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Original Research Article

Sensitivity of Cattle Genetic Types to Tick Species Infestations at the Yamoussoukro Dairy Station

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Abstract

Ticks are a significant impediment to the establishment of cattle production units in West Africa, notably in Côte d'Ivoire. A research was conducted at the Yamoussoukro Dairy Station from April to July 2020 to help in the battle against ticks and tick-borne diseases. A total of 1560 ticks were collected from cattle at the indicated station, subdivided into three genera (Boophilus, Amblyomma, and Hyalomma) and four species (*R. (B) microplus, R. (B) annulatus, A. variegatum*, and *H. truncatum*). *R. (B) microplus* was the most prevalent species (48.08 %). The most common species (63.40 %), the most infesting (3.87 ticks/cattle), and the most active (6.10 ticks/cattle) among the cattle at the station were *R. (B) microplus*. The most common, most numerous (1.63 and 1.62 ticks/cattle), and most active (3.18 ticks/cattle) species among the N'Dama and Zebu were *R. (B) microplus* (52.73 %) and A. variegatum (50.91 %). The species *R. (B) microplus* and *R. (B) annulatus* infest Metis animals significantly. These species have the highest incidence of infection and severity of an attack. In terms of parasite intensity, there was a positive association between *R. (B) microplus* and *R. (B) annulatus.*

Keywords: Ectoparasite, epidemiological parameters, cattle, Côte d'Ivoire.

INTRODUCTION

In Côte d'Ivoire, livestock production contributes little (2.9 %) to total GDP. It covers only 49 % and 12 % of meat and milk consumption respectively [1]. The gap is filled by imported products [2]**.** To reduce this dependence on imports, the Ivorian government implemented a livestock strategy with the creation in 1970 of the former Animal Production Development Corporation (SODEPRA), technical support structures (ANADER, LANADA), and agro-pastoral infrastructures [3]**.** Despite these efforts, the meat and milk deficit remain [4]**.** This situation is linked, among other things, to the food and health constraints of livestock. Thus, tick parasitism is one of the major constraints in cattle breeding [5]. According to a study conducted by Touré *et al.* [6], six (6) species of ticks belonging to four genera or sub-genera (Amblyomma spp, Rhipicephalus spp, Rhipicephalus (Boophilis) spp and Hyalomma sp) are present in Côte d'Ivoire. Achi *et al.* [7] stated that the cowdriosis tick *A. variegatum* is predominant with prevalence varying between 66 and 90% in Côte d'Ivoire. In addition, since 2007, a new tick species *R. (B) microplus* has been discovered in Côte d'Ivoire [8]**.** This tropical cattle tick, which was accidentally imported from Brazil, has gradually invaded the entire national territory of Côte d'Ivoire [9**]**. These ticks bring down the genetic potential of cattle by causing reduced productivity, stunted growth, and weight loss[10]**.** Because of their hematophagous feeding mode, they often cause severe anemia in their hosts [11]**.** Moreover, they have the propensity to transmit a wide range of pathogenic organisms such as viruses, bacteria, rickettsiae, and spirochetes [12]**,** which are responsible for several animal and zoonotic diseases. Annual losses from these tick-borne diseases in animals were estimated at $17.33 billion worldwide in 2014 and affect about 80 % of the world's livestock population [3]**.**

Several control approaches have been tested in Côte d'Ivoire to fight against these parasites. The most prevalent tick control products are chemical products (synthetic acaricides) [4]**.** Throughout Europe, South America [13, 14**]**, and several West African nations such as Côte d'Ivoire and Burkina Faso [15], a reduction in sensitivity or even resistance to chemicals has been documented in recent years.

In order to overcome the resistance problems observed during the abuse of chemicals for the eradication of ticks, we study the genetic variation of cattle that show resistance to tick infestation. Therefore, this investigation is focused on the cattle genetic types sensitivity of the tick’s species infestation at the Yamoussoukro dairy station. The aim of this project is to contribute to the increasing of cattle output by controlling ticks. To this purpose tick species at the Yamoussoukro, Dairy Station was inventoried and the genetic variation of the most resistant cattle to tick infestations has been identified.

MATERIALS AND METHODS

MATERIALS

Study site

The autonomous district of Yamoussoukro is a unique type of territorial collectivity which includes the current department of the same name. It has an area of 3500 km2 and is located between 06 ° 49 north latitude and 05 ° 17 west longitude. The vegetation of this autonomous district is Guinean. Pre-forest savannas with mostly grassy sections, densely mixed with small trees from the north, distinguish it. The Marahoué and N'Zi rivers, both tributaries of Bandama, supply this territory with water. It has a dry season that lasts from November to March, with average temperatures of 25.8 ° C. The rainy season is defined by heavy rainfall of around 1,145 mm in June. Yamoussoukro Dairy Station (S.L.Y.), one of the branches of the Integrated Ranch and Station Management Project (PROGIRS). It is located in the premises of the former Institute for Tropical Agronomic Research (IRAT) in the village of Toumbokro, about 32 km from Yamoussoukro (Figure 1).

Biological material

For the study, 1,560 ticks were collected from 194 parasitized cattle at the Yamoussoukro Dairy Station.

Feeding and health management

Plots of freshly planted of panicum maximum C1 is used to feed all the animals at the dairy station. These plots are managed using a three-week rotating grazing technique. The daily grazing time is limited to ten hours. Suckler cows regularly are fed with wheat bran, broken maize, cottonseed, copra cake, and minerals. The animals have constant access to the station's water reservoirs. In addition, the calves are allowed free access to supplements, and all animals have free access to the lick stone.

The farmer gives routinely basic care to the animals, and deworming is done more selectively on zebu and Metis cattle, which are known to be more sensitive to parasites than N'Dama cattle. External deworming in a deworming bath is done once a week during the rainy season and once every two weeks during the dry season. The animals are dewormed internally every six months under the guidance of a private veterinarian.

