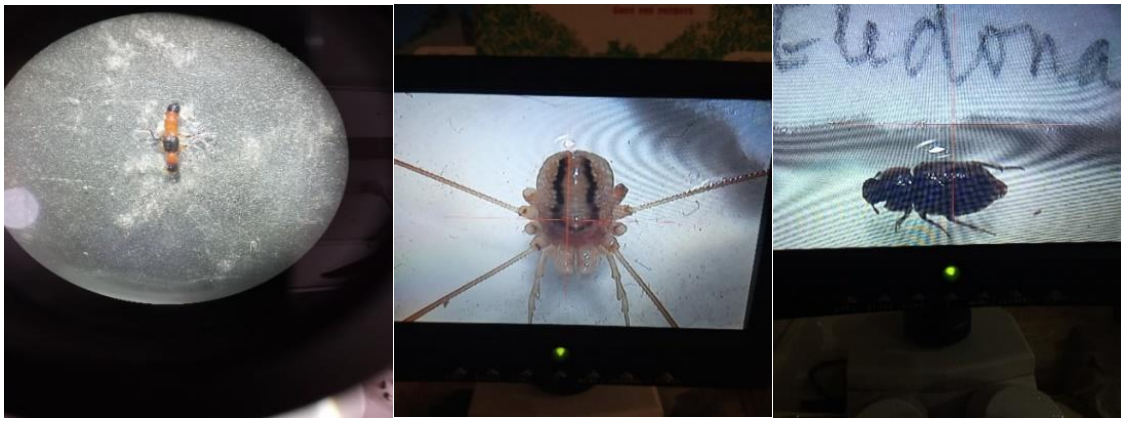

Figure 3: Images of some identified species (from left to right: *Paederus littoralis*, *Pholcus phalangioïdes*, *Eledona agricola*)

RESULT

The seasonal variation of arthropods collected in the village of Bia has been presented in table 1.

Table 1: **Seasonal variation of arthropods caught in Bia**

Season	**2021**				**2022**			
	E-trap		**T-trap**		**E-trap**		**T-trap**	
	Number	%	Number	**%**	Number	**%**	Number	**%**
Rainy	32	36,4	112	61,2	-	-	-	-
Dry	56	63,6	71	38,8	19	41,3	27	58,7
Total	88		183		19	41,3	27	58,7

It can be seen that, the total number of arthropod individuals captured by the T-trap is greater than that of the emergence trap (E-trap). However, in terms of individuals caught, there is a predominance of the T-trap. In the dry season, the percentage of individuals captured by the emergence trap (E-trap) was higher (63.6)% than that of the T-trap (38.8%). The number of individuals captured by the T-trap also dominates in the dry season. The number of individuals captured is also important even in the dry season with the availability of vegetation cover. The presence of arthropods was observed in all seasons. The classification of the main species in the taxonomy of Arthropods collected at Bia is presented in Table 2.

Table 2: Specific diversity of captured arthropods

Class	**Order**	**Family**	**Genus**	**Species**	**Number**
Arachnide	Aranea	Agelenidae	Tegenaria	domestica	1
		Clubionidae	NID	NID	1
		Lycosidae	NID	NID	3
		NID	NID	NID	2
		Tetragnathidae	NID	NID	1
Insecte	Coléoptère	Buprestidae	Agrilus	angustulus	7
			Agrilus	spp	2
		Cantharidae	Cantharis	fusca	2
		Carabidae	Chlaenius	vestitus	1
			Dromius	bicolor	1
			Harpalus	spp	1
			Notiophilus	spp	3
			Odacantha	melanura	1
			NID	NID	15
		Chrysomelidae	Hispella	atra	3
			Phyllotreta	spp	1
			NID	NID	6
		Coccinellidae	Adalia	bipunctata	1
			Dysis	bisquatuorguttata	2
			Scymnus	oblongosignatus	1
			NID	NID	5
		Curculionidae	Phyllobius	spp	1
			NID	NID	4
		Cybocephalidae	Cybocephalus	nipponicus	2
			Cybocephalus	spp	4
		Dytiscidae	Dytiscus	marginatis	1
		Elateridae	Agriotes	lineatus	1
			Agriotes	obscurus	1
			Agriotes	spp	3
		Hydrophilidae	NID	NID	1
		NID	NID	NID	1
		Scarabaeidae	Psamnodius	asper	4
			Scarabaeus	semipunctatus	6
			NID	NID	1
		Scolytidae	NID	NID	1
		Silphidae	Necrodes	spp	1
		Staphylinidae	Ocypus	olens	4
			Paederus	littoralis	5
			Staphylinus	caesereus	5
			Staphylinus	olens	2

Class	Order	Family	Genus	Species	Number
			Staphylinus	spp	2
		Tenebrionidae	Alphitophagus	bifasciatus	1
			Gnathocerus	cornutus	1
	Diptère	Agromyzidae	Agromyza	spp	16
		Calliphoridae	Lucilia	sericata	6
			Lucilia	spp	1
		Culicidae	Culex	spp	10
		Diopsidae	Diopsis	thoracica	3
		Drosophilidae	Drosophila	melanogaster	5
		Muscidae	Musca	domestica	16
			Musca	spp	1
			Ophyra	leucostoma	1
			NID	NID	1
		Psilidae	Chamaepsila	rosoe	1
		Tabanidae	Tabanus	bovinus	2
			NID	NID	2
	Hémiptère	Anthocoridae	NID	NID	1
		Cicadellidae	Cicadella	viridis	2
		Coreidae	NID	NID	1
		Nabidae	Neides	tipularius	1
		NID	NID	NID	9
		Pentatomidae	Aspavia	armigera	6
		Pyrrhocoridae	Dysdercus	spp	3
		Reduviidae	NID	NID	6
	Hyménoptère	Apidae	Apis	mellifera	1
		Braconidae	Diachasmimorpha	longicaudata	2
			Psyttalia	fletcheri	7
		Formicidae	Camponotus	vagus	8
			Dorylus	nigricans	9
			Formica	rufa	2
			Lasius	niger	5
			Myrmica	laearinodis	1
		Ichneumonidae	Fopius	arisanus	1
			Rhyssa	persuasoria	2
			NID	NID	7
		Tenthredinidae	Rhogogaster	viridis	1
		Vespidae	NID	NID	7
	Isoptère	Kalotermidae	Kalotermes	flavicollis	5
	Lépidoptère	NID	NID	NID	5
		Pieridae	Pieris	rapae	1
	Mantoptère	Mantidae	Ameles	decolor	1
	Odonaptère	Coenagrionidae	Ceriagrion	tenellum	3
			Ischnura	elegans	2
		Gomphidae	Gomphus	spp	1
	Orthoptère	Acrididae	Catantops	stramineus	1
			Chrotogonus	senegulensis	2
			Morphacris	fasciata	2
			Tetrix	undulata	1
			NID	NID	4
		Gryllidae	Acheta	domestica	12
			Gryllus	campestris	1
		Pyrgomorphidae	Chrotogonus	senegalensis	5
		Tetrigidae	Tetrix	subulata	11

Analysis of Table 2 shows the presence of 2 classes, 10 orders, 47 families and 54 species of arthropods identified in the village of Bia. The individuals collected in Bia are grouped in two sub-branches (Antennates and Chelicerates). The largest number of families was observed in Coleoptera (15) with

a predominance of Carabidae, Coccinellidae, Chrysomelidae, Scarabaeidae, Curculionidae, Elateridae, Buprestidae, Silphidae, Cybocephalidae, Staphylinidae, Cantharidae, Dystiscidae, Scotylidae and Hydrophilidae. Diptera come in second position with 8 families including mainly Tabanidae, Agromyzidae, Calliphoridae, Culicidae, Diopsidae Drosophilidae, Muscidae and Psilidae. Hemipterans have 7 families with a predominance of Pentatomidae, Reduviidae, Pyrrhocoridae, Cicadellidae, Nabidae, Anthocoridae and Coreidae. Hymenoptera total 6 families among which Formicidae, Braconidae, Apidae, Tenthredinidae, Vespidae and Ichneumonidae. The Tetrigidae, Pyrgomorphidae, Acrididae and Gryllidae are the most important families among the Orthoptera. The order of Araneids is represented by the Tetragnathidae, Clubionidae, Agelinidae and Lycosidae. The Gomphidae and Coenagrionidae are the 2 respective families of Odonapteres. Finally, only one family (Mantidae) was observed in Mantoptera, Lepidoptera (Pieridae) and Isoptera (Kalotermidae). Coleoptera has the largest number of species (20). Hymenoptera total 11 species followed respectively by Orthoptera (8), Diptera (7), Hemiptera (3), Odonaptera (2). Araneids, Isoptera and Mantoptera are represented by a single species. Figure 4 shows the distribution of arthropods by group of interest in the wet and dry seasons.

