



## Propagation and morphological diversity of ticks *Rhipicephalus (boophilus) microplus* (Canestrini, 1888) in northern Côte d'Ivoire

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### Abstract

*Rhipicephalus (Boophilus) microplus*, although newly introduced in Côte d'Ivoire, is well known to livestock producers in other countries. This tick has a strong invasive power because several parameters such as its strong resistance to common acaricides. In our study, we assessed the level of diversity of *R. (B.) microplus* populations. The ticks were collected in November 2014 from cattle on ten (10) farms located north of Côte d'Ivoire. These farms are located on the transhumance corridor located between Côte d'Ivoire and Burkina Faso. After the identification of the ticks, seven (7) species were obtained. The species *R. (B.) microplus* was numerically in the majority with 82.78% followed by *Amblyomma variegatum* with 14.86%. The other species were obtained in very small proportions. Analysis of the qualitative and quantitative parameters therefore allowed us to highlight a variation of form of *R. (B.) microplus* which is a species capable of transmitting pathogens.

**Keywords:** Côte d'Ivoire, resistance, morphological diversity, transhumance, *Rhipicephalus (Boophilus) microplus*

### 1. Introduction

Ticks have a major role in human and animal epidemiology. Thus, they transmit a wider variety of pathogens than any other group of arthropods and are among the most important vectors capable of infecting both humans and pets [1]. In Côte d'Ivoire, they constitute one of the main threats to cattle breeding where the identified tick species are distributed in three genera: *Rhipicephalus*, *Hyalomma* and *Amblyomma* [2, 3, 4, 5]. Ticks of the genus *Boophilus*, recently grouped as a subgenus of *Rhipicephalus*, are among the most important species in cattle farming in the world [6]. Each of the five species of the sub-genus *Rhipicephalus (Boophilus)* has a monoxene life cycle which can last from 3 to 4 months and the parasitic load of these species per animal is really considerable [7].

Among these species, *Rhipicephalus (Boophilus) microplus* (Canestrini, 1888) is considered to be the most economically important livestock ectoparasite in tropical and subtropical regions [6]. Indeed, in several regions where this species is present, we have observed in populations of *R. (B.) microplus* the appearance and then the evolution of resistance to acaricides. And according to [8] Furlong, this resistance situation is due to the inappropriate use of chemical acaricides in these regions. Several studies indicate an extension of the distribution of *R. (B.) microplus* in different African countries, such as in South Africa [9], in Tanzania [10], in Côte d'Ivoire [11, 12] and recently in Nigeria [13].

In Côte d'Ivoire, some studies have confirmed this presence and the invasion capacities of this species in the souther

region [14, 15] and in the north [12, 4, 5] where this tick is already experiencing increased proliferation. It is in this northern part of Côte d'Ivoire that borders with Burkina Faso that most of the breeding and transhumance takes place. During these transhumances, animals infested with ticks are exchanged between these two countries.

The objective of this study is, after the harvest and the identification of ticks, to draw up a list of tick species and to assess the morphological diversity of the populations of *R. (B.) microplus* on the transhumance corridor located between Côte d'Ivoire and Burkina Faso. This study will therefore make it possible to obtain information on the species present and on the morphological variability in this species. It will also make it possible to validate certain criteria for identifying the tick granted by Walker *et al.* [7].

### 2. Material and methods

#### 2.1 Study area

The study area is located in the northeastern part of the Côte d'Ivoire, precisely that between (08° - 09° N; 04° - 05° W) (Table 1). This area has the particularity of receiving most of the cattle transiting from Burkina Faso to Côte d'Ivoire. These cattle movements are made by interstate transhumance between these two border countries. In this transhumance corridor located between these two countries we have two axis. The farm composition of the two identified axis is as follows: axis 1 includes the farms Hamdalaye (O3), Ferké (F1), Sepikaha (N4), Petionara (N5), Darakokaha (K1) and axis 2 includes the farms Doropo (G3), Kafolo-bac (G1), Nafana (G8), Torokinkenin

(G10), Dabakala (D3) (Figure 1).

### 2.1 Ticks populations studied and sampling method

Ten (10) farms distributed along the transhumance corridor between Côte d'Ivoire and Burkina Faso were selected based on various criteria: their location along this corridor, the number of animals (20 cattle at least) and the presence of infrastructures for livestock support (water retention dams, livestock management structure). The ticks were removed in November 2014 from these ten (10) farms. In each of the selected farms, ticks were sampled for 5 to 7 minutes on each animal (15 cattle per farm). The collected ticks were conserved 70% alcohol. The geographical coordinates of the collection site recorded using a Global Positioning System (GPS) and date were mentioned on each pot.

