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Relative Prevalence of Tick Species in Cattle Body Parts and Breeds under Different Management Systems in Semi-arid Environment in Maiduguri, Borno State, Nigeria

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Abstract:
The blood ecto-parasites, ticks (Order: Acarina) pose serious threat to cattle health in Nigeria. The present study assessed the effects of management system and cattle breed on infection by different species of tick on different cattle body parts, over eight weeks period in Maiduguri. Results generally indicated significant ($P<0.05$) difference among cattle husbandry system, tick species, cattle body parts and cattle breeds. The result on cattle husbandry system revealed significantly higher tick incidence under extensive than intensive cattle management system.The result also showed that out of the three tick species encountered, Hyalomma was significantly more predominant than Amblyomma and Boophilus on cattle in Maiduguri. Result of the study further expressed preference for infection by tick different cattle body parts in which the anus, followed by udder, abdomen and then inguinal. Conversely, tick infection on the chest, tail, dewlap, eye, ear, genitalia and scrotum was generally low. The result also indicated differences among cattle breeds in which Kuri breed, closely followed by Ambala was the most vulnerable to infection by tick, but incidence on Wadara, Red Bororo, White Fulani, Sokoto Gudali were statistically at par. In contrast, the incidence on Wadara/Simental, White Fulani/Frezan, White Fulani/Simental and Wadara/Frezan were generally lower. Regression results on population dynamics expressed differences in the initial take-off population in tick under the two husbandry system (r^2 = 0.8239 - 0.8932), and in different cattle breeds (r^2 = 0.6929 - 0.9054) over eight weeks period. Thus, initial tick population under extensive (16.094 ticks/cattle) cattle management system was comparably higher than in the intensive (2.7277 ticks/cattle) system, and the respective rate of population increase (r) per individual tick of 0.0764 vs 0.0872 ticks/week were similar under both systems. In respect of the cattle breeds, initial tick population varied from 2.2110 - 23.717 ticks/cattle, and was less for crossbreeds compared to pure locals, in which lowest and the highest take-off population was recorded on Sokoto Gudali and Kuri, respectively. Rate of population increase (r) per individual tick varied from 0.0398 - 0.1739 among breeds, and was higher on Wadara/Simental, Sokoto Gudali, Wadara, Ambala, relative to lower rates on White Fulani/Frezan. In conclusion, the present study has shown that tick incidence under extensive system of cattle management was higher than under intensive system, and that out of the three tick species encountered, Hyalomma was the most predominant in Maiduguri. The study generally revealed higher preference by tick for cattle anus, followed by udder, abdomen and then inguinal, than other body parts with generally infection, and that local breeds were more prone to infection than the improved crossbreeds of cattle. Therefore, tick was a serious menace to cattle production in Maiduguri, regardless of the management system employed and type of breed, and that three species of ticks are prevalent, while ticks showed preference for infection to certain cattle body parts.

Keywords: *Prevalence, Ticks, Species, Cattle, Semi-Arid, Environment, Management*

1. Introduction

Ticks (Arachnida: Ixodidae and Argasidae) pose serious health threat to cattle production in Nigeria, with an estimated cattle population of 19.2 million (NBS, 2012). Cattle production contributes about 12.7% of the Agricultural Gross Domestic Product (GDP), mainly from beef, milk and hides for leather industry, but also provides draught animal power for cultivation and transportation (Central Bank of Nigeria, 1999; Okunmadewa, 1999; Payne and Wilson, 1999; FAO, 2006;Tibi and Aphunu, 2010; Kubkomawa *et al*., 2011; Babayemi *et al*., 2014). In spite, both production and productivity of cattle are hampered by poor husbandry practices that continue to have grave implications on health management (Bowman *et al*. 1996; Abubakar and Garba, 2004).In

Nigeria, 90% of the cattle population is concentrated in the northern region, owned by Fulani pastoralistand managed traditionally under indigenous methods, thus tick infestation is prevalent in 80% of thecattle population in Nigeria(Mafimisebi *et al*., 2012).The indigenous cattle breeds are grouped into two broad classes, the Zebu (Bunaji, Rahaji, Sokoto Gudali, Adamawa Gudali, Azawak and Wadara), and the Taurine (Ketetu, N'dama and Kuri), and over (Blench, 1999; Lawal-Adebowale, 2012).

Tick has been extensively research by entomologists, parasitologists, animal scientists and veterinarians and pathologists, and the aspects of the pest's biology, epidemiology, and control has been dealt with adequately, while attempts were made to quantify the extent of infestation by the pest. Ticks are obligatory blood sucking ecto-parasite that require blood meal to molt to the next developmental stage and for females to develop eggs and a single adult female sucks 0.5 - 2.0 ml of blood daily (Pegram and Chizyuka, 1990).Number of eggs laid is dependent on the volume of blood taken and may range from a few hundred to several thousand. Blood loss due to heavy infestation could lead to a condition known as "tick worry", while injected toxins induce toxicoses or "tick-bite paralysis"- an acute ascending flaccid motor paralysis caused as a result of injection of toxins by certain species of ticks while feeding on its host (Soulsby, 1982, Drummond, 1983). The major losses however, caused by ticks are due to their ability to transmit protozoan (theileriosis and babesiosis), rickettsial (anaplasmosis and cowdriosis) and viral (dermatophilosis) diseases of cattle, leading to anemia, stress, reduction in weight gain and milk yields depreciation of hide value(Jongejan and Uilenberg, 2004; Rajput *et al*., 2006; Mehlhorn and Armstrong, 2010).It was estimated that, ixodidae tick infestation caused a global loss of 2.45 trillion naira annually, equivalent to US $ 7.0 billion (Radostits *et al*., 2000). Ticks are difficult to eliminate/eradicate due to limited natural enemies, host-specific reactions and natural resistance, and resistance to acaricides in ticks and toxic residues in meat and milk (Drummond, 1976; Mwase *et al*., 1990; Duncan, 1991; Soneshine, 1991;Miller *et al*., 2001; Samish *et al*., 2004).Ticks belong to seven main genus Amblyomma, Boophilus, Hyalomma, Rhipicephalus, Rhipicetor, Haemaphysalis and Dermacentor.

There are currently little studies on the prevalence and epidemiology of ticks commonly affecting cattle production in Maiduguri, despite the fact that it is endowed with favorable weather condition suitable for the proliferation and multiplication of ticks as well as serving as a focal point of cattle concentration in the Northeastern Nigeria. Single period survey on prevalence of tick infestation carried out by individual in different parts of the country revealed wide range of infestation of 12.5 - 88.4% from Borno, Yobe, Plateau, Kaduna and Enugu States of Nigeria (James-Ragu and Jidayi, 2004; Olabode *et al*., 2010; Obadiah and Shekaro, 2012; Biu *et al*., 2012; Eyo *et al*., 2014). There is therefore the need to monitor tick population growth, species distribution, infestation on different cattle breeds and cattle body parts in order to come up with a more precise finding -tick species, cattle breeds, the most prevalent point of attachment of the tick on the cattle, and intensive and extensive husbandry methods.

2. Methodology

The research was conducted on cattle of various breeds at the University of Maiduguri Animal Farm (intensive husbandry system) and Maiduguri Metropolitan Central Cattle Market (extensive husbandry system). The cattle herds at Maiduguri Metropolitan Central Cattle Market were mostly trade stock raised on nomadic herds from all parts of the state and the neighboring Chad, Cameroon and Niger Republics.

2.1. Sample Collection and Identification

Tick population build-up was monitored at weekly interval over eight weeks period, on five cattle each from different breeds that were selected and tagged at the two locations. Tick samples were collected based on cattle breeds and body parts, preserved in 10% formalin, and later identified and classified according to species and counted in the veterinary parasitology and microbiology laboratory, University of Maiduguri. Tick samples were placed in Petri-dish using forceps, examined under a stereoscope and identified using the key of morphological character as described by Soulsby (1982).

