HORIZONTAL DISPERSAL AND CLIMBING BEHAVIOUR OF THE CAMEL TICK *HYALOMMA DROMEDARII* (*ACARI: IXODIDAE*) IN DESERT ECOSYSTEM OF NORTHERN SUDAN

ElGhali, A.[1*] and Hassan, S. M.[2]

1- Central Veterinary Research Laboratories, P. O. Box 8067, Amarat, Khartoum, Sudan.,
2- Department of Parasitology, Faculty of Veterinary Medicine, University of Khartoum, Sudan.

المستخلص

تم إطلاق عدد ٣٠ من قراد هايلوما دروميدارى البالغ فى ساحات عشبية ثم قيست المسافات التى ينتشر فيها القراد كل ٤٨ ساعة لمدة ١٤ يوم. أيضا تم وضع ٥٠٠٠ يرقة و ٥٠ قراد بالغ من نفس النوع فى كل من خمسة ساحات معدنية دائرية مثبت بها عدد من العصى (فروع اشجار) الرأسية وقيست هنا الإ رتفاعات التي يصعد إليها القراد نهارا عند اليساعة السادسة صباحا، الثانية عشرة مساء والسادسة مساء خلال ثلاثة ايام متتالية. إتضح من هذه الدِراسة أن القراد البالغ ينتشر خلال الحشائش لمسافات ما بين ٤١ سم و١٤٤سم وأنه لا يصعد لأعلي الأشجار او الحشائش. أما اليرقات فقد صعدت فى اليوم الثانى للتجربة لإرتفاع ما بين ٢٨.٩ إلى ٣٤.٤ سم. هذه اليرقات صعدت لأعلى إرتفاع لها(٣٧.٩ -٥٠.٩ سم) عند الساعة الثانية عشر مساء.

Keywords: *Hyalomma dromedarii*, Dispersal and climbing of ticks

*Author of correspondence email: elghaliaahmed@hotmail.com

Abstract

Thirty adults of Hyalomma dromedarii were released in grass arenas. Dispersal distances of the recaptured ticks were measured every other day for 14 days. Similarly, 5000 larvae and 50 adults of the same tick species were released in each of five metal arenas containing vertically erected sticks. Their diurnal climbing heights were measured at 0600, 1200 and 1800 hours for three successive days. Dispersal of adults in grass ranged between 41 and 144 cm. Adults had no tendency of climbing vegetation. Larvae climbed on the second day for maximum heights of 28.9 and 34.4 cm. They preferred to climb in the afternoon hours to reach maximum heights that ranged between 37.9 and 50.3 cm.

Introduction

During their host seeking, some ticks horizontally move on the ground or in grass for short distances ranging from zero to few metres (Rechav 1979; Punyua *et al*. 1984; Lane *et al*., 1985; Falco and Fish 1991; Stafford, 1992; Goddard 1993). Lewis, (1970), however, reported that strong wind and casual hosts played a role in dispersal of *B. microplus* larvae for 260 and 900 feet, respectively. On the other hand, climbing of some tick species on grass blades, trees or other objects occurs to certain heights in their trials to find a passing host. This behaviour was observed in different tick species particularly among *Rhipicephalus* and *Amblyomma* species where adults and larvae, respectively were found aggregating at the top of grasses (Browning 1976; Camin and Drenner, 1978; Rechav 1979; Loye and Lane, 1988; Hassan *et al.,* 1994). This vertical movement is humidity dependent, where high humidity leads to high proportion of larvae and adults to climb grass (Punyua *et al.* 1984; Chiera, 1985; Snyman *et al*., 1994). The current study was designed to elucidate dispersal and climbing behaviour of the camel tick *H. dromedarii* under field conditions in desert ecosystem

of northern Sudan. The study of it's dispersal behaviour is important in the formulation of control procedures.

Materials and Methods

This study was conducted in Atbara Town (34^{o}E, 18^{o}N), Northern Sudan which is in the desert ecosystem where mean daily maximum ambient temperature in summer reaches 45^{o}C and in winter it falls to less than 10^{o}C. The annual rainfall ranges between 0-100 mm with very low ambient relative humidity in summer and winter. The mean soil temperature ranges between 30^{o}C and 60^{o}C in the morning and afternoon hours, respectively in summer and between 15^{o}C and 30^{o}C in winter.