### 2.3 Study of morphological characters

Beforehand, the collected ticks were identified at the species level, using a binocular magnifier OPTIKA at 10X and 20X magnification and identification keys [7, 16, 17, 18]. This identification of ticks was performed in the laboratory of "Ecole d'Élevage et des Métiers de la Viande de Bingerville (ESEMVB)".

The study of morphological characters only concerned male individuals. As such, two (2) qualitative parameters (Form the spurs of adanal plates, Color conscutum) and two (2) quantitative parameters (Number hypostomal teeth, Number of setae on second and third article of pedipalpe) have been observed.

These qualitative and quantitative parameters were observed using identification keys and a binocular magnifier. The characters observed on the ventral side of the tick are: Number hypostomal teeth; Number of setae on second and third article of pedipalp and Form the spurs of adanal plates. Color conscutum was observed on the dorsal side of the tick.

The analyzes focused on the comparison of a total of 259 individuals of *R. (B.) microplus* observed for these four (4) characters.

The composition of individuals by farms is as follows: on axis 1 farms F1 (21 individuals), K1 (27 individuals), N4 (25 individuals), N5 (26 individuals), O3 (29 individuals), and on axis 2 farms D3 (30 individuals), G1 (27 individuals), G10 (25 individuals), G3 (23 individuals), G8 (26 individuals).

### 2.4 Statistical analysis

For the parameter analysis, the Fisher test was carried out with the STATA software. This test makes it possible to compare the means and the variances. The value of F is compared to the values of p (or 'p-value'). If this p-value is less than 0.05 (limit of significance), the observed results are statistically significant. The test allows us to compare the frequencies of the different characters between the two axes.

## 3. Results & Discussion

### 3.1 Genera and species of ticks identified

Of the ten farms located on the two axis of the transhumance corridor, 2079 ticks belonging to three genera were identified. These are the genera *Amblyomma*, *Hyalomma* and *Rhipicephalus*. The size of the tick species encountered and their abundance in decreasing order are

given in Table 2.

Seven (7) ticks species have been identified, including 82.78% *R. (B.) microplus*, 14.86% *Amblyomma variegatum* (Fabricius, 1794), 1.11% *Hyalomma truncatum* (Koch, 1844) and the other species *Hyalomma marginatum rufipes* (Koch, 1844) *Hyalomma impressum* (Koch, 1844), *Rhipicephalus (Boophilus) annulatus* (Say, 1821) and *Rhipicephalus (Boophilus) geigy* (Aeschlimann & Morel, 1965) had rates below 1%.

### 3.2 Paramètres étudiés

The analyzes focused on the comparison of a total of 259 male individuals of *R. (B.) microplus* observed for four (4) characters. Observation of the qualitative and quantitative parameters revealed the presence of different characters at the specimen level. These results are summarized in Table 3.

For the parameters such as the number of setae on second and third article of pedipalp, the number hypostomal teeth and the color conscutum, there is no significant difference between the ticks located on the two axis. On the other hand at the level of the parameter form the spurs of adanal plates, there is a significant difference because the P value ( $P < 0.05$ ). There is therefore a link between form the spurs of adanal plates and the axis of the transhumance corridor. The ticks *R. (B.) microplus* located on axis 1 are different from those located on axis 2 for this parameter.

## 4. Discussion

During our study on the transhumance corridor, the identification of ticks collected from cattle yielded seven (7) species. These species are divided into three genera and one sub-genus. These are the genera *Amblyomma*, *Hyalomma*, *Rhipicephalus* and the sub-genus *Rhipicephalus (Boophilus)*. These genera and subgenus have also been identified by several authors in the breeding areas of Côte d'Ivoire [2, 3, 4]. This identification of ticks resulted in the majority *R. (B.) microplus* with 82.78% of all ticks. In 2007, *R. (B.) microplus*, a potential vector of *Babesia bovis*, had been identified for the first time in the south-east of Côte d'Ivoire, where this species now seems to cause major problems on dairy farms [19]. Indeed after the introduction of this tick in Côte d'Ivoire, this species has proliferated and is currently found as the predominant species in all the major breeding areas of Côte d'Ivoire [14, 3, 4, 5]. This species has a great capacity for invasion and a real resistance to the acaricide used [8]. And according to Baffi *et al.* [20] the resistance acquired by this species to most of the acaricides available on the market in several regions of the world, could have favored the replacement of the other species of *R. (Boophilus)*.

To secure livestock production and the improvement of cattle breeds, it is necessary to import exotic breeds of cattle. Thus, the development of identification methods could offer opportunities for the surveillance of ticks on livestock, especially during importation. It turns out that the morphological differences between the species of the subgenus *R. (Boophilus)* are extremely small and some of the characteristics also seem to be very variable especially in females [21]. Also at the level of individuals of the species *R. (B.) microplus*, we have differences and characteristics which can be variable. Thus in this study we observed heterogeneity in the shape of the individuals collected in the different geographic regions of the transhumance corridor.

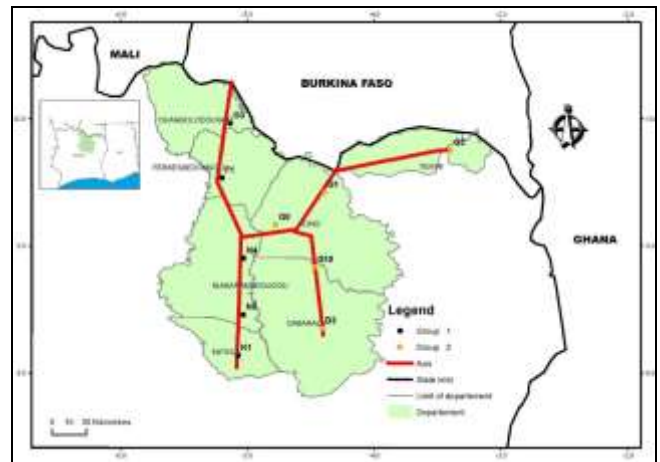
This morphological variation was significant at the level of the adanal plaques. For this parameter, the ticks observed at the farms located on axis 1 showed a morphological difference compared to those located in the farms on axis 2. Unlike the study by Walker *et al.* [7] who showed that the spurs of adanal plates were indistinct, we observed on top of that very distinct spurs of adanal plates which can cause confusion as to identification. The presence of *R. (B.) microplus*, this new invasive species, could be the basis of certain emerging diseases such as Babesiosis, anaplasmosis and the decrease in specific diversity. As is the case with the other species of the sub-genus *Rhipicephalus (Boophilus)* which have almost disappeared in most farms in Côte d'Ivoire. This morphological diversity could contribute to a better adaptation of the species which makes it the most abundant tick in breeding. It would therefore contribute to the invasive power of the species. The study of morphology therefore allows us to highlight the shape variations of *R. (B.) microplus*. In this study, we also observed as Lempereur *et al.* [21] a variation in the Number hypostomal teeth because in some individuals we observed a dentition of  $4.5 \times 4.5$  (three or four additional teeth between the interior rows). *R. (B.) microplus* has  $4 + 4$  columns of teeth on its hypostome and *R. (B.) Decoloratus* has only  $3 + 3$  columns. In *R. (B.) decoloratus*, we note the presence of caudal appendage, elongated and very pointed adanal plates and particularly the presence of three pairs of rows of teeth. The characteristics of *R. (B.) geigy* are similar to those of *R. (B.) decoloratus* except that it has four pairs of rows of teeth. As for the species *R. (B.) microplus*, we observe four rows of teeth, a caudal appendage and thick and less elongated adanal plates [7]. We observed in the majority of ticks two (2) setae on the 2nd and one (1) setae on the 3rd article of pedipalp as shown by Walker *et al.* [7] Some ticks had 2 setae on the 2nd and 2 setae on the 3rd article of pedipalp as observed by Estrada-Pena *et al.* [22] in *R. (B.) microplus* from Australia where *Rhipicephalus (Boophilus) Australis* for a very long time had been taken for *R. (B.) microplus*. These authors provided by their study a morphological separation of these two species and showed that *R. (B.) australis* had long been confused with *R. (B.) microplus*. In a minority of individuals we observed 3 setae on the 2nd and no setae on the 3rd article of pedipalp. In all the individuals observed there was no setae on article 1 of pedipalp.

In Côte d'Ivoire, ticks are one of the main threats to farming and the transmission of zoonoses. For all these reasons, the ability to identify *R. (B.) microplus* is of importance and helps to prevent spread. Taxonomy is therefore a fundamental part of science for the recognition of species [23]. However, in addition to the implication of taxonomy by data generated here, our results will also raise new questions relating to biology and ecology. This study is capable of helping to choose the vector control strategy, especially in

the context of the control of *R. (B.) microplus*. However, additional studies are therefore necessary for an in-depth study of the phylogeny of cattle ticks in Côte d'Ivoire and in the West African sub-region.

