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Original Article

Study on Ecological Growth Conditions of Cattle Hyalomma Ticks in Punjab, Pakistan

***AZ Durrani[1], AR Shakoori[2]**

[1]*Dept. of Clinical Medicine & Surgery, University of Veterinary and Animal Sciences, Lahore, Pakistan*

[2] *School of Biological Sciences, Punjab University, Lahore, Pakistan*

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Abstract

Background: The survey for the prevalence of different species of cattle *Hyalomma* ticks was carried out in three districts (Rawalpindi, Multan and Lahore) of Punjab province in Pakistan. The bionomical conditions suitable for *Hyalomma* were also studied in laboratory.

Methods: One hundred specimens of ticks of different genera were collected from each district. After identification, the *Hyalomma* ticks were reared in laboratory under the influence of varying temperature and humidity.

Results: The results showed highest prevalence (67%) of ticks in district Lahore. The highest prevalence (12%) of *Hyalomma* ticks and lowest prevalence (3.1%) of *Rhipicephalus* in cattle was recorded. The bionomical study showed the highest mean pre oviposition period was during spring while it was lowest in autumn .The mean oviposition period was also highest in spring . The incubation period of the ova of *Hyalomma* varied in different seasons. No oviposition was recorded at the temperature 10^0C and 85% humidity. The maximum number of eggs was laid at 34^0C and lowest egg production occurred at 15^0C. The maximum number of eggs hatched at 32^0C and 85% humidity.

Conclusion: The variation in relative humidity had no appreciable effect on rate of development of ticks while the number of eggs laid increase with rise in temperature.

Keyword: Hyalomma*, Preoviposition, Oviposition, Temperature, Humidity, Pakistan*

Introduction

Pakistan being a tropical country provides optimal climatic conditions for growth and multiplication of ticks. Tick fauna of Pakistan is rich in number of genera and species (1). Despite this richness and suitability of the climatic conditions little systematic work has been done to investigate taxonomy, bionomics, seasonal and regional occurrence of ticks infesting the livestock in Pakistan. It is reported the highest prevalence (15%) of *Hyalomma* tick followed by *Boophilus* (12%)*, Haemaphysalis* (5%) and *Rhipicephalus* (3%) in district Kasur, Pakistan (2). Ticks are the most important ectoparasites of livestock in tropical and subtropical areas and are responsible for substantial economic losses. Ticks not only cause direct effect on animals by sucking blood, they are also responsible for the transmission of

***Corresponding Author:** Tel: 092-042-5304937,
E-mail: Aneela_nadeem8@hotmail.com

several-dreaded protozoan, rickettsial and viral diseases (3). The harm done by tick bites and blood sucking has been reduced by control measures taken to prevent the diseases transmitted by them (4). The two forms of harm are themselves importance. Estimates of the amount of blood removed vary according to the species under consideration. A single adult female tick may remove 0.5 — 2.0 ml. of blood (5). If an animal carries numerous ticks, a substantial loss of blood may occur. Heavy infections do occur in nature, it is more usual for animals to carry a few hundred ticks. These produce what is generally known as "tick worry." *Hyalomma* ticks, as vectors of tropical theileriosis are widespread in North Africa, southern Europe, Middle East, Central Asia and China (6). In Pakistan piroplasmosis, theileriosis and anaplasmosis are common livestock diseases, which are transmitted by the ticks (7). The information on the ticks of livestock in Pakistan is scanty (1).

In the present study the prevalence of different tick genera and bionomics of the species of genus; *Hyalomma* was undertaken, which help in control of various tick borne diseases transmitted by ticks of this genus in Pakistan.

Material and Methods

Collection of ticks

Surveillance studies of ticks as vector in transmission of the disease was carried out in Rawalpindi, Multan and Lahore districts. Three hundred cattle were randomly selected and ectoparasites specimen were collected from them. Specimen were brought to the laboratory in wide mouthed ,screw capped ,glass jars which were carefully labeled at the collection site and identified by using key of morphological characters. All parts of the body of cattle were carefully examined. The ticks were removed from the body of the host with the help of fine and smooth forceps taking all necessary precautions to avoid damage to the mouthparts of the ticks and skin of host. Specimens were preserved in 1:1 solution of 10% formalin and chloroform for identification by using low power stereoscopic microscope. The collection was stored for record in screw capped specimen bottles. The live *Hyalomma* ticks were placed in tubes covered on top with a small piece of muslin cloth for bionomical studies.

Rearing on the host

For rearing on the host, adult ticks were attached to the rabbits. The animals were kept in small steel cages and provided with food and water .The cages were placed in trays containing grass. These trays were in turn placed in larger trays containing creosote solution to prevent escape of ticks. As the cages were entirely in open, the ticks were exposed to the same conditions, they encounter in nature, with the possible exception of the relative availability of the host (8).

Effect of Temperature and Humidity

Influence of temperature and humidity on the rate of development of *Hyalomma* was studied by confining adult female ticks in glass tubes covered with muslin cloth in four seasons of the year i.e. summer, autumn, winter and spring. For rearing in tubes, 15 cm long tubes with bottom removed were taken and fixed in vertical position on the trays containing a mixture of moist sand and clay. For obtaining outdoor records, the tubes were kept under two different conditions. In one lot, the tubes were exposed to direct sunlight and rainfall as well as variation of temperature, humidity, and air circulations. The tubes of other lot were placed under trees so that they were sheltered from direct sunlight and rainfall but exposed to all variations of temperature, humidity and air circulation (9).

Results

The survey result showed highest percentage of 67 % (67/100) ticks in district Lahore while 39 %(39/100) and 14 %(14/100) was recorded in district Rawalpindi and Multan respectively. Out of total 120 tick specimens, the results showed highest prevalence (12%) of *Hyalomma* ticks followed by 8.1% *Boophilus,* 5% *Haemaphysalis,* and 3.1% *Rhipicephalus.*

Pre oviposition period

The mean pre oviposition period recorded during spring varied from 10 to 30 days. In mid summer, it was 15-25 days. In autumn, it was observed to vary from 6-8 days (Table 1).

Ovi position Period

The mean oviposition period during the study period varied from 15-20 days in spring, 10 to 15 days in summer, 10 to 18 days in autumn (Table 2).

Incubation period

The incubation period of the ova of *Hyalomma* was found to vary in different seasons. In spring under natural conditions, this period was found to be 19 to 30 days, in summer, 15 to 25 days, and in autumn 10 to 20 days. The eggs were oblong in shape and measured 0.475 X 0.424 mm in size and weight 0.047 mg on an average. Total number of eggs laid by a single female under natural conditions varied seasonally. It was observed that the maximum number of eggs laid by a single female tick in spring varied from 3735 to 3920, in summer from 2615 to 2970 and in autumn from 2425 to 2610(Table 3) .

The larva

For larvae during spring maximum longetivity without food was observed to vary from 35 to 90 days. It was observed that the larvae engorged between 8-15 days in spring, 8 to 19 days in summer and 7 to 10 days in autumn. The weight of unfed larva was found to vary from 0.037 to 0.048 mg and of engorged larvae from 0.160 to 0.175 mg. The amount of blood sucked during this period was found to vary from 0.130 to 0.133 ml. The moulting period varied from 8 to 28 days in spring, 8 to 20 days in summer, 8 to 20 days in autumn.

Nymph

The maximum longetivity without food during spring was found to vary from 49 to 90 days. It was observed that nymph engorge between 6 to 15 days in spring, 4 to 10 days in summer, 6 to 10 days in autumn. The weight of unfed nymph was found to vary from 0.106 to 0.126mg and of engorged nymph from 0.895 to 1.528 mg. The amount of blood sucked varies from 0.790 to 1.407mg. The fully engorged nymphs were placed in rearing tubes and exposed to natural environmental conditions during different seasons. The moulting period varied from 10 to 30 days in spring, 8 to 20 days in summer and 9 to 15 days in autumn.

The Adult

It was observed that females engorged between 8 to 18 days in spring, 7 to 19 days in summer, 5 to 8 days in autumn. The weight of unfed female was found to vary from 1.30 to 2.15 mg and of engorged nymph from 0.895 to 1.528 mg. The amount of blood sucked varies from 180.75 to 239.00mg. The total amount of blood sucked by single female was found to be 211.102 mg.

Influence of temperature and humidity on the rate of development of *Hyalomma* tick:

The mean duration of 6 days of pre-oviposition period of *Hyalomma* was recorded at constant temperature of 30 degree centigrade with variable humidity's at 52%, 72%, 79%, 83%, 91% and 100% (Table 4). At a constant humidity of 85% and duration of pre-oviposition period of Hyalomma was found to be highest at 15^0C (25 to 35 days) while it was shortest at 25^0C 6 to 8 days (Table 5). It was observed that variation

of relative humidity has no appreciable effect on oviposition period. The longest oviposition period was noticed at 15^0C and 85% humidity while the shortest oviposition period was noticed at 34^0C and 36^0C at 85% humidity. No oviposition occurred at 10^0C at 85% humidity (Table 6) .It was observed that the number of eggs laid varied with the rise in temperature. The maximum number of eggs was laid at 34^0C and lowest egg production occurred at 15C. The maximum number of eggs hatched at 32^0C and 85% humidity (Table 7).

Table 1: Pre-oviposition period of *Hyalomma* tick in different seasons under Lahore conditions

Season	Female #	Dropped on	Oviposition began on	Preoviposition period	Mