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Oviposition capacity and egg mass to fecundity weight ratios in laboratory cultured amblyoma variegatum fabricius, 1794 (Acari: Ixodida)

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ABSTRACT

We studied the reproductive characteristics of female Amblyoma variegatum in the laboratory. These included variations in engorged weight, percentage body mass due to eggs, and quantity of eggs an engorged female could lay. The results showed that different volumes of blood meals would be consumed by the same progeny of Am. variegatum female ticks leading to different engorged weights. The study revealed that in Am. variegatum egg mass could account for as high as 51% of the engorged body weight. The female tick could also oviposit as high as 31,487 eggs and also as low as 2421 eggs in same study cohorts. The study also showed that the actual engorged weight might not reflect the actual ovipositing capacity of the tick. Only the weight of the egg mass laid determined the actual quantity of eggs.

1. Introduction

Ticks are obligate hematophagous arthropods that parasitize every class of vertebrates in almost every region of the world, Sonenshine (1991).

Ticks consume large quantities of host blood during their period of attachment which may be extensive depending on the tick species and the unique host association.

The medical and economic importance of ticks has long been recognised due to their ability to transmit diseases to humans and animals. Ticks cause great economic losses to livestock and adversely affect the livestock hosts in diverse ways. As potential vector of blood living parasites of livestock hosts, blood is lost by the livestock as a result of the presence of the blood parasites. When large number of ticks are found on hosts, the blood meal intake results in anaemia and live weight loss. Their bites affect the quality of the hides of the animals. Apart from the parasitic infestations they may transmit as vectors, ticks are also responsible as transmitting agents of bacteria, fungal and rickettsial infections to the animals.

Amblyoma variegatum continues to persist as the major tick species affecting livestock in Southern Ghana despite considerable efforts by farmers through integrated approach to control the menace. Various works done on other tick species produced results that showed minimum fecundity characteristics that would possibly be reasons for their low prevalence.

Am. variegatum Fabricius, 1794 (Acari:Ixodida) is known as the tropical bont tick as a result of the coloured pattern on the scutum. It is one of the commonest and most widely distributed ticks on livestock in Africa, Walker et al. (2003). It is associated with some tick-borne diseases as described below.

Theileriosis is the infection of ruminants and others with tick borne protozoan parasites of the genus Theileria. The disease causes morbidity in cattle and sheep and this infection can be very severe, often lethal in indigenous breeds. The disease distribution is influenced by the distribution and seasonal activity of the tick vectors in Europe, Africa, North, Central and South America as well as Asia, Preston (2001). The disease affects cattle, goats, buffalo, sheep, horse, donkeys, zebras and sometimes affects man.

Transmission is transtadial; transmitted from one life stage to the other depending on gametocytes in the blood of infected animals being ingested by the larvae or nymph of the particular species of the two or three-host ixodid ticks in which the parasite can undergo sexual recombination and sporogony and also making it possible for the sporogony and sporozoites to be inoculated into the appropriate mammalian host by the next stage of the tick, nymph or adult.

Various forms of Theileriosis exist based on the species of the parasite involved. Tropical form of the disease is known as tropical Theileriosis and is caused by Theileria annulata and it exhibits extensive strain variation. The parasite causes similar disease symptoms across most of its range, from North Africa to China. Symptons of the disease include faeces often mixed with blood and mucus; the skin may raise nodules containing schizont infected cells. The animal is emanciated and anaemic.

The other form of the disease is called East Coast fever and is transmitted by T.parva which is mainly parasite of the African buffalo (Syncerus caffer). It is highly pathogenic to cattle causing a lympho proliferative disease known as East Coast fever, Corridor and January disease. Symptons are varied based on the type of disease but generally include anaemia, animals growing very thin, frothy exudates around the nostrils and dehydration.

Control strategies are geared towards an integrated approach which must include vector and parasite control. Prophylactic and therapeutic drugs are used to treat the disease.

The heartwater or cowdriosis disease is caused by rickettsial organism,Cowdria ruminantium and is prevalent in ruminants. It is often very fatal in cattle, sheep and goats in Sub-Saharan Africa as well as India and Caribbean regions. Ixodid ticks of the genus Amblyoma are responsible for the transmission of the causative organism, Sumption (2001). The C. ruminantium is known to replicate only within mammalian or tick cells. In mammalian host the infection is detected in endothelial cells lining the major and minor blood vessels. It results in accumulation of excess fluid in body cavities as a result of altered function of the endothelium.

The disease starts with sudden rise in body temperature exceeding 41oC over a period of 2-3 days. The animal becomes anxious and exhibits hypertensive responses to light and hand movements about the eye. Muscular tremors, trembling, locomotor control, leaning or circling. There may even be mild diarrhoea in cattle. It quickly progresses to coma and death Sumption (2001).The disease is treated with tetracycline and this must start early. The major means of control is to target the tick vectors through the use of acaricides.