**Table 1:** Geographical coordinates of tick collection sites

Regions	Farm code	Geo-References (DM)
Ouangolodougou	O3	9°58,86'N 5°8,38'W
Ferkéssedougou	F1	9°33,05'N 5°12,33'W
Niakaramadougou	N4	8°55,03'N 2°2,04'W
	N5	8°28,37'N 5°2,16'W
Katiola	K1	8°9,01'N 5°4,57'W
Doropo	G3	9°46,34'N 3°24,01'W
	G1	9°26,14'N 4°23,71'W
	G10	8°50,88'N 4°28,39'W
Kong	G8	9°10,89'N 4°46,9'W
	D3	8°21,86'N 4°24,62'W



**Fig 1:** Location of farms on the two axis of the transhumance corridor.

**Axis 1:** O3- Hamdalaye; F1- Ferké; N4- Sepikaha; N5- Petionara; K1- Darakokaha  
**Axis 2:** G3-Doropo; G1- Kafolo-bac; G8- Nafana; G10- Torokinkenin; D3- Dabakala

**Table 2:** Number of ticks species encountered and their abundance in descending order

Ticks species	Number of ticks	Fréquence %
<i>Rhipicephalus (Boophilus) microplus</i>	1721	82.78
<i>Amblyomma variegatum</i>	309	14.86
<i>Hyalomma truncatum</i>	23	1.11
<i>Hyalomma marginatum rufipes</i>	16	0.77
<i>Hyalomma impressum</i>	6	0.29
<i>Rhipicephalus (Boophilus) geigy</i>	3	0.14
<i>Rhipicephalus (Boophilus) annulatus</i>	1	0.05

**Table 3:** Qualitative and quantitative parameters of *R. (B.) microplus* collected in different axis of the corridor

Parameters		%		Statistical data					
		Axis I	Axis II	Pearson K $\chi^2$	P	Likelihood-ratio K $\chi^2$	P	Fisher's	
Qualitative Parameters	Form the spurs of adanal plates	Blunt	61.719	42.748	0.051	0.821	0.051	0.821	0.899
		sharp	38.281	57.252					
	Color conscutum	Dark	60.156	58.779					
		Pale	39.844	41.221					
Quantitative Parameters	Number hypostomal teeth	4 full rangers each side	97.656	95.42	0.965	0.326	0.985	0.321	0.5
		4 full rangers and 1 small rangers	2.344	4.58					

		rangers each side							
Number of setae on second and third article of pedipalp	2 on the 2 <sup>nd</sup> Article and 1 of the 3 <sup>rd</sup> Article	85.938	90.84	1.549	0.461	1.558	0.459	0.466	
	3 on the 2 <sup>nd</sup> Article and 1 of the 3 <sup>rd</sup> Article	3.125	2.29						
	2 on the 2 <sup>nd</sup> Article and 2 of the 3 <sup>rd</sup> Article	10.938	6.767						

## 5. Conclusion

This study revealed seven (7) tick species in cattle in the north of Côte d'Ivoire. These species divided into three genera are: *Amblyomma variegatum*, *Rhipicephalus (Boophilus) microplus*, *Rhipicephalus (Boophilus) geigyi*, *Rhipicephalus (Boophilus) annulatus*, *Hyalomma marginatum rufipes*, *Hyalomma impressum*, *Hyalomma truncatum*. The species *R. (B.) microplus* was numerically in the majority with 82.78% followed by the species *Amblyomma variegatum* with 14.86%. The study on the morphology of the male *R. (B.) microplus* in the regions located on the two axes of the transhumance corridor located between Côte d'Ivoire and Burkina Faso has concluded that there is a variation in shape within the species. On the ten (10) farms coming from the corridor, the analysis of the quantitative and qualitative parameters showed a morphological heterogeneity in this species, in particular at the level of the adanal plates. From this study, we assessed the level of diversity of *R. (B.) microplus* using morphological characters of the tick. Our results will therefore be able to contribute to an even more effective planning and execution of monitoring and control programs in these regions located on the axes of the Ivoir-Burkinabé transhumance corridor. Henceforth, these heterogeneities of *R. (B.) microplus* populations should be taken into account in the development of control strategies.

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