2.2. Data Collection and Analysis

Data were collected on tick incidence, estimated as:

$$\text{Tick incidence (\%)} = \frac{\text{Number of infested cattle}}{\text{Total number of sampled cattle}} \times 100$$

Population growth rate was also estimated using the formula: $N_t = N_0 \times e^{rt}$

Where,

N_t = number of individuals at a time,

N_0 = initial number of individuals

e = base of the natural logs (2.781)

r = rate of population increase per individual

Data on tick count collected were subjected to statistical analysis, using the software, Statistix (SX) version 8.0 (Microsoft, 2013) with which analysis of variance (ANOVA) was computed and the difference between treatment means separated using Least Significant Difference at 0.05%.

3. Results

Table 1 compares tick infestation under different cattle husbandry systems, tick species abundance and infestation levels in different cattle body parts and breeds. Result did not show significant ($P<0.05$) difference in the incidence of tick, as all (100%) the sampled cattle under both the intensive and extensive cattle husbandry systems were infested. However, the result expressed that mean number

of ticks under the extensive management system (23.1±1.41) significantly (P<0.01) outnumbered those under intensive (4.13±0.24) system.

The result on species abundance also indicated highly significant (P<0.01) difference in both incidence and mean population of the three encountered species of ticks. Hyaloma was prevalent species in 100% sampled cattle, while the incidence of Boophilus(1.2%) and Amblyoma(6.2%) were extremely lower in the sampled cattle. Similarly, the mean population of Hyaloma species (13.6±1.29) was significantly higher than Boophilus (0.01±0.01) and Amblyoma(0.06±0.03) species that were statistically at par.

The result further revealed significant (P<0.01) difference in the incidence and mean population of tick on different cattle body parts. The incidence was very high (92.5%) on anus, moderate (50.0%) on udder, low (18.7 - 27.5%) on the tail, abdomen, inguinal and chest,and very low (2.5 - 3.7%) on dewlap, eye, ear, scrotum and genitalia. The result also expressed significant difference in the mean population of tick on the different body parts which ranged from 0.03 - 4.69 ticks/cattle. The anus, closely followed by udder had significantly higher tick loadthan inguinal and abdomen, which were in turn significantly more than other body parts, except chest.

The result showed that all (100%) of the sampled cattle, irrespective of breed were generally infested by ticks, but mean population differed significantly (P<0.01) among breeds. Mean population among all improved breeds (4.00 - 4.67 ticks) were generally similar, but significantly lower than among local breeds (17.3 - 34.5 ticks). In contrast, tick loadon Red Bororo was significantly lower, while Kurihad the highest among the local cattle breeds.

Table 2 gives the best fit (r^2 = 0.8239 - 0.8932) exponential equations that describe population dynamics in tick under different husbandry system and in different cattle breeds over eight weeks period. The equation shows that the initial take-off population (N_0) under extensive system of cattle management (16.094 ticks)was comparably higher than in the intensive (2.7277 ticks) system; however, the respective rate of population increase (r) per individual tick of 0.0764 vs 0.0872 ticks/week were similar under both systems. The population growth equations (r^2 = 0.6929 - 0.9054) show that the initial tick population per cattle varied from 2.2110 - 23.717 ticks/cattle, and the initial population for crossbreeds was less compared to pure locals. However, among the local breeds, the lowest and the highest take-off population was recorded on Sokoto Gudali and Kuri, respectively. Rate of population increase (r) per individual tick varied from 0.0398 - 0.1739 among breeds, and was higher on Wadara/Simental, Sokoto Gudali, Wadara, Ambala, relative to lower rates on White Fulani/Frezan.

