

New foci of *Rhipicephalus microplus* in West Africa

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Abstract The invasive character of *Rhipicephalus microplus* was observed in Benin, the second West-African country from which this ticks species has been collected after the initial confirmed record in Ivory Coast in 2007. A cross-sectional study was carried out in the Department of Mono to examine the presence of the tick *R. microplus*. The survey covered 9 herds (villages) in an agro-ecological zone inhabited by agro-pastoralists, including the State Farm of Kpinnou that imported Girolando cattle from Brazil. Almost 800 ticks were sampled from 36 cattle, on average four cattle per village. The morphological identification revealed ticks of two different genera: *Rhipicephalus* and *Amblyomma*. *Rhipicephalus microplus* was the only representative of the species previously known as *Boophilus* or blue ticks. Its taxonomic identity was confirmed molecularly by PCR–RFLP. A comparison was made with the situation of *R. microplus* in Brazil.

Keywords Cattle · *Rhipicephalus* · *Boophilus* · *Microplus* · Import · Ticks · Benin · Girolando

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Introduction

Malnutrition is one of the major problems faced by low-income countries like Benin. The limited access to protein sources as milk and meat is one of the major reasons. Annually, Benin imports an average of 60 tons of meat and 40,000 tons of milk, leading to foreign exchange outflows estimated at 21 million € for meat and 15 million € for milk (www.afdb.org).

Several countries in the regions decided, as part of their national poverty reduction strategy, to improve local cattle breeds by artificial insemination with imported semen or by importing live exotic cattle breeds.

Recent publications (Madder et al. 2007, 2011) highlighted risk factors associated with the import of exotic cattle from tick endemic areas; more precisely areas infested by the tick *Rhipicephalus microplus*, one of the most important cattle ticks in the world (Coetzer and Tustin 2004; Angus 1996). Inappropriate, uncontrolled use of many chemical products has led to the selection of resistant genotypes in many populations of *R. microplus* worldwide (Baffi et al. 2008; Beugnet et al. 1994), and could lie at the basis of the failure to free cattle for export of *R. microplus*. In addition, tick control in more susceptible and productive exotic or improved cattle-breeds of livestock is cumbersome as *Bos taurus* cattle are much more susceptible to ticks and therefore require intensive and expensive chemical tick control compared to *Bos indicus* cattle (Jongejan and Uilenberg 2004). A cattle breed introduced from Brazil to mitigate protein production insufficiency in both Ivory Coast and Benin is Girolando (Gir x Holstein). This cattle breed combines the rusticity of Gir (*Bos indicus*) with the high milk yield of Holstein (*Bos taurus*) and is common in the sub-tropical areas in Brazil (Castilho et al. 2000; Cardellino 2000).

The objective of this paper is to examine the presence of *R. microplus* in one of the State Farms in Kpinnou (Mono Department), to which a number of Girolando cattle were imported in November 2004, and possible spillover from the State Farm to adjacent private farms.

Materials and methods

Study area

The sampling took place between October and November 2008. Eight villages were randomly selected out of a total of 52 in the Department of Mono: Salahoué, Zoungbonou, Adjacomè, Ouèdèmè, Awamè, Sazouékpa, Akodéha and Tovi (see Fig. 1). This department is one of the twelve department of Benin with a surface of approximately 1,400 km² and is situated in the Southwestern part of the country, neighboring Togo. The department harbours one of the five state farms (Kpinnou), which gives technical support to farmers of the department and to which the Girolando cattle imported from Brazil were brought.

Tick collection

In each of the eight villages and in the state farm in Kpinnou, as indicated in Table 1, four bovines were sampled with a total of 36 animals for the entire study. Predominantly, the predilection sites of *Rhipicephalus* (blue) ticks were sampled but ticks obviously present on other areas of the body were also collected. Much care was taken to collect male ticks, as they are easier to identify compared to female ticks. All ticks were removed with forceps and stored in individual vials per animal containing 70% alcohol until identification.