During this study, we determined some biological characteristics of Am. variegatum, such as oviposition capacity in terms of quantity of eggs that an engorged female could produce, the relativity between engorged weight and quantity of eggs produced by a single female.

2. Materials and methods

The parental experimental engorged female Am. variegatum ticks were harvested on livestock by Field Technical Officers, to the Parasitology laboratory. The ticks were delivered on cotton wool in plastic vials covered with muslin cloths held in place by rubber bands. The engorged ticks were singly weighed in plastic vials on Electronic Balance (Model: ae ADAM). Next the ticks were placed in brooding troughs, with the relative humidity controlled by placing wet filter paper soaked in distilled water. The humidity was maintained throughout the period. The ticks were monitored till eggs were laid. 12 hours of light and 12 hours of darkness were maintained throughout the study. The eggs were weighed and monitored till they hatched. About a week after hatching, the larvae were fed in vivo on naive African Rabbits using feeding cloths with sleeve held on animals by adhesives. They were monitored for maximum attachment and also till the nymphs detached. Each nymph was picked by a forceps, placed in petri dish and then into labelled brooding vials. They were monitored to undergo ecdysis to the adult ticks that are fed on rams for fully engorged females.

250 fully engorged female ticks were then selected for the analyses. They were regrouped into 25 weight categories with similar weights.

3. Results and discussion

Table 1 showed results obtained during the study of 25 Cohorts of Am variegatum female ticks in the laboratory depicted in Fig.1 below. The Table showed correlation between the weight of the egg mass produced and the actual egg counts obtained by an engorged female. The higher the egg mass, the larger the quantity of eggs produced. The table also showed that half the engorged weight of a female Am. variegatum tick could be due to egg mass.

Table 2 and Fig.2 below compared the % body masses of fully engorged females and their relationship to egg quantity. The table showed that the % body mass was not related to the actual quantity of eggs laid by the engorged female. As shown in the table, at 36%, 10,485 eggs were laid whilst at 37%, 8006 eggs were laid. The same trend was observed for 41% and 42% respectively. The highest egg count was produced by 50% at 31,487 whilst 51% gave 15,527 respectively.

Am. variegatum undergoes a three-host life cycle. This life cycle is the commonest. Here the larvae feed on a host and detach to the soil or vegetation. They mould to the nymphs which also locates a suitable host, feeds and moulds to the adult stage. The adult tick on locating a suitable host, mates, engorges blood meal and detaches to the soil or vegetation. It lays one huge batch of eggs and dies. The male may take several blood meals, mates and finally also dies. Ticks that are newly hatched have very soft cuticle and are inactive for one to two weeks until the cuticle hardens. This life cycle is normally slow and usually takes from six month to several years. This life cycle is commonest in temperate countries where stages are used to outwit winter. Ticks are very important to man and his domestic animals, and must be controlled if livestock production is to meet world needs for protein consumption. Knowledge of the nature and habits of the tick and the disease agents it transmits help in control, Stewart et al. (1981). The urgency in demand for tick control is basically due to the problems associated to economics of livestock trade, George et al. (2004). As a result of the challenges posed by tick infestations and tick born diseases, tick control has become a priority for many a tropical and sub-tropical countries, Lodos et al. (2000). Money values have been estimated for losses due to tick infestations and tick born diseases in some countries. For example, it was estimated that in Australia, the damage caused by Rhipicephalus microplus was USD 62 Million as far back as 1974, Springell (1983) and Brazil estimated its effect at USD 2Billion per year, Gris et al. (2002). It is envisaged that with effective control measures, these monetary values could be drastically reduced. Ticks are controlled through the application of chemicals such as Acaricides, the use of host resistance, Pasture spelling, and pasture burning, use of certain grasses and legumes to inhibit or kill ticks and the use of vaccines, Zahid et al. (2006).

4. Conclusion

The study therefore showed that in Am. variegatum egg mass could account for as high as 51% of the engorged body weight. The female tick could also oviposit as high as 31,487 eggs and also as low as 2421 eggs in same study cohorts. The study also showed that the actual engorged weight might not reflect the actual ovipositing capacity of the tick. Only the weight of the egg mass laid determined the actual quantity of eggs.