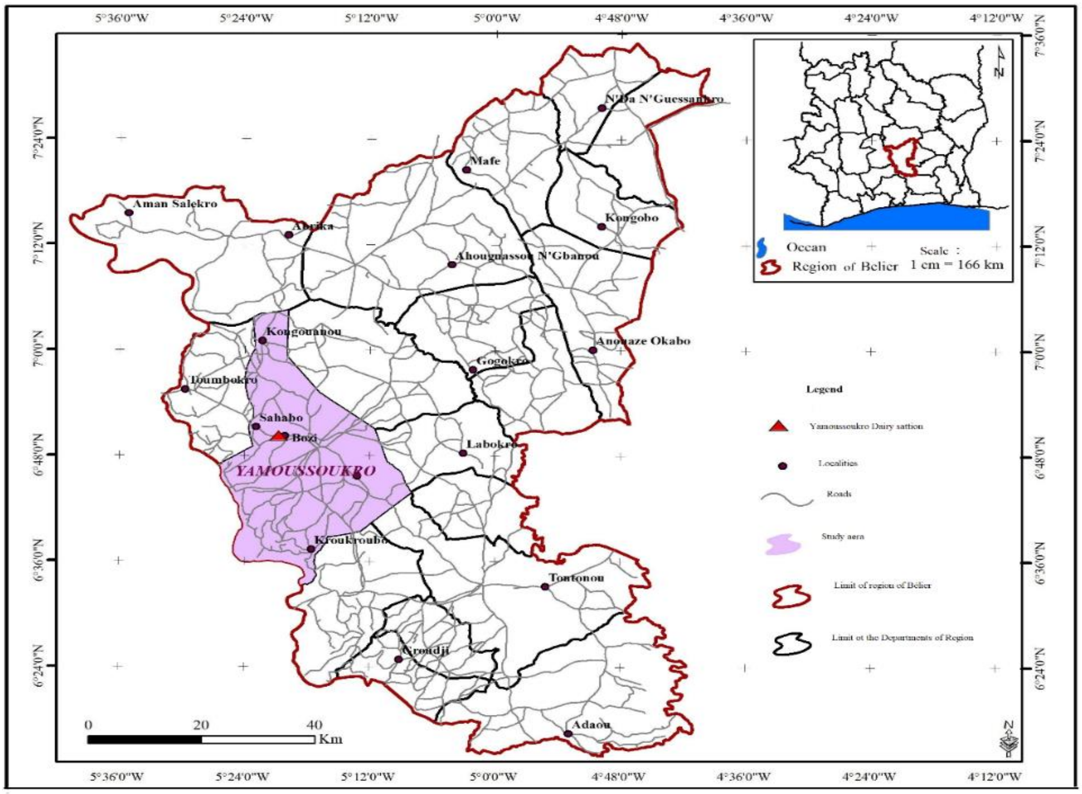

Fig-1: Study aera of Yamoussoukro District

METHODS

Tick collection

Ticks collections were carried out from April to June 2020. The whole body of the cattle was examined to find ticks, but especially around the ticks' preferred attachment sites such as armpits, urogenital area, between the hooves, between the udders and ears. The method involves visually inspecting the coat by spreading it out and removing ticks with a surgical clip. This activity is performed by gently tugging the tick's rostrum, which is an important feature in tick identification.

Conservation of ticks

To retain the ticks' suppleness, they were stored in vials (urine tubes) containing 70% alcohol and glycerin. On each vial, an animal identification number and the date of the collection of the tick were written

Tick identification

To distinguish the different stages of development, the contents of each vial were sorted (larvae, nymphs, and adults). Ticks were identified in the lab by using a light microscope (VWR - BI500) or a digital microscope (USB PCE-MM200) linked to a computer. Each tick's genus was established based on the physical traits of key regions of the tick's body (rostrum, eyes, and festoons). Using the entomological identification keys of Elbe and Anastos [16], Camicas and Morel [17], Matthysse *et al*. [18], and Walker *et al.* [19], the species was determined based on morphological characteristics (scutum punctuation, leg coloring, stigma form, groove, festoon, and eye traits).

Evaluation of epidemiological parameters

Frequency (%)

The presence of a tick species in a location or over a period of time is measured by its frequency. It is the ratio of the number of effective presences of a species (ni) to the number of ticks collected (N) given as a percentage [20].

$$\boldsymbol{F}\,(\%) = \frac{\boldsymbol{ni}}{\boldsymbol{N}} * \mathbf{100}$$

Where **F** is the frequency of a tick species; ***ni*** is the number of individuals of that species and **N** is the total number of ticks collected.

Epidemiological indicators

Three epidemiological indicators were estimated according to Laamri *et al.* [21].

Prevalence of infestation

The percentage or ratio of the number of hosts infected (**N)** by a tick species to the number of hosts (H) investigated is called infestation prevalence (**Pi**).

$$\boldsymbol{Pi}\,(\%) = \frac{\boldsymbol{N}}{\boldsymbol{H}} * \mathbf{100}$$

Infestation abundance

The infestation abundance of a tick species (**Ai**) is the ratio of the total number of individuals of that species ***(ni)*** to the number of hosts examined (**H**).

$$\boldsymbol{Ai} = \frac{\boldsymbol{ni}}{\boldsymbol{H}}$$

Average parasite intensity

The average parasite intensity **(Ip**) is the ratio of the total number of individuals of a tick species (***ni***) in a sample of hosts to the number of infected hosts (**N**) in the sample.

$$\boldsymbol{Ip} = \frac{\boldsymbol{ni}}{\boldsymbol{N}}$$

Statistical analysis

On the acquired data, a simple descriptive analysis was performed to evaluate factors such as frequency, standard deviation, and correlation of the various tick infestations. Then, according to Fisher, an analysis of variance (ANOVA) of the different tick infestation characteristics is used to evaluate the significance of a particular component at the 0.05 level. A post ANOVA Student Newman Keul (SNK) test was used to identify the statistical units tested when the ANOVA test was significant ($p<0.05$). A correlation matrix was used to examine the Pearson correlation coefficients between the parasite intensities of the tick species. The SPSS Statistics program version 25.0 was used to conduct all these analyses.

RESULTS

Cattle inventoried

Three genetic types were identified among the 194 cattle in this study (Figure 2). The local breed (N'Dama), the imported breed (Zebu), and the crossbred (N'Dama x exotic breed) or (N'Dama x introduced breed). The N'Dama (56.70 %) is the most popular breed, followed by Metiss (32.99 %). Only 10 % of the herd analyzed is made up of zebu (Figure 6).