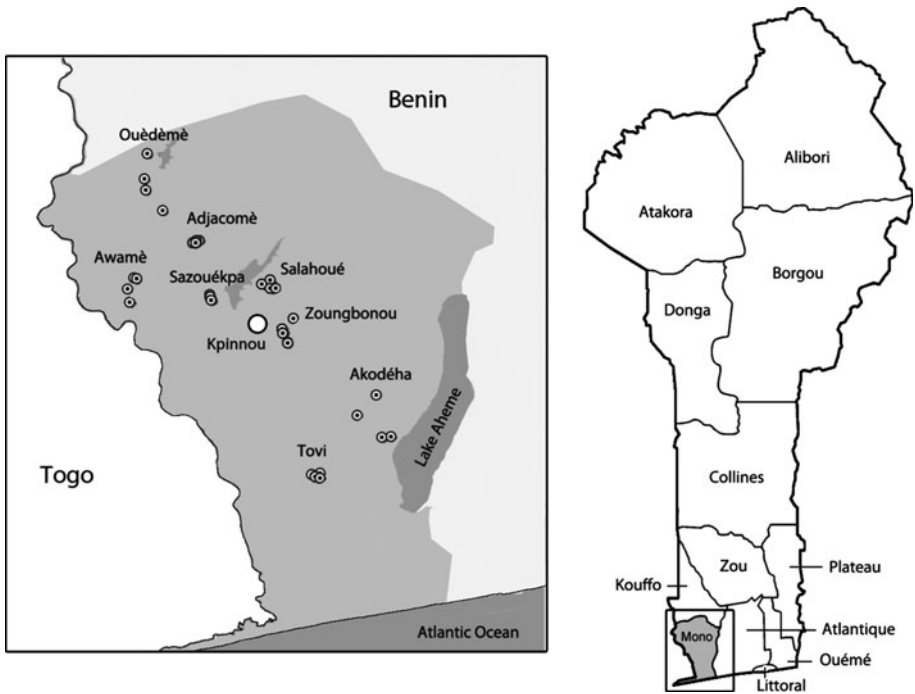


Fig. 1 Situation of the collection sites. *Left* Department of Mono, *right* Benin and 12 departments

A pencil written label containing date, farm, species, sex and age of the host was included in the vial. The geographic coordinates of each farm were registered using a hand-held GPS-receiver.

Tick identification

The collected ticks were first identified up to genus level using a Zeiss Stemi 2000 stereomicroscope. Only *Rhipicephalus* (blue) ticks were further identified up to species level with a microscope (Zeiss Axioscope, at magnification 100×). The main characteristics used for identification were the hypostome dentition, presence or absence of the ventro-internal protuberance bearing setae, shape of the adanal plates and their internal and external spurs and the presence of scalelike external spurs on coxae 2 and 3 of the female ticks.

The identification of a subset of the *Rhipicephalus* (blue) ticks was confirmed molecularly using a PCR–RFLP test (Lempereur et al. 2010).

Results

Tick collection

In total 756 ticks were collected from 36 cattle in nine different villages in the department of Mono. Two genera were identified morphologically: *Amblyomma* spp. (185 ticks) and

Table 1 Collection sites, dates and animals sampled

Nr.	Village	Geo-reference		Date of collection	Number of animals sampled
		Longitude	Latitude		
1–4	Kpinnou*	1.788083	6.566972	21/10/08	4
5	Salahoué	1.802444	6.600008	22/10/08	1
6	Salahoué	1.793972	6.604056	22/10/08	1
7	Salahoué	1.802556	6.608056	22/10/08	1
8	Salahoué	1.808250	6.599611	22/10/08	1
9	Adjacomè	1.726833	6.644028	23/11/08	1
10	Adjacomè	1.733000	6.646250	23/11/08	1
11	Adjacomè	1.729694	6.643917	23/11/08	1
12	Adjacomè	1.730194	6.646250	23/11/08	1
13	Zoungbonou	1.814028	6.560000	23/10/08	1
14	Zoungbonou	1.819833	6.546361	23/10/08	1
15	Zoungbonou	1.825000	6.570750	23/10/08	1
16	Zoungbonou	1.814611	6.556194	23/10/08	1
17	Tovi	1.846500	6.416669	20/10/08	1
18	Tovi	1.842694	6.419361	20/10/08	1
19	Tovi	1.850944	6.415944	20/10/08	1
20	Tovi	1.850944	6.420194	20/10/08	1
21	Akodéha	1.887389	6.476389	20/10/08	1
22	Akodéha	1.906361	6.496333	20/10/08	1
23	Akodéha	1.920500	6.455861	20/10/08	1
24	Akodéha	1.911611	6.455278	20/10/08	1
25	Sazouékpa	1.744000	6.591444	16/11/08	1
26	Sazouékpa	1.744806	6.588000	16/11/08	1
27	Sazouékpa	1.743111	6.591889	16/11/08	1
28	Sazouékpa	1.743111	6.593833	16/11/08	1
29	Ouèdèmè	1.682222	6.730833	16/11/08	1
30	Ouèdèmè	1.697194	6.675667	16/11/08	1
31	Ouèdèmè	1.681000	6.695361	16/11/08	1
32	Ouèdèmè	1.679222	6.706083	16/11/08	1
33	Awamè	1.665250	6.586444	23/11/08	1
34	Awamè	1.669389	6.610167	23/11/08	1
35	Awamè	1.663083	6.599139	23/11/08	1
36	Awamè	1.672139	6.609250	23/11/08	1