Three arenas cultivated with the grass *Cynodon dactylon* were used for dispersal of ticks. Arena 1 was 270 X 240 cm, arena 2 was 450 X 420 cm and arena 3 was 600 X 450 cm. In the centre of each area, a piece of stick was erected to indicate the point of release of ticks (Plate 1). Thirty adult *H. dromedarii* (males and females), from a field collection that was reared in Atbara Regional Veterinary Research Laboratory, were released in centre of each arena. Prior to release, the ticks were painted on the scutum using non-toxic and non-fluorescent artist oil paints (Shanghai, Sic. Marie painting materials Co. LTD). A small drop of the paint was carefully placed on the scutum avoiding spill of the paint to the spiracles. The paint was allowed to air dry. These ticks were recaptured every other day for 14 days and the distance from the release point was measured using the simple metric measurement system. This experiment was conducted in September, March, and August 2002.

For climbing behaviour of ticks, 5 metal arenas of 57 cm in diameter and 20–22 cm high were fixed on the ground and filled close to the top with damp soil. Three dry sticks of the plants of each of *Prosopis chilnses*, *Capparis decidua* and *Acacia flora* (i.e. nine branches in each arena) were vertically fixed 30 cm from the centre (Plate 2). The three plants used in this study represent the common trees in the study area. To minimize number of ticks escaping out of the arena, a small amount of green grass

Cynodon dactylon was placed in each arena at the time of release. About 5000 larvae and 50 adults of hydrated *H. dromedarii* were released each time in the centre of each arena. Climbing heights of each stage on the sticks were measured using the simple metric measurement system, without disturbing the ticks, at 0600, 1200 and 1800 hours every day starting from the day of release for three consecutive days. This experiment was conducted for larvae in February 2000, March 2002, May 2003 and August 2003 and for adults in March 2002, July 2004 and August 2004.

Results

In March, the dispersal distance of the adults was significantly shorter and only on day two (Table 1). The mean maximum distance of dispersal was on day eight, which was not significantly longer than the distances on days 4 to 14. The mean minimum distance recorded was about 100 cm. In August, the mean maximum distance was about 144 cm whereas in September it was 123 cm. A considerable number of ticks were recaptured in March after their release while in September very few ticks were recaptured. In August and September, there were no significant differences between dispersal distances in all days. These adults rarely climbed plant sticks. Only 7/50 (0.14%) adults climbed to a range of 3 to 50 cm high in March while none climbed in other months.

Unlike adults, larvae climbed the three plant sticks reaching mean maximum heights on the second day but the mean minimum heights were reached on the third and fourth days. They reached mean maximum heights at 1200 hours that were significantly higher than the heights at 0600 hours and 1800 hours. These heights were 37.9±4.8, 50.3±5.3 and 42.4±3.4 cm on *P. chilnses*, *A. flora* and *C. decidua*, respectively (Table 2). No significant differences were observed among the mean numbers of larvae climbing at different times of the day except for *A. flora* on day zero (Table 3). More larvae climbed the sticks *P. chilnses* and *C. decidua* on the first day of their release. On *A. flora*, the mean maximum number

climbed was on day two. The pattern of diurnal climbing was apparent on *P. chilnses* and *A. flora* while on *C. decidua* the lowest number was 1.4±0.2 larvae (Table 4).

Discussion

Horizontal movement of ticks is an important phenomenon in host seeking behaviour as it ensures the opportunity for picking up by a host. Goddard (1993) reported that most adults of *I. scapularis* were recaptured at distances between zero to 50 cm from the point of release and only few at 100–300 cm. Adults of *A. hebraeum* dispersed for as far as 520 cm and 80% of *R. appendiculatus* were found within 80 cm (Rechav, 1979). In the present study, *H. dromedarii* adults dispersed in grass for distances that ranged between 41.3 to 144.3 cm. Punyua *et al.* (1984) recovered majority of *R. appendiculatus* adults on the fourth day within a radius of 10 cm. Although horizontal movement of ticks is minimal, but winds are important in their dispersion particularly of the larvae. Lewis (1970) observed that over short pasture larvae were carried by wind up to 260 feet. Camels browse trees and shrubs which are too high for ticks to reach. However, camel ticks seek shelter at the base of trees from where they disperse to be picked by camels.

Hyalomma dromedarii larvae were observed to climb the sticks. Larvae of *A. hebraeum*, *R. appendiculatus* and *R. e. evertsi* were found at the top of short grass (Rechav, 1979). Similarly, Hassan *et al.* (1994) reported that larvae of *R. appendiculatus* were found aggregated at the underside of the plant *Acalypha fruticosa*. Larvae of *Haemaphysalis leporispalustris* were found to climb on vegetation to the level of the heights of rabbits (Camin and Drenner, 1978). In this study, larvae climbed to a maximum height of 50 cm. The climbing heights were significantly affected by the day and time, when larvae climbed to maximum heights on the second day (28-34 cm) and at 1200 hours (37-50 cm). This may be a reflection of temperature and/or time of camel browsing behaviour. Despite climbing heights, time of the day seemed to have no effect on the number of larvae

climbing which was found to be highest on the releasing days .Even at the peak time of climbing, larvae were not seen aggregated on the sticks but were seen moving up and down. This behaviour may be due to the microclimate effect particularly relative humidity which was generally low, a factor which may force ticks to move down. Robertson *et al.*, (1975) reported that ticks ascend vegetation as a result of development of negative geotaxis when they need to rid their bodies of excess water. When their body water content reduces, a positive geotaxis appears and they return to the ground level. This activity of continuous movement together with generally high temperature and low relative humidity may adversely affect larval survival leading to depletion of water reserve and thus minimize number of larvae that find hosts. Since the plant sticks used were dry and relative humidity in the microclimate of the ticks was low the hydrated ticks started to lose water a fact that may help explain the returning behaviour to the release point (Chiera 1985). *H. dromedarii* adults in the present study did not climb but showed hunting behaviour unlike *Rhipicephalus* and *Ixodes* species that show ambushing behaviour according to Punyua *et al*. (1984), Chiera (1985), Loye and Lane (1988) and Hassan *et al.* (1994). It was observed in the field that the quiescent *H. dromedarii* adults at the base tree trunks were activated in response to the presence of hosts or even humans and were observed actively running towards the hosts. Waladde and Rice (1982) pointed out that ticks in their host seeking behaviour, actively run towards the hosts and these are called hunters.

Conclusively, adult *H. dromedarii* disperses in grass for a distance ranges between 41 and 144 cm. and had no tendency of climbing vegetation (hunters). The larvae can climb vegetations waiting for the hosts (ambushers).

Plate 1: Grass arena prepared for dispersal study of *H. dromedarii* larvae and adults (Arrow indicates the point of tick release)

Plate 2: Metal arenas with erected sticks of three plant specie (*Prosopis chilnses*, *Capparis decidua* and *Acacia flora*) for climbing study of larvae and adults of *H. dromedarii*.

Table 1 Means (±SE) dispersal distances (cm) of flat adult *H. dromedarii* in grass in different season of the year..

Month	Days of release						
	2	4	6	8	10	12	14
March	41.3±9.2b (21)	76.5±8.8ab (27)	43.0±9.2ab (13)	101.9±16.0a (14)	70.5±22.1ab (6)	87.3±16.4a (11)	98.7±18.1a (19)
August	79.9±14.2a (22)	98.9±20.1a (11)	101.3±29.8a (6)	144.3±20.8a (6)	95.8±33.7a (5)	86.5±9.5a (2)	67.0±0.0a (1)
September	88.8±15.2a (8)	103.5±16.0a (6)	87.4±18.5a (5)	112.3±22.8a (3)	123.0±0.0a (1)	-	-

Means (±SE) followed by the same letter in each row are not significantly different at 5% level based on Ryan's Q test (REWGQ), Figures in parenthesis = Number of ticks recaptured, - =No ticks recaptured.

Table 2: Mean (±SE) climbing heights (cm) of *H. dromedarii* larvae on plant sticks on successive days following day of release (Day 0) and at different times of the day.

	N	*Prosopis chilnses*	N	*Acacia flora*	N	*Capparis decidua*
Days after release						
0	49	19.6±2.2ab	22	23.0±3.9a	89	25.5±2.5a
1	54	28.9±3.6a	19	34.4±5.6a	60	33.2±3.3a
2	11	14.5±3.6b	6	9.7±2.9b	33	22.7±3.3a
3	-	-	-	-	2	21.5±8.5a
Time of the day						
0600	-	-	-	-	14	12.1±2.5c
1200	33	37.9±4.8a	14	50.3±5.3a	59	42.4±3.4a
1800	81	17.7±1.7b	33	15.5±2.0b	111	21.4±1.8b

Means (±SE) followed by the same letter in each column for days and time are not significantly different at 5% level based on Ryan's Q test (REWGQ).

N = Number of observations. - = No ticks recovered.

Table 3: Mean (±SE) number of larvae of *H. dromedarii* climbing plant sticks in successive days following day of release (Day 0) and at times of the day

Days after release	Time of the day (hours)	N	*Prosopis chilnses*	N	*Acacia flora*	N	*Capparis decidua*
0	0600	-	-	-	-	-	-
	1200	10	4.1±1.1a	3	17.3±16.3a	25	3.2±0.5a
	1800	39	5.0±0.9a	18	2.9±0.6b	64	4.5±0.7a
1	0600	-	-	-	-	9	1.3±0.2a
	1200	23	3.4±0.8a	11	4.1±1.3a	21	1.9±0.2a
	1800	30	2.6±0.4a	8	6.0±2.2a	30	1.6±0.2a
2	0600	-	-	-	-	3	1.0±0.0a
	1200	-	-	-	-	13	1.0±0.0a
	1800	11	3.8±1.2	5	6.6±3.8	17	1.7±0.3a
3	0600	-	-	-	-	2	1.5±0.5
	1200	-	-	-	-	-	-
	1800	-	-	-	-	-	-

Means (±SE) followed by the same letter in each column for each day are not significantly different at 5% level based on Ryan's Q test (REWGQ)

N = Number of observations, - = No ticks recaptured.

Table 4: Mean (±SE) number of flat larvae of *H. dromedarii* climbing plant sticks in successive days.

Days after release	N	*Prosopis chilnses*	N	*Acacia flora*	N	*Capparis decidua*
0	49	4.8±0.8	21	5.0±2.3	89	4.1±0.5
1	53	3.0±0.4	19	4.9±1.2	60	1.7±1.2
2	11	3.8±1.2	5	6.6±3.8	33	1.4±0.2
3	-	-	-	-	2	1.5±0.5

N = Number of observations. - = No ticks were recaptured.

Reference

Browning, T. O. (1976). The aggregation of questing *Rhipicephalus pulchellus* on grass stems with observations on *R. appendiculatus*. Physiological. Entomol. **1**: 107-114

Camin, J. H and Drenner, R. W. (1978). Climbing behaviour and host finding of larval rabbit ticks *Haemaphysalis leporispalustris*. J. Parasitol. **64**(5): 905-909.

Chiera, J. W. (1985). The distribution and climbing behaviour of *R. appendiculatus* Neumann on grass stems. Insect Sci. Appl. **6**(2): 213-215.

Falco, R. C. and Fish, D. (1991). Horizontal movement of Adult *Ixodes dammini* (Acari: Ixodidae) attracted to CO_2 baited traps. J. Med. Ent. **28**(5): 726-729.

Goddard, J. (1993). Ecological study of *Ixodes scapularis* (Acari: Ixodidae) in central Mississippi: Lateral movement of adult ticks. J. Med. Ent. **304**: 824-826.

Hassan, S. M.; Dipeolu, O. O and Malonza, M. M. (1994). Natural attraction of livestock ticks by the leaves of a shrub. Trop. Anim. Hlth. Prod. **26**: 87-91.

Lane, R. S.; Anderson, J. R.; Yanink, J. S. Burgdorfer, W. (1985). Diurnal host seeking of adult Pacific Coast ticks, *Dermacentor occidentalis* (Acari: Ixodidae), in relation to vegetation type, meteorological factors, and rickettsial infection rates in California, USA. J. Med. Entomol. **22**(5): 558-571.

Lewis, I. J. (1970). Observations on the dispersal of larvae of the cattle tick *Boophilus microplus*. Bull. Ent. Res. **59**: 595-604.

Loye, J. E and Lane, R. S. (1988). Questing behaviour of *Ixodes pacificus* (Acari: Ixodidae) in relation to meteorological and seasonal factors J. Med. Entomol. **25**(5): 392-398.

Punyua, D. K.; Newson, R. M and Mutinga, M. J. (1984). Diurnal and seasonal activity of unfed adult *Rhipicephalus appendiculatus* (Acarina: Ixodidae) in relation to some intrinsic and extrinsic factors.. I. Factors affecting vertical distribution of ticks in the habitat. Insect Sci. Applic. **5**(4): 245-246

Rechav, Y. (1979). Migration and dispersal patterns of three African ticks (Acari: Ixodidae) under field conditions. J. Med. Entomol. **16** (2): 150-163.

Robertson, A. S.; Patrick, C. D.; Semtner, P. J. and Hair, J. A. (1975). The ecology and behaviour of the lone star tick (Acarina: Ixodidae). V1. Response of unfed adults to certain environmental parameters. J. Med. Entomol. **12**(5): 525-529.

Snyman, A.; Fourie, L. J.; Koj, D. J. and Horak, I. G. (1994). Vertical migration of adult *Ixodes rubicundus*, the Karoo paralysis tick (Acari: Ixodidae). Exp. Appl. Acarol. **18**: 101-110.

Stafford, K. C. (1992). Oviposition and larval dispersal of *Ixodes dammini* (Acari: Ixodidae) J. Med. Ent. **29**(1): 129-32.

Waladde, S. and Rice, M. J. (1982). The sensory basis of tick feeding behaviour. In: Physiology of Ticks. (Ed. Obenchain, F. D. and Galun, R.). Pergamon Press. New York. pp 71 – 118.