Tick species inventoried

Three genera and four species were identified out of the 1560 ticks collected in this study (Table 2). The species *R. (B) microplus* was the most represented with 48.08 %, followed by *R. (B) annulatus* (27.43 %) and *A. variegatum* (23.59 %). The species *H. truncatum* represented only 0.90% of the ticks collected (Table 2).

Prevalence and infestation rate of ticks in the cattle studied

The overall prevalence was 86.08 % or 167 infested cattle out of a total of 194 head. This prevalence varied from 83.64 % in the N'Dama to 90.63 % in the Metiss (Table 3). Among the genetic types of cattle, the Metiss were susceptible to ticks with a prevalence of 63.91%, followed by the N'Dama with a prevalence of 31.73 %. Zebu was the least susceptible to ticks (4.36 %) (Table 3).

A: N'Dama; B: Zebu; C: Local Métis (N'Dama × Zebu) and D: Exotic Métis (N'Dama × Montbeliarde)

Fig-2: Different genetic types of cattle

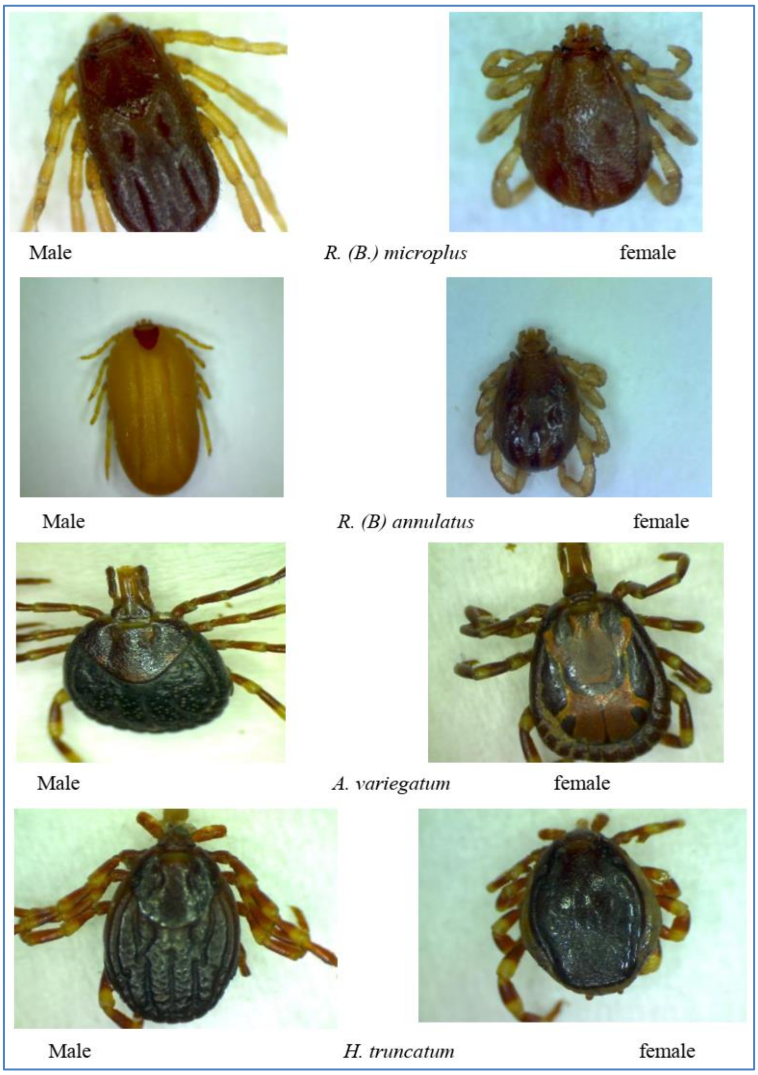

Fig-3: Tick species identified (X 20)

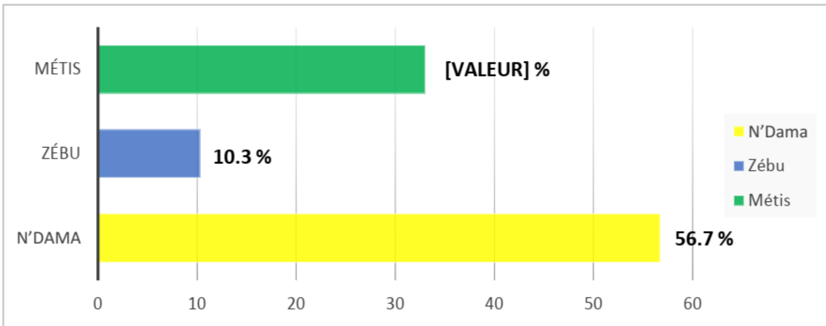

Fig-4: Proportions of genetic types of cattle at the Yamoussoukro Dairy Station

Table-2: Tick species recorded at the Yamoussoukro Dairy Station

Genres	Tick species	Number	Prevalence(%)
Rhipicephalus (Boophilus)	*R. (B) microplus*	750	48.08
	R. (B) annulatus	428	27.43
Amblyomma	*A. variegatum*	368	23.59
Hyalomma-	*H. truncatum*	14	0.90
Statistic test			X^2= 699.754 p< 0. 05

Table-3: Tick prevalence and infestation rate in the Yamoussoukro Dairy Station's cattle population

Bovines	Number	Animals infested	Prevalence (%)	Ticks collected	Infestation rate (%)
N'dama	110	92	83.64	495	31.73
Métis	64	58	90.63	997	63.91
Zébu	20	17	85.00	68	4.36
Total	194	167	86.08	1560	100

The most common species, *R. (B) microplus*, was found in 63.40 % of cattle, followed by A. variegatum (55.67 %) and *R. (B) annulatus* (51.03 %). The species *H. truncatum* has just a 5.57 % prevalence rate. *R. (B) microplus* was the most abundant tick species, with 3.87 ticks per cattle, followed by *R. (B) annulatus* (2.21 ticks/cattle) and A. variegatum (1.90 ticks/cattle). These three species dominate *H. truncatum*, which has a relative abundance of less than 1. In terms of parasite intensity, *R. (B) microplus* activity was notable when compared to the other species. *R. (B) microplus* had 6.10 ticks per cattle, *R. (B) annulatus* had 4.32 ticks per cattle, and A. variegatum had 3.41 ticks per cattle. With 1.27 ticks/cattle, the intensity of *H. truncatum* is low (Table 4). In comparison to other tick species, cattle of three (3) genetic kinds are less sensitive to *H. truncatum* ticks (Table 5). The crossbred cattle are more vulnerable to *R. (B) microplus*, *R. (B) annulatus*, and *A. variegatum* than the N'Dama and Zebu cattle. The N'Dama and mestizo are also susceptible to *A. variegatum*.

Table-4: Epidemiological parameters of parasitic ticks in the cattle herd of the Yamoussoukro Dairy Station

Ticks' species	Prevalence (%)	Abondance	Parasitize intensity
R. (B) microplus	63.40^{a}	3.87 ± 4.82^{a}	6.10 ± 4.81^{a}
R. (B) annulatus	51.03^{b}	2.21 ± 2.93^{b}	4.32 ± 2.76^{ab}
A. ariegatum	55.67^{ab}	1.90 ± 2.34^{b}	3.41 ± 2.17^{b}
H. truncatum	5.67^{c}	0.07 ± 0.31^{c}	1.27 ± 0.47^{c}
Statistic test	F= 66. 825 p<0.05	F= 50.130 p<0.01	F= 12. 058 p<0.01

Values with the same superscript letter (a,b,c) in the same column are not significantly different.

Table-5: Parasite intensity of tick species according to cattle genetic type

	Genetic types			
Ticks' species	N'Dama (Moyenne ± Ecart-type)	Metis (Moyenne ± Ecart-type)	Zebu (Moyenne ± Ecart-type)	Test
R. (B) microplus	3.10 ± 1.62^{b}	9.90 ± 4.87^{a}	3.36 ± 1.56^{b}	F = 57. 906 p<0.001
R. (B) annulatus	2.91 ± 1.44^{b}	5.88 ± 2.91^{a}	1.80 ± 1.30^{b}	F = 22. 775 p<0.001
A. variegatum	3.18 ± 2.15^{ab}	4.04 ± 2.17^{a}	2 ± 1.15^{b}	F = 4. 539 p<0. 05
H. truncatum	1.40 ± 0.55^{a}	1.25 ± 0.5^{a}	1 ± 0^{a}	F = 0. 638 p>0. 05

Values with the same superscript letter (a,b,c) in the same column are not significantly different.

Epidemiological parameters and susceptibility of genetic types of cattle to ticks

N'Dama

The species *R. (B) microplus* was the most common in the N'Dama, accounting for 36.16 %, followed by A. variegatum (35.96 %) and *R. (B) annulatus* (26.46 %). With a frequency of 1.41 %, the N'Dama breed was less sensitive to *H truncatum* species. *R. (B) microplus* (52.73 %), A. variegatum (50.91 %), and *R. (B) annulatus* (40.91 %) were significantly (p<0.05) more common in N'Dama cattle than *H. truncatum* (4.55 %). Despite the high infestation prevalences of *R. (B) microplus, A. variegatum*, and *R. (B) annulatus* on N'Dama cattle, these species were less common. The number of ticks per cattle ranged from 1.20 (*R. (B) annulatus*) to 1.63 (*R. (B) annulatus*). Infestation with *H. truncatum* was found in 0.06 ticks per cattle on average. There is a significant difference (p<0.05) in the number of ticks parasitizing the N'Dama in this infestation. *R. (B) microplus* and *A. variegatum* exhibited an average parasite intensity of 3 ticks/cattle. *R. (B) annulatus* had 2.91 ticks per cow, while *H. truncatum* had 1.4 ticks per cow. The different tick species' infection intensities exhibited no significant differences (p>0.05) (Table 6).

Metis

The species *R. (B) microplus* constitue 53.56 % of the ticks collected in the Metis population. It was followed by *R. (B) annulatus* (28.89 %) and A. variegatum (28.89%). In these Metis, however, the sensitivity of infestation of *H. truncatum* (0.5 %) is modest. Infestation levels were extremely high. *R. (B) microplus* was the most common species, accounting for 84.38 % (p<0.05). The next most common species was *R. (B) annulatus* (76.56 %), which was likewise considerably more common (p<0.05) than *A. variegatum* (65.63 %). With a prevalence frequency of 6.25 %, *H. truncatum* was the least common. The abundance of parasites varied considerably from one species to another. With 8.34 ticks/cattle, *R. (B) microplus* was the most abundant (p<0.05), followed by R. (B) annulatus with 4.50 ticks/cattle. With 2.66 ticks per cattle, it is likewise significantly (p<0.05) more abundant than A. variegatum species. The parasite abundance of H. truncatum species was found to be very high. *H. truncatum* species has a parasite abundance of 0.08 ticks per cattle. The parasitic intensities of the tick species that infested Metis cattle varied a lot as well. *R. (B) microplus* had a much higher intensity (9.90 ticks/cattle) than *R. (B) annulatus*, which had 5.88 ticks/cattle. The parasitic activity of *H. tuncatum* was minimal, with just 1.25 ticks per cattle (Table 7).

Table-6: Epidemiological parameters of ticks in the N'Dama

Ticks species	Frequencies (%)	Prevalence (%)	Abondance (ticks)	Parasitize intensity (ticks)
R. (B) microplus	36.16	52.73^{a}	1.63 ± 1.94^{a}	3.10 ± 1.62^{a}
R. (B) annulatus	26.46	40.91^{a}	1.20 ± 1.70^{a}	2.91 ± 1.44^{a}
A. variegatum	35.96	50.91^{a}	1.62 ± 2.21^{a}	3.18 ± 2.15^{a}
H. truncatum	1.41	4.55^{b}	0.06 ± 0.30^{b}	1.40 ± 0.55^{a}
Test statistics		F = 27.440 p < 0.05	F = 20.023 p < 0.05	F = 1.635 p > 0.05

Values with the same superscript letter (a,b,c) in the same column are not significantly different.

Table-7: Epidemiological parameters of ticks in mestizo

Ticks species	Frequencies (%)	Prevalence (%)	Abondance (ticks)	Parasitize intensity (ticks)
R.(B) microplus	53.56	84.38^{a}	8.34 ± 5.75^{a}	9.90 ± 4.87^{a}
R.(B) annulatus	28.89	76.56^{ab}	4.50 ± 3.57^{b}	5.88 ± 2.91^{b}
A. variegatum	17.05	65.63^{b}	2.66 ± 2.61^{c}	4.04 ± 2.17^{bc}
H. truncatum	0.5	6.25^{c}	0.08 ± 0.32^{d}	1.25 ± 0.5^{c}
Test statistics		$F = 49.790$ $p < 0.05$	$F = 54.604$ $p < 0.05$	$F = 25.878$ $p < 0.05$

Values with the same superscript letter (a,b,c) in the same column are not significantly different.

Zebu

Table 8 shows the distribution of tick species found on zebus. *R. (B) microplus* was the most common tick, accounting for 54.41 % of the 68 ticks collected from zebu cattle, followed by A. variegatum (29.41 %, *R. (B) annulatus* (13.24 %), and *H. truncatum* (2.94 %). R. (B) microplus and A. variegatum had significantly higher infection rates (p<0.05) than H. truncatum (55 % and 50 %, respectively) (10 %). *R. (B) annulatus* infection was found in 25 % of zebu cattle. The various tick species had a low parasite abundance. *R. (B) microplus* was considerably (p>0.05) more numerous than A. variegatum (1 tick/cattle), *R. (B) annulatus* (0.45 ticks/cattle), and *H. truncatum* (0.1 ticks/cattle), despite a density of 1.85 ticks/cattle. *R. (B) microplus* showed significantly (p<0.05) higher activity (3.36 ticks/cattle) than the other tick species. Regarding the parasite intensities of *A. variegatum* (2 ticks/cattle), *R. (B) annulatus* (1.80 ticks/cattle) and *H. truncatum* (1 tick/cattle) no significant differences (p>0.05) were observed.

Table-8: Epidemiological parameters of ticks in Zebu

Ticks species	Frequencies (%)	Prevalence (%)	Abondance (ticks)	Parasitize intensity (ticks)
R. (B) microplus	54.41	$55^{\mathbf{a}}$	$1.85 \pm 2.06^{\mathbf{a}}$	$3.36 \pm 1.56^{\mathbf{a}}$
R. (B) annulatus	13.24	$25^{\mathbf{ab}}$	$0.45 \pm 1^{\mathbf{b}}$	$1.80 \pm 1.30^{\mathbf{b}}$
A. variegatum	29.41	$50^{\mathbf{a}}$	$1 \pm 1.3^{\mathbf{b}}$	$2 \pm 1.15^{\mathbf{b}}$
H. truncatum	2.94	$10^{\mathbf{b}}$	$0.1 \pm 0.31^{\mathbf{b}}$	$1 \pm 0^{\mathbf{b}}$
Test statistics		$F = 4.413$ $p < 0.05$	$F = 6.633$ $p < 0.05$	$F = 3.232$ $p < 0.05$

Values with the same superscript letter (a,b,c) in the same column are not significantly different.

Tick co-infestation in different genetic types of cattle

The parasite intensities correlation matrix (Table 9) indicated the causal links between the parasite intensities of the various tick species at the station. As a result of this matrix, it was discovered that the parasite intensity of the tick species *R. (B.) microplus* and *R. (B.) annulatus* has a positive and significant correlation (p<0.01). There was no significant association (p>0.05) between the other tick species found in this station, except for these two tick species (Table 9).

N'Dama

The parasite intensity of *R. (B) microplus* and *R. (B) annulatus* ticks had a negative and significant correlation (p<0.05) according to the correlation matrix. The other tick species, on the other hand, showed no significant difference (p>0.05) (Table 9).

Metis

The parasite intensities of the different tick species were shown to have both negative and positive relationships in the mestizo. None of these associations, however, were statistically significant (p>0.05) (Table 9).

Zebu

All other correlations in Zebu were negative, with the exception of positive correlations between parasite intensities of *R. (B) microplus* and *R. (B) annulatus* ticks and *R. (B) microplus* and *H. truncatum* ticks. None of these relationships, however, were significant (p 0, 05) (Table 9).

Table-9: Tick co-infestation in different genetic types of cattle

	N'Dama			
Ticks	*R. (B.) mi*	*R. (B.) a*	*A.v*	*H.t*
R. (B) microplus	1			
R. (B) annulatus	- 0.263*	1		
A. variegatus	- 0.151	0.112	1	
H. truncatum	0.105	0.001	- 0.151	1
	Metis			
R. (B) microplus	1			
R. (B) annulatus	- 0.100	1		
A. variegatum	- 0.081	0.106	1	
H. truncatum	- 0.013	0.011	0.146	1
	Zebu			
R. (B) microplus	1			
R. (B) annulatus	0.012	1		
A. variegatum	- 0.442	- 0.289	1	
H. truncatum	0.150	- 0.187	- 0.191	1
	All genetic types			
R. (B) microplus	1			
R. (B) annulatus	0.272**	1		
A. variegatus	0.066	0.141	1	
H. truncatum	0.030	- 0.001	- 0.020	1

DISCUSSION

The fact that the study was conducted during the rainy season explains the high frequency of tick infection in cattle at the Yamoussoukro Dairy Station (86.08 %). Tick activity is lower during the dry season and higher during the rainy season. Adult ticks are to account for the increased activity [22-23]**.** These results are similar to those of Sassa *et al.* [24], who found that 94.74 % of cattle farms in Adamou, Cameroon, were infested with ticks.

The ticks recovered belonged to three (3) genera: Rhipicephalus (B), Amblyomma, and Hyalomma, according to the inventory. Previous studies in Côte d'Ivoire have also identified these three (3) genera [25,5,26,27]**.** The herd studied yielded four kinds of ticks from these three genres. Knopf *et al.* [28], on the other hand, identified five species in the Toumodi region: *A. variegatum, R. (B) geiygi, R. (B) annulatus, R. sanguineus*, and *H. Rufipes*, of which the first four are common to this research.

R. *(B) microplus, R. (B) annulatus, A. variegatum*, and *H. truncatum* are the four species identified. The genus R. (B) was the most abundant of the three genera (75.51 %), whereas the genus Hyalomma was the least abundant (0.9 %). The genus *R. (Boophilus)* has a high number of species, which contributes to its dominance (2 species identified). These results supported those of Tuo *et al.* [29], who found that *R. (Boophilus)* is the most prevalent of the four species found in the Poro area. The low prevalence of ticks in the genus Hyalomma might be correlated to the genus's single species (*H. truncatum)*, as well as with the life cycle of ticks. Ticks of the genus Hyalomma have just one generation each year, according to Walker *et al.* [30], with a massive appearance of adults during a specified period of the year (beginning of the rainy season).

R. (B) microplus appears to be the most common of the tick species found. The findings of Touré *et al.* [5], who showed that *Rhipicephalus (B) microplus* is the most prevalent tick species in the Yamoussoukro district, are confirmed by these results. As this species is monogenic, it ends its parasitic life on the same host, which shortens its life cycle and allows it to spread more rapidly [30]**.** In addition, the species R. (B) microplus would be specific to livestock and adaptable to a multitude of different environments, allowing rapid development. Due to its shorter life cycle than other species of the same subgenus (Boophilus), this tick has aroused the interest of various livestock stakeholders and researchers since its arrival in Côte d'Ivoire [31].

Resistance to acaricides used for control appears to emerge often and quickly, which might justify its higher abundance [8]**.** Before the accidental introduction of *R.(B) microplus*, multiple investigations conducted in Côte d'Ivoire [5] and elsewhere in Africa revealed that A. variegatum was the most prevalent species [32-35].

With a frequency of 63.91 percent, crossbred cattle were the most sensitive to ticks; Achi *et al.* found similar results [36]. Their work showed that crossbred cattle are the most vulnerable to ticks. The high occurrence might be due to the high level of exotic blood in crossbred cattle. Their work showed that crossbred cattle are the most vulnerable to ticks. The high occurrence might be due to the high level of exotic blood in crossbred cattle.

Exotic dairy bulls are also very vulnerable to ticks, according to Merlin *et al.* [37]. Zebus, on the other hand, has a 4.36 % vulnerability rate. Freish's discoveries are supported by these results [38]. Locally produced zebu and bovines are less infected than imported breeds, as this author demonstrated. The targeted tick control treatments on the apparently vulnerable Metis and Zebu rather than the more resistant N'Dama might account for this low susceptibility.

The most common tick species in the cattle herd is *R. (B) microplus*, which has a prevalence of 63.40 %, followed by *A. variegatum*, which has a prevalence of 55.67 %. The resistance of these species to commonly used acaricides is assumed to be the cause of their high prevalence [35, 39].

The monoxenous and invasive behavior of *R. (B) microplus* [8] and the huge quantity of eggs deposited by Amblyomma females (10 to 30,000) compared to ticks of other genera [40] might explain these prevalences. As well, before the advent and quick expansion of *R. (B) microplus* in Côte d'Ivoire and the sub-region, these two species were the most often recorded hard tick species infesting cattle in West Africa [41-42]**.**

The most prolific and infesting indigenous species, A. variegatum, has long been linked to the biggest economic losses. The limited occurrence of *H. truncatum* is assumed to be due to unfavorable environmental conditions for its growth [43]. *H. truncatum* is a Sahelian and Sudanian species, after all. It has a distribution range of 500 to 1500 mm of rainfall isohyets. These observations back up Tuo *et al.* findings [29]. In the Poro area (Côte d'Ivoire), these authors discovered that *R. (B) microplus* and *A. variegatum* species had large prevalences, with 64 % and 80 %, respectively.

On all breeds, all tick species have been found and, in the station, various populations of animals share the same grazing grounds that might explain the simultaneous presence of these different tick species. Indeed, sharing of grazing grounds and crossbreeding across herds can result in an infection of cattle by the same ticks [44]. Infestation of cattle on farms by the same tick species is further aided by the same tick species colonizing grazing areas [27].

Although distinct tick species had significant infestation prevalence's in the N'Dama and Zebu, parasite intensities were comparatively moderate. These works support those of [20], who discovered low parasite intensities in *R. (B) microplus, A. variegatum,* and *R. (B) decoloratus.* Indeed, these observations might indicate that these tick species were widely spread on these cow breeds, with no evidence of aggregation. Metis cattle, however, had a high incidence of tick infection as well as parasite intensities. This might be due to the fact that these cattle were more prone to tick infection. This might also be attributed to ticks' fondness for crossbreeds or the fact that ticks rapidly adhere to crossbreeds for a blood meal.

The absence of acaricide treatments on the N'Dama compared to other cattle genetic types contributes to the N'Dama's resilience to diverse tick species. Ticks of *the R. (B) microplus* species, which have a parasite intensity that rises with that of *R. (B) annulatus* ticks, were found to be the most prevalent at the station. The parasite intensity of R. (B.) microplus rises as the parasite intensity of *R. (B.) annulatus* increases. This observation may be explained by the fact that, on the one hand, these two tick species belong to the same genus and hence had similar dietary requirements (blood demand), and, on the other hand, there was a need for reproduction or hybridization between them.

The resistance of the N'Dama to different tick species compared to other cattle types is due to the lack of acaricide treatments on the N'Dama compared to the genetic types of cattle.

The tick inventory at the station revealed a prevalence of *R. (B) microplus* species, which had higher parasite intensity than *R. (B) annulatus* ticks. The parasite intensity of *R. (B.) microplus* grows in tandem with that of *R. (B.) annulatus*, according to this connection. This observation may be explained by the fact that, on the one hand, these two tick species belong to the same genus and hence had similar dietary demands (blood need), and that, on the other hand, there was a need for reproduction or hybridization between them.

The presence of *R. (B) microplus* favors the elimination of *R. (B) annulatus*, according to a correlation analysis in the N'Dama. The fact that *R. (B) microplus* ticks have been introduced into the *R. (B) annulatus* tick population might explain this.

The absence of a significant link between tick species collected from zebu and mixed-race cattle can be explained by the fact that, in comparison to N'Dama cattle, the latter are frequently treated because of their vulnerability to ticks.

CONCLUSION

The Yamoussoukro Dairy Station discovered three (3) genetic varieties of cattle: N'Dama, Zebu, and crossbred. Three genera and four species of ticks parasitize cattle at this station, according to the inventory of 1560 ticks collected. *R. (B) microplus* is the most common tick species, accounting for 48.8% of all ticks. Ticks infested the animals at the station in large numbers, with an overall frequency of 86.08 percent. Crossbred cattle were the most vulnerable to tick infestations (63.91 %) when compared to other genetic groups of cattle. When compared to other tick species, *R. (B) microplus* was the most numerous (3.87 ticks/cow) and ubiquitous (63.40 %) among cattle genetic types. With parasite intensities of 6.10 and 4.32 ticks/cattle, the species of the genus Boophilus, specifically *R. (B.) microplus* and *R. (B.) annulatus*, were the most infesting. *R. (B.) microplus* parasite intensity is intimately associated with *R. (B.) annulatus* parasite intensity. *R. (B.) microplus* wipes out *R. (B.) annulatus* presence in the N'Dama.

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Conflict of Interest

The authors declare that there is no potential conflict of interest with this research or and in the publication.

REFERENCES

1. BNETD. (2003). Evaluation de l'impact de la crise sociopolitique du 19 septembre sur les ressources animales et halieutiques. Note technique. Abidjan : BNETD.
2. Diallo, Y. (2007). Les Peuls, les Sénoufo et l'État au nord de la Côte d'Ivoire. Problèmes fonciers et gestion du pastoralisme. *Bulletin de l'APAD*, pp 10 – 11.
3. MIPARH. (2003). Place de consommation des viandes rouges (bovine, ovine, caprine) dans le régime des consommateurs en côte d'ivoire Rapport Service d'étude et de suivi.-Abidjan, DGRA.- 21 p.
4. Djakaridja, B., Kouassi, Y.P., Biego, G.G., Acapovi-Yao, G. et Mavoungou, J.L. (2014). Situation épidémiologique des hémiparasites des bovins dans deux zones d'élevage de la Cote d'Ivoire : cas des anciennes régions des Savanes et de la vallée du Bandama. *Revue de Medecine Veterinaire*, 165, pp 297 – 303.
5. Yapi, A. D.W. (2007). Contribution à l'étude des tiques parasites des bovins en Côte d'Ivoire : cas de quatre troupeaux de la zone sud. Thèse med.vet. Dakar. 109 p.
6. Toure, A., Diaha, C. A., Sylla, I., & Kouakou, K. (2014). Récente recomposition des populations de tiques prévalent en Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, *8*(2), 566-578.
7. Achi, Y.L., Koné, P., Stachurski, F., Zinstag, J., Bethschart, B. (2012). Impact des tiques sur les bovins métissés dans le nord de la Côte d'Ivoire. *Bulletin of Animal Health Production in Africa*, 60,pp 109-118.
8. Madder, M., Thys, E., Geysen, D., Baudoux, C. et Horak, V. (2007). Boophilus microplus ticks foundin West Africa. Exp. Appl. Acarol 43, 233-234.
9. Madder, M., Thys, E., Achi, L., Touré, A. et De Deken, R. (2011). Rhipicephalus (Boophilus) microplus: a most successful invasive tick specics in West Africa. *Expérimental & Applied Acarology*, 53 (2). pp 139-145.
10. Stachursky, F. (2004). Le pédiluve acaricide. - Bobo-Dioulasso : CIRDES. - 8 p.- Fiche technique n° 1.
11. Kéïta, K. (2007). Les tiques parasites des ovins dans les élevages des régions du centre et du sud de la Côte d'Ivoire. Thèse de doctorat. Univ. Cheick Anta Diop, 157 p.
12. Jorgensen, W.K., Weilgama, D.J., Navaratne, M. et Dalgliesh, R. (1992). Prevalence of Babesia bovis and Anaplasma marginale at selected localities in Sri Lanka. *Tropical Animal Health and Production*, 24, 9 - 14.
13. Fernández-salas, A., Rodríguez-Vivas, R.I et Alonso-Díaz, M.A. (2012). Resistance of Rhipicephalus microplus to Amitraz and Cypermethrin in Tropical Cattle Farms in Veracruz, Mexico. *Journal of Parasitology*, 98(5): pp 1010-1014.
14. Lovis, L. (2012). Evaluation of acaricide resistance in the cattle tick, Rhipicephalus (Boophilus) microplus, using a new in vitro test and molecular tools. Th.Doctorat. Univ. Neuchatel, 204 p.
15. Kandé, S. (2014). Evaluation de la résistance des tiques Rhipicephalus (Boophilus) microplus (Canestrini, 1888) aux acaricides dans les zones d'introduction en Afrique de l'Ouest (Bénin, Burkina Faso et Côte d'Ivoire). Mémoire master. 57 p.
16. Elbe, A. et Anastos, G. (1966). Ixodid ticks (Acarina, Ixodidae) of Central Africa. Vol. 1. General introduction. *Genus Amblyomma Koch, 1844*. Maryland Univ College Park Dept of Zoology.
17. Camicas, J.L. et Morel P.C. (1977). Position systématique et classification des tiques (Acarida : Ixodida). *Acarologie*, 28 (3). pp 410 – 420.
18. Matthysse, J.G et Colbo M.H. (1987). The ixodid ticks of Uganda, together with species pertinent to Uganda because of their present known distribution. Entomological Society of America.
19. Walker, J. B., Keirans, J. E., & Horak, I. G. (2005). The genus Rhipicephalus (Acari, Ixodidae): a guide to the brown ticks of the world. *Cambridge University Press*, 643;
20. Mollong, E., Nuto, Y. Rawa R. et Amevoin K. (2018). Diversité des tiques de bovins et variation saisonnière des infestations dans la region maritime au Togo. *Tropicultura 36*(4). 684 – 696.
21. Laamri, M., El Kharrim, K., Belghyti, D., Mrifag, R. et Boukba, M. (2012). Identification et biogéographie des tiques parasites des bovins dans la Région du Gharb-Chrarda-Beni Hssen (Maroc). *World Journal of Biological Research*, volume 5 Issue 1994 – 5108. 12 p.