* State farm

Rhipicephalus spp. (571 ticks). Among them, 405 Rhipicephalus (blue) ticks were observed, all *R. microplus*.

One anomalous tick was encountered showing a hypostome dentition of 4.5/4.5 instead of the normal 4/4 characteristic for all African blue ticks, except for *R. decoloratus*. The extra denticles were found on the postero-median site of the hypostome and were significantly smaller than the other denticles.

For each of the villages, the microscopic identification of a few *R. microplus* ticks was confirmed molecularly using a PCR–RFLP test. All ticks showed the typical profile of *R. microplus* as presented in Lempereur et al. (2010).

Discussion

Since 1999, Benin has implemented a national poverty reduction strategy for sustainable human development. From this, a range of strategic plans has evolved one of them being the PAFILAV project (Milk and Meat Sectors Support Project). This Project falls within the Growth Strategy for Poverty Reduction (SCRP 2007–2009), which puts emphasis on diversification policies aimed at accelerating economic growth, promoting good governance and strengthening the social sector in order to support poverty reduction and sustainable human development. Within the PAFILAV project, one of the activities of the component “Improvement of milk and meat production systems” aims at provision of improved genetic material to stockbreeders. In 2004, before the onset of the FAFILAV project, a first herd of Girolando cattle was imported to the State Farm in Kpinnou, to evaluate its milk production capacity under local conditions before engaging in a large-scale import of this cattle breed, foreseen as one of the activities in the PAFILAV project.

This preliminary survey revealed the presence of *R. microplus* in all eight villages sampled in the department of Mono. Considering the limited magnitude of this study, it can be stated that *R. microplus* is indeed present in the country but its spread over the country is not known yet. Moreover, the tick apparently displaced the local *Rhipicephalus* (blue tick) species in the study area and spread to neighboring farms in the Department of Mono. More detailed studies including a national distribution tick-survey are planned for 2011 and 2012 in an attempt to develop a suitability map of *R. microplus* for the entire West-African region, fine-tuned with the Benin tick-survey results.

The import of Girolando cattle from Brazil in the State Farm in Kpinnou probably caused the introduction of the pantropical blue tick, *R. microplus* in Benin. Considering the time frame between the initial import of Girolando cattle in November 2004 and the first sampling in October 2008 of ticks in the department, we conclude that local conditions (habitat and host suitability) are ideal for this tick to establish itself in this Department. This is not surprising since climatic conditions of the regions are within the requirements for the ticks’ survival and reproduction.

A similar introduction of Girolando cattle in Ivory Coast also resulted in the establishment and widespread occurrence of *R. microplus* ticks (Madder et al. 2007, 2011). Initially it was hypothesized that the spread of this tick would be limited and localized around the farms where the Girolando cattle were first introduced allowing eradication. However, the current situation and the notorious acaricide resistance of this tick of Brazilian origin (Baffi et al. 2008; Li et al. 2005; Martins and Furlong 2001; Mendes et al. 2011), eradication would be a time consuming and expensive exercise similar to the eradication campaigns at the border between Mexico and Texas (USA) (Temeyer et al. 2004).

The speed, with which the replacement occurred in Ivory Coast, is alarming. If a similar scenario takes place in Benin, displacement of local *Rhipicephalus* ticks could be foreseen in just a few years, depending on the rate of cattle movement due to trade or transhumance. As highlighted in Madder et al. (2011), *R. microplus* is known for its invasive character and displacement capacities.

In Brazil, *R. microplus* is known to cause enormous problems in the cattle industry: of the roughly 200 million cattle, most of them as part intensive breeding programs, 99.9% is infested with *R. microplus* (Labruna, pers. comm.). An estimated loss of \$1 billion/year due to tick drug resistance, almost thirty years ago, must have almost doubled (Graf et al. 2004). The control of the tick is cumbersome in Brazil; the favourable climate for tick survival, acaricide resistance, and especially the inappropriate use of acaricides forms the basis of unsuccessful control of the tick in this but also many other countries. Recently, the beef sector shifted towards more tick resistant zebu breeds because the tick problems are too difficult to control (Labruna, pers. comm.). Looking at the similar environmental conditions in coastal regions of West Africa and the poor resources for intensive tick control, the introduced tick *R. microplus* could become a major treat to livestock production in the region, especially when it survives the more arid regions in the north.

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References

- Angus BM (1996) The history of the cattle tick *Boophilus microplus* in Australia and achievements in its control. *Int J Parasitol* 26:1341–1355
- Baffi MA, de Souza GR, de Sousa CS, Ceron CR, Bonetti AM (2008) Esterase enzymes involved in pyrethroid and organophosphate resistance in a Brazilian population of *Rhipicephalus (Boophilus) microplus* (Acari, Ixodidae). *Mol Biochem Parasitol* 160(1):70–73. doi:10.1016/j.molbiopara.2008.03.009
- Beugnet F, Costa R, Chardonnet L (1994) Adaptations des méthodes de lutte contre les tiques à l'extension du phénomène de chimiorésistance: exemple de *Boophilus microplus* en Nouvelle-Calédonie. *Rev Méd Vét* 145:931–940
- Cardellino RA (2000) Animal genetic resources in southern Brazil. *Arch Zootec* 49:327–331
- Castilho C, Gambini AL, Fernandes P, Trinca LA, Teixeira AB, Barros CM (2000) Synchronization of ovulation in crossbred dairy heifers using gonadotrophin-releasing hormone agonist, prostaglandin F2alpha and human chorionic gonadotrophin or estradiol benzoate. *Braz J Med Biol Res* 33(1):91–101
- Coetzer CAW, Tustin RC (2004) Infectious diseases of livestock, 2nd edn. Oxford University Press, Oxford
- Graf JF, Gogolewski R, Leach-Bing N, Sabatini GA, Molento MB, Bordin EL, Arantes GJ (2004) Tick control: an industry point of view. *Parasitology* 129(S1):S427–S442
- Jongejan F, Uilenberg G (2004) The global importance of ticks. *Parasitology* 129(supplement):S3–S14
- Lempereur L, Geysen D, Madder M (2010) Development and validation of a PCR-RFLP test to identify African *Rhipicephalus (Boophilus)* ticks. *Acta Trop* 114(1):55–58
- Li AY, Davey RB, Miller RJ, George JE (2005) Mode of inheritance of amitraz resistance in a Brazilian strain of the southern cattle tick, *Boophilus microplus* (Acari: Ixodidae). *Exp Appl Acarol* 37(3–4):183–198
- Madder M, Thys E, Geysen D, Baudoux C, Horak I (2007) *Boophilus microplus* ticks found in West Africa. *Exp Appl Acarol* 43:233–234
- Madder M, Thys E, Achi L, Toure A, De Deken R (2011) *Rhipicephalus (Boophilus) microplus*: a most successful invasive tick species in West-Africa. *Exp Appl Acarol* 53(2):139–145
- Martins JR, Furlong J (2001) Avermectin resistance of the cattle tick *Boophilus microplus* in Brazil. *Vet Rec* 149:64
- Mendes MC, Lima CKP, Nogueira AHC, Yoshihara E, Chiebao DP, Gabriel FHL, Ueno TEH, Namindome A, Klafke GM (2011) Resistance to cypermethrin, deltamethrin and chlorpyrifos in populations of *Rhipicephalus (Boophilus) microplus* (Acari: Ixodidae) from small farms of the State of Sao Paulo. *Braz Vet Parasitol* 178(3–4):383–388
- Temeyer KB, Pound JM, Miller JA, Chen AC, Pruett JH Jr, Guerrero F et al (2004) Organophosphate resistance in Mexican strains of *Boophilus microplus*: a major threat to the U.S. cattle industry. *South Assoc Agric Sci Bull Biochem Biotechnol* 17:43–51