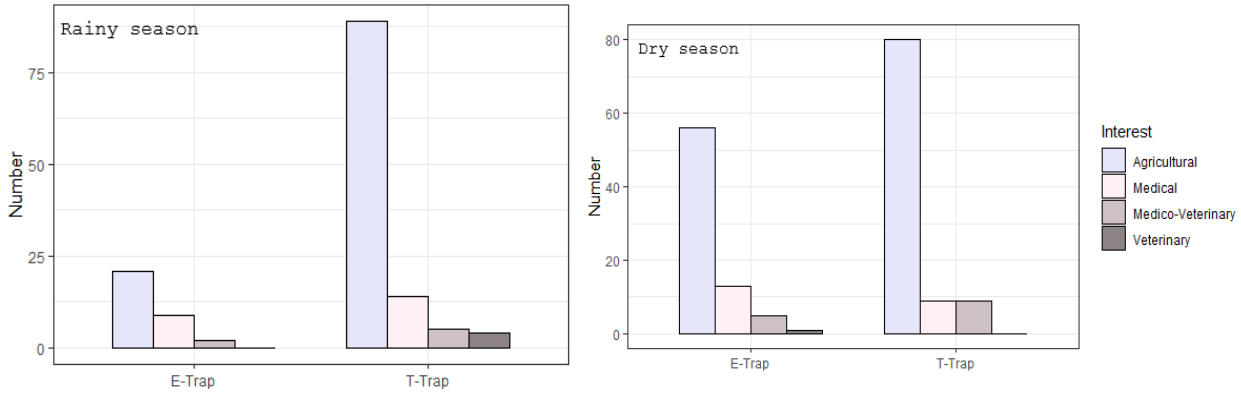

Figure 4: Distribution of arthropods according to group of interest

The number of arthropods captured by the "T" trap is higher than that of the emergence trap (E-trap) during the rainy season with a predominance of arthropods of agricultural interest at the level of each type of trap (77.6% for T-trap and 22.4% for E-trap). Arthropods of medical interest come second with 14% for T-trap and 9% for E-trap. Arthropods of medico-veterinary interest total 4% for the T-trap and 2% for the E-trap. The group of arthropods of veterinary interest was observed only with the use of the "T" trap (4%). In the dry season, arthropods of agricultural interest are also found to be most numerous. The "T" trap achieved 80% capture and the emergence trap totaled 56%. Arthropods of medical interest take second place with 13% for the emergence trap and 9% for the "T" trap.

Arthropods of medico-veterinary interest account for 9% for the emergence trap and 5% for the "T" trap, respectively. However, only 1% of arthropods of veterinary interest were observed with the emergence trap.

DISCUSSION

Dynamics and taxonomy of captured arthropods

The results of this study reveal the presence of two classes of arthropods among which insects are the most represented. These results are similar to those of Koné (2019) in a study on the inventory and identification of endophilic arthropods of medico-veterinary interest in the peri-urban and urban area of Bamako District.

A study conducted on the seasonal variation of arthropods (from October to January) at Thiérola by Yaro *et al.*, (2018), showed that 80% of the arthropods captured belonged to the insect class. The results are also similar to those of Boussad & Doumandji (2004) who report that insects rank first in their sampling with 73 species compared to Arachnids represented by 1 species. A study conducted in Algeria on faunal biodiversity in Sebkhet by Gouga (2014) showed that the insect class represents the largest number of species with 93.6 of all invertebrates recorded. The number of arthropods captured by the T-trap was greater than that of the emergence trap, but the frequency of Arthropods per season was approximately equal. Therefore, there was no significant difference (P-value= 0.142214).

This result could be explained by the optimal humidity and temperature that are favorable to the evolution and development of arthropods. The presence of arthropods is related to the vegetation. Vegetation is the refuge for some arthropods and the food source for others. When the vegetation is dense, the diversity of the arthropod population increases. We can find several species sharing the same biotope. A study on the seasonal variation of Arthropods of medico-veterinary and agricultural interest in 3 ecoclimatic zones in Mali by Assitoun *et al.*, (2019), showed that the village of Bia

occupies the first position compared to the villages of Thiérola and Keniéroba with a frequency of 49% of Arthropods captured during the dry rainy season.