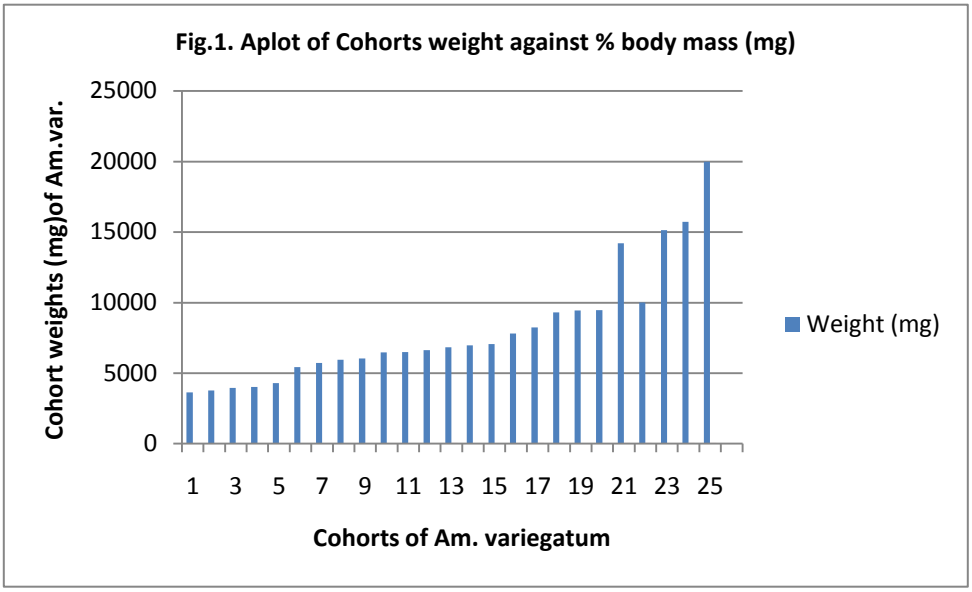
Table 1
Determined cohort weights, egg quantity and % of egg mass produced by ovipositing female Am. variegatum against cohort weight depicted as % Body Weight.

Weight (mg)	Egg Qty.	% Body Weight
3628	2421	22a
3779	3246	28
3963	2,024	17
4025	4000	33a
4298	3227	25
5428	5729	35
5733	5782	33a
5954	7024	39
6033	5230	29
6476	7030	36a
6499	5924	30
6635	8530	42
6842	8824	43
6972	7491	36a
7059	8006	37a
7803	5297	22 a
8244	11521	46
9309	13445	48
9444	11700	41
9473	10485	37a
10015	15527	51
14216	21482	38

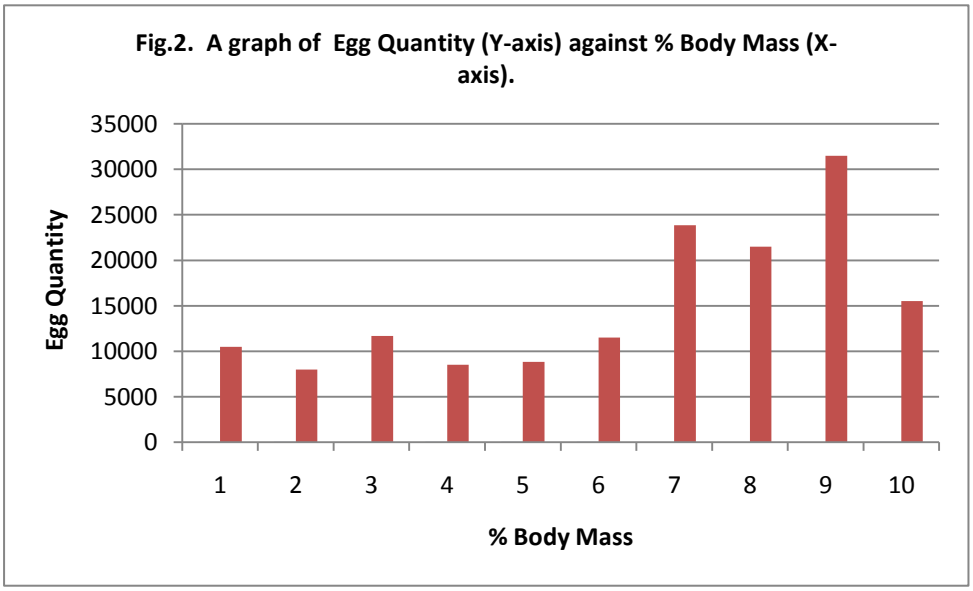
[a,] occurred in two weight groups: [b], occurred in three weight groups

Table 2
% of laid egg mass to mass of engorged tick as % Body Mass is shown against quantity of egg laid by female Am. variegatum under study.

No.	% Body Mass	Egg Quantity
1	36	10,485
2	37	8,006
3	41	11,700
4	42	8,530
5	43	8,824
6	46	11,521
7	50	23,863
8	50	21,482
9	50	31,487
10	51	15,527



To outwit the dangers associated with host location, ticks must produce a copious amount of eggs to effect infestation.



This could be the possible reasons for the high egg output by the Cohorts studied.

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