22. Douffissa, A. (2000). Les tiques et les maladies transmissibles. Afrique Centrale. Journée vétérinaire organisée par MODESA, Yaoundé, Cameroun. 158 p.
23. Wesonga J.O., Chemuliti, J., Wesonga, S.D., Wanyala, K., Munga, L., Ngara, P.et Murilla G.A. (2005). Prevalence of parasitic infestions in small ruminants in a pastoral community in Norok district, Kenya. *Bull. Of Anim. Health ang Prod. In Africa*. pp 218 – 225.
24. Sassa, M.A., Etchike A.C., Gambo H. et Nloga, N.A. (2014). Inventaire et prévalence des tiques du bétail dans les élevages de l’Adamoua au Cameroun. *Revue Africaine de Santé et de Productions Animales* 12 (1), pp 15 - 19.
25. Achi, L., Zinsstag, J., Nagto, Y. et Kan Y. (2001). Impact des tiques sur les métis Montbéliardes dans les fermes modernes. Rapport d’activités Centre Suisse de Recherches Scientifiques en Côte d’Ivoire. 139 p.
26. Adehan, S.B., Gbaguidi, M.A., Guédou M.S.E., Badarou, K.O., Capo, E.C.M., Adehan, R., Farougou, S., Madder, M. et De Clercq E.M. (2017). Perception des éleveurs sur la typologie des tiques du bétail et les dommages causés aux bétail. Document Technique et d’Information 12 p.
27. Tuo, Z., Yao K.P., Kouassi, W.Y.R., Zouh Bi, Z.F., Traoré, S.I. et N’goran E.K. (2021). Identification des tiques parasites des bovins (Bos taurus et Bos indicus) dans la Région du Poro, Côte d’Ivoire. *Afrique SCIENCE, 18*(3) ; 87 - 101.
28. Knopf, L., Komoin-Oka, C., Betshart, B., Jongejan, F., Gottstein, B. et Zinsstag, J. (2002). Seasonal epidemiology of ticks and aspects of cowdriosis in N’Dama village cattle in Guinea savannah of Côte d’Ivoire. *Prev. Vet. Med., 53*(7); 21 – 30.
29. Tuo, Z., Yao, K.P., Zouh ,Bi, Z.F., Douan, B.G. et N’goran, E.K. (2020). Tiques des bovins (Bos Taurus et Bos indicus) et des aulacodes (Thryonomys swinderianus) dans le District des Savanes de Côte d’Ivoire. Bull. Soc. Pathol. DOI 10.3166/bspe. pp 52-59 p.
30. Walker, A.R., Bouattour, A., Camicas J-L., Estrada-Pena, A., Horak, I.G., Latif, A.A., Pegram R.G. et Preston P.M. (2003). Ticks of domestic animals in Africa: a guide to identification of species, guide-book. 221 p.
31. Zouh Bi Z.F., Touré A., Komoin O.C., Karamoko Y. et Fantodji, A. (2015). Prevalence of ticks infesting grasscutters (Thryonomys swinderianus Temminck, 1827) in the south of Côte d’Ivoire. *J. Appl. Biosci*. pp 8085 – 8093.
32. Pegram, R.G., Perry, B.D., Musisi, F.L. et Mwanaumo, B. (1986). Ecology and phenology of ticks in Zambia: seasonal dynamics on cattle. *Exp. Appl. Acarol*, 25 - 45.
33. Bayemi, P.H. (1991). Seasonal dynamics of tick infestations (Ixodidea) in cattle sold in the area of Yaoundé, Cameroon. *Rev. Elev. Med. Vet. pays trop*., 44; 309 – 318.
34. Mekonnen, S., Hussein, I. et Bedane, B. (2001). The distribution of ixodid ticks (Acari: ixodidae) in central Ethiopia. *Onderstepoort J. vet. Res*., 68: pp 243 – 251.
35. Farougou S. (2007). Les tiques et les maladies transmises au bétail en Afrique tropicale : les hémoparasites et la cowdriose. Thèse de doctorat 3[ème] cycle : Med. Vét. Université d’Abomey-calavi.
36. Achi, L., Adakal H., Betschart, B., Zinsstag, J., Knopf L. et Madder, M. (2014). Impact des tiques et des maladies transmises au bétail dans le Nord, le Centre et le Sud de la Côte d’Ivoire. *Santé animale en Afrique de l’Ouest*, CIRDES, Fiche n° 35. 8 p.
37. Merlin, P., Tsangueu, P. et Rousvoal, D. (1986). Dynamique saisonnière de l’infestation des bovins par les tiques (Ixodidea) dans les hauts plateaux de l’ouest du Caméroun. Etude de trois sites autour de Bamenda pendant un an. *Rev. Elev. Vét. Pays trop*, 39 (3-4) ; 377 – 379.
38. Frisch, J.E. (1999). Towards a permanent solution for controlling cattle ticks. International *Journal for Parasitology*, 57 - 71.
39. Diaha-Kouamé A.C.A., Tian-Bi T.Y.N., Yao K.P., Achi Y.L., Kouakou K. et Dujardin J-P. (2017). Apport de la morphométrie géométrique dans la lutte contre Rhipicephalus (Boophilus) microplus (Canestrini, 1888) sur le couloir de transhumance Ivoiro-Burkinabé. *Int. J. Biol. Chem. Sci. 11*(6) ; 2630 – 2648.
40. Barré N. (1997). Les des ruminants dans les petites Antilles : biologie, importance économique, principes de lutte. *Prod. Anim.*, 111- 119.
41. Barré N. et Uilenberg G. (2010). Propagation de parasites transportés avec leurs hôtes : cas exemplaires de deux espèces de tiques du bétail. *Rev. Sci. Tech. Off. Int. Epiz.* 29 (1) : pp 135 – 147.
42. Biguezoton A., Adehan S. et Adakal H. (2016). Community structure, seasonal variations and interactions between native and invasive cattle tick species in Benin and Burkina Faso. *Parasites and Vectors*, 9(1) ; 1-16.
43. Aeschlimann A. (1967). Biologie et écologie des tiques (Ixodidae) de Côte d’Ivoire. *Revue Acta Tropica Separatum*. Institut Suisse, Bâle centre Suisse et Recherche Scientifique, Adiopodoumé, Côte d’Ivoire, 282 – 405.
44. Yeo, N., Karamoko, Y., Soro, D., Zouh, Bi Z.F. et Traoré, S.I. (2017). Elevages de bétail dans la région du Poro (Côte d’Ivoire) : Caractérisation et modélisation de lutte contre les pathogènes transmis par les tiques. *Int. J. Biol. Chem. Sci. 11*(1). ; 237 - 246.