The arthropods captured were mostly insects and some arachnids. The class of insects included several orders: Coleoptera, Diptera, Hemiptera, Hymenoptera, Mantoptera, Orthoptera, Odonaptera, Lepidoptera, Isoptera. In terms of orders identified and families, this observation is similar to that of Banjo *et al*., (2006), carried out on tropical Basilisk in Nigeria, except for Mantoptera and Lepidoptera with a total of 52 families. This result is similar to that of Yarou Boni *et al*., (2018) who used swath nets as a sampling method. The global inventory revealed the existence of 57 species, divided into 50 families and 9 orders. The family Carabidae (order Coleoptera) was the most dominant in terms of species identified compared to the other families. This result corroborates with that found by Assitoun *et al.,* (2019), having used the same sampling method.

This result is similar to that of Gouga (2014), who showed that 39.18% of the species found belong to the order Coleoptera. In Algeria, Mekki (2016), on the ecological study of the artthropodofauna in some stations in Retama raetam reported that the order Coleoptera was the most represented with a total of 28 species grouped into 9 families in all capure stations. The larger number of species in the order Coleoptera could be explained by the fact that many species in this group feed on leaves, roots and stems of plants. However, the importance of the order Hymenoptera would be due to their role as plant pollinators or parasitoids. A similar study in Brazil found that a significant number of Hymenoptera are attracted to flowers (Schoeninger *et al.*, 2011).

Arthropods of medical, agricultural and veterinary interest

This study revealed the presence of several groups of arthropods of agricultural, medical, medico-veterinary and veterinary interest in the village of Bia. The arthropods of agricultural interest are the most dominant. This could be due to the biological development and survival conditions that seem to be easy for Arthropods that live at the expense of available plants during the rainy season as reported by Yaro *et al.*, (2018) and Florio *et al.*, (2020). The low representation of Arthropods of veterinary interest could be due to other factors. The capture methods used in this study would necessarily not be appropriate for their sampling.

CONCLUSION

The objective of this study was to document the diversity of arthropods in the Sudanian zone of Mali in order to identify potential disease vectors for humans, animals and crops. It allowed the inventory of 54 species divided into 2 classes, 10 orders and 47 families. Arthropods of agricultural interest are the most frequent group during the rainy and dry seasons. This research work constitutes a contribution to the knowledge of the arthropod fauna in the village of Bia in the Sudanian zone of Mali, which is of capital importance for the enrichment of the regional inventory.

REFERENCES

- Abate, T., Van Huis, A., & Ampofo, J. (2000). Stratégies de lutte contre les ravageurs dans l'agriculture traditionnelle: une perspective africaine. *Revue annuelle d'entomologie*, 45(1), 631-659.
- Annabelle, L., Sophie, D. R., & Clément, S. (2012). Identification des insectes utiles en entomologie légale. Muséum National d'Histoire Naturelle.
- https://f2school.com/wp-content/uploads/2020/04/Entomologie-R%C3%A9sum%C3%A9-02.pdf
- Assitoun, A., Keïta, Y. F., Yaro, A. S., & Camara, M. (2021). Variation saisonnière des Arthropodes d'intérêt médical, vétérinaire et agricole dans différentes zones éco-climatiques du Mali. *International Journal of Advanced Research*, 9(16), 656-668.
- Banjo, A., Lawal, O., & Aina, S. (2006). Insect diversity of two medicinal Labiatae in Southwestern Nigeria. *Journal of Entomology*, 3(298–304).
- Bohac, J. (1999). Les coléoptères staphylinidés comme bioindicateurs. Agriculture, écosystèmes et environnement. *Agriculture, Ecosystems and Environment*, 74(1-3), 357-372.
- Chahed, S., Brahimi, K., & Djouaher, T. (2021). Étude sur la faune Culicidienne (Diptera: Culicidae) de la région de Tizi-Ouzou (Nord d'Algérie): Biodiversité, abondance et répartition. *Entomologie faunistique*, 1(74).
- Delfosse, E. (2015). Addendum sur les Arachnides, les Myriapodes et les insectes de France et du monde(Arthropoda). *Bulletin d'Arthropoda*, Issue 48.
- Duvallet, G., Fontenille, D., & Vincent, R. (2018). Arthropodes d'importance médicale ou vétérinaire. IRD, Marseille. 688p.
- Fain, A. (1992). Arthropodes d'importance médicale. Médecine et hygiène en Afrique centrale. s.l.:s.n.
- Fanello, C., Santolamazza, F., & della Torre, A. (2002). Identification simultanée d'espèces et de formes moléculaires du complexe Anopheles gambiae par PCR-RFLP. *Entomologie médicale et Vétérinaire*, 16(4), 461-464.
- Favia, G., Della Torre, A., & Bagayoko, M. (1997). Identification of sympatric chromosomal forms of Anopheles gambiae and further evidence of their reproductive isolation. *Insect molecular biology*, 6(4), 377-383.
- Florio, J., Verú, L. M., & Dao, A. (2020). Diversity, dynamics, direction,and magnitude of high-altitude migrating insects in the Sahel. *Sci Rep*, 10, 20523. https://doi.org/10.1038/s41598-020-77196-7