Parameter	Incidence	Tick population			CI (95%)	
	%	Total	Mean±SE	Range	Lower	Upper
1. Husbandry system						
Intensive	100	165	4.13±0.24^{b}	1 - 7	3.6491	4.6009
Extensive	100	925	23.1±1.41^{a}	11 - 44	20.268	25.982
2. Tick species						
Hyaloma	100	1084	13.6±1.29^{a}	1 - 44	10.992	16.108
Boophilus	1.2	1	0.01±0.01^{b}	0 - 1	-0.0124	0.0374
Amblyoma	6.2	5	0.06±0.03^{b}	0 - 1	0.00829	0.1167
3. Body parts						
Anus	92.5	375	4.69±0.37^{a}	0 - 13	3.9460	5.4290
Udder	50.0	358	4.48±0.65^{a}	0 - 24	3.1847	5.7653
Dewlap	3.7	12	0.15±0.09^{de}	0 - 5	-0.0309	0.3309
Tail	18.7	32	0.40±0.12^{cde}	0 - 5	0.1716	0.6284
Eye	2.5	2	0.03±0.02^{e}	0 - 1	-0.0100	0.0600
Ear	3.7	7	0.09±0.05^{e}	0 - 3	-0.0139	0.1889
Scrotum	2.5	13	0.16±0.13^{de}	0 - 10	-0.0964	0.4214
Abdomen	21.2	90	1.13±0.28^{bc}	0 - 9	0.5783	1.6717
Genital	2.5	12	0.15±0.11^{de}	0 - 7	-0.0627	0.3627
Inguinal	27.5	118	1.48±0.30^{b}	0 - 10	0.8889	2.0611
Chest	25.0	69	0.86±0.21^{bcd}	0 - 8	0.4515	1.2735
4. Cattle breeds						
^{x}Wadara/ Simental	100	69	4.31±0.37^{e}	2-7	3.5169	5.1081
^{x}White Fulani/Frezan	100	14	4.67±0.33^{e}	4-5	3.2324	6.1009
^{x}White Fulani/Simental	100	4	4.00±0.00^{e}	4	-	-
^{x}Wadara/Frezan	100	77	4.05±0.35^{e}	2-7	3.3257	4.7796
^{y}Sokoto Gudali	100	82	20.5±6.54^{cd}	1-28	-0.3080	41.308
^{y}Wadara	100	346	24.7±2.44^{bc}	16-44	19.440	29.989
^{y}Red Bororo	100	260	17.3±1.26^{d}	11-28	14.639	20.027
^{y}Ambala	100	60	30.0±10.0^{b}	20-40	-	-
^{y}White Fulani	100	109	27.3±5.57^{abc}	18-43	9.5130	44.987
^{y}Kuri	100	69	34.5±7.50^{a}	27-42	-	-
5. Total (N)	100	1090	13.6±1.28	0 - 44	11.069	16.181

Table 1: Relative tick infestation under different cattle husbandry systems, tick species abundance and infestation levels in different cattle body parts and breeds in Maiduguri, 2016

[x]Improved local with exotic breeds under intensive management system, [y]Pure local breeds under extensive management system

Variable	Equation	R^2
Husbandry system		
Intensive	$y = 2.7277e^{0.0872x}$	0.8932
Extensive	$y = 16.094e^{0.0764x}$	0.8239
Cattle Breed		
Wadara/Simental	$y = 2.2110e^{0.1220x}$	0.8199
White Fulani/Frezan	$y = 3.8437e^{0.0398x}$	0.7143
White Fulani/Simental	$y = 2.8342e^{0.0730x}$	0.8504
Wadara/Frezan	$y = 3.3898e^{0.0710x}$	0.6929
Sokoto Gudali	$y = 6.2767e^{0.1739x}$	0.7992
Wadara	$y = 13.975e^{0.1278x}$	0.8919
Red Bororo	$y = 10.496e^{0.1062x}$	0.9054
Ambala	$y = 16.445e^{0.1238x}$	0.8865
White Fulani	$y = 17.687e^{0.0897x}$	0.7637
Kuri	$y = 23.717e^{0.0792x}$	0.8967

Table 2: Tick population rate of growth under different husbandry system and cattle breed over eight weeks' period

4. Discussion

The present study has revealed that ticks are serious menace to cattle production in Maiduguri, irrespective of cattle management system and breed. However, the mean population under extensive system of cattle management was higher than under intensive system. This could be attributed to improved management under the intensive system, in which cattle are disinfected and often quarantined resulting in lower incidences of the tick. Previous surveys had shown tick was prevalent on 80% of world cattle population, while 63.4% of the cattle examined in Maiduguri were infected (Bowman et al., 1996), and sex and age were identified as major determinants. Thus, male cattle had slightly higher prevalence compared to females, and calves higher than adult. In contrast, the present study found that tick was prevalent in 100% of the cattle under both extensive intensive system of cattle management. The present study further asses population dynamics, and found that the initial population under extensive husbandry system highly surpassed that under the intensive system; however, the rate of population increase (r) per individual tick were similar under both systems.

Furthermore, the present study revealed differences in the incidence and population of the three encountered tick species on cattle in Maiduguri. The relative abundance of any pest species is dependent on the environment, parasite reproductive capacity and host availability. In the present result, Hyalomma was the most prevalent species in 100% sampled cattle, while the incidence of Boophilus (1.2%) and Amblyoma (6.2%).Therefore, Hyalomma species could be highly prolific and better adapted to the harsh environment prevalent in Maiduguri.In contrast, Biu et al. (2012) reported that Rhipicephalus (Boophilus) species was the most prevalent (56%), followed by Hyalomma species (43.9%) in cattle from Maiduguri. Elsewhere, Obadiah and Shekaro (2012) found that *Amblyomma variegatum* was the most prevalent (22.5%), followed by *Boophilus decolaratus* (17.5%), and *Hyalomma* and *Rhipicephalus sanguineus* at 6.7% and 3.3% respectively, at Zaria.The relative superiority of the present study over single point surveys is that both incidence and population build-up in tick were monitored over longer period of eight weeks in hot dry and wet conditions.

The present result further revealed preference for different body parts by tick, in which the anus, closely followed by udder was the most vulnerable parts, judging by the high incidences and tick load. Tick being a blood-sucking parasite would naturally prefer softer parts of the body, such as the anus and udder than other body parts with tougher skin (Young et al., 1988). Preference for these hidden cattle body parts than those that are exposed could be for protection against predators and harsh weather, and could have serious implications for the control of this important ecto-parasite. The complex nature of ticks infestation has led to the evolution of diverse methods of controlling ticks that ranged from mechanical, biological, host resistance, acarcides by dipping, spraying, dusting and vaccines (Samish et al., 2004; Soneshine et al., 2006).

The result further revealed that local breeds were more prone to infection than the improved crossbreeds of cattle. Kuri, closely followed by Ambala was the most infected breed, but all pure breeds, Wadara, Red Bororo, White Fulani, and Sokoto Gudali were equally vulnerable. In a related study, Obadiah and Shekaro (2012) assessed three pure local cattle breeds and found that tick was more prevalent in White Fulani (75%), followed by Red Bororo (16.7%) and then Sokoto Gudali (8.3%). This could be because local breeds of cattle are predominantly under extensive management system, which that roam freely and therefore exposed to the parasites (Obadiah and Shekaro, 2012). In contrast, infection was comparably low on all the crossbreeds, normally reared under improved management system, where appropriate control measures were employedthat served as check against ticks. Furthermore, the result on population dynamics among cattle breeds also expressed variability in initial tick population, which was generally less for crossbreeds compared to pure locals. However, the lowest and the highest take-off population among the local breeds were from Sokoto Gudali and Kuri, respectively. Rate of population increase (r) per individual tick also varied among breeds, and was higher on Wadara/Simental, Sokoto Gudali, Wadara, Ambala, relative to lower rates on White Fulani/Frezan.

The present study has generally shown that tick was prevalent in Maiduguri, however, incidence under intensive management system was low, indicating the need for routine control of this ubiquitous parasite in cattle herds. The study similarly, revealed differences in tick incidences among breeds, owing to variability in husbandry system. It is therefore, recommended that routine tick control

management practices by dip, spray and injection be employed by cattle owners to control tick. The differences in the abundance of the three species of tick, suggest the need for careful monitoring, especially *Hyalomma* before the threshold population is reached. The preference by ticks for the soft and hidden parts, also calls for proper treatment of all cattle body parts against the ecto-parasite. From the foregoing therefore, there is the need for further study to determine the basis for preference by tick of certain cattle body parts and seasonal variation in the abundance of tick species.

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