- Gouga, H. (2014). Biodiversité faunistique à Sebkeht Bazer (Sud Sétif), connaissance et conservation. Thèse de Doct, Université Ferhat Abbas de Sétif. 174p. https://mmagister.univ-setif.dz/images/facultes/SNV/2014/GOUGA%20Hadjer.pdf
- Greathead, D., Kooyman, C., Launois-Luong, M., & Popov, G. (1994). Les Ennemis Naturels Des Criquets Du Sahel. Paris: Ministère des Affaires étrangères des Pays-Bas.
- James, B., Atcha-Ahowe, C., & Godonou, I. (2010). Lutte intégrée contre les ravageurs dans la production maraîchère: Un guide pour les agents de vulgarisation en Afrique de l'Ouest.. s.l.:IITA.
- Koné, S. I. (2019). Inventaire et Identification des genres ou espèces d'Arthropodes endophiles d'intérêt médico-vétérinaire dans la zone péri-urbaine et urbaine du district de Bamako (Mali), Bamako. Mémoire de Master, FST/USTT-B.
- Launois-Luong, M. H., & Lecoq, M. (1989). Vade-Mecum des criquets du Sahel. s.l.:s.n.
- Launois, M. (1978). Manuel pratique d'identification des principaux acridiens du Sahel. Paris: Centre de documentation du Ministère de la Coopération.
- Mekki, A. (2016). Contribution à l'étude écologique de l'Arthropodofaune dans quelques stations à Retama raetam (Fabacées) dans la région de Naâma, Naâma: s.n.
- Mestre, J. (1988). Les Acridiens des formations herbeuses d'Afrique de l'Ouest. Paris: CIRAD-PRIFAS.
- Mignon, J., Haubruge, E., & Francis, F. (2016). Clé d'Identification des Principales Familles d'Insectes d'Europe. Les Presses Agronomiques de Gembloux.
- Mineli, A., Boxshal, G., & Fusco, G. (2013). Arthropod Biology and Evolution. Berlin: Springer-Verlag Berlin Heidelberg 2013.
- Nabila, B. B., & Ayad, M. (2017). Inventaire des Arthropodes de quelques milieux naturels de la région de Bejaia, Bejaia: s.n.
- Popov, G. (1989). Les larves des Criquets du Sahel. s.l.:s.n.
- Renou, A. (2007). Importance et contrôle des ravageurs en zone cotonnière au Mali. https://agritrop.cirad.fr/567196/1/document_567196.pdf
- Rhodain, F., & Prerez, C. (1985). Précis d'entomologie médicale et vétérinaire: notions d''épidémies des maladies à vecteurs. Editions Maloine, 458p.
- Saethre, M., Godonou, I., & Hofsvang, T. (2011). Pucerons et leurs ennemis naturels dans les agroécosystèmes maraîchers au Benin. *Journal international de la science des insectes tropicaux* 31(1-2), pp. 103-117.
- Schoeninger, K., Somavilla, A., & Köhler, A. (2011). Community of floral visiting insects of Ocimum selloi Benth (Lamiaceae) in Santa Cruz do Sul, Rio Grande do Sul, Brazil. *Biotemas*, 1(25), pp. 55-63.
- Yaro, A.S., Dao, A., & Camara, M. (2018). Diversité saisonnière des arthropodes à Thiérola, un village sahelien du Mali., Bamako: s.n.
- Yarou, B. B., Aimé H, B. G., Assogba-Komlan, F., Armel, M., François, V., & Frédéric, F. (2018). Inventaire de l'entomofaune associée au basilic tropical (Ocimum gratissimum L., Lamiaceae), dans le sud du Benin. *Entomologie Faunistique*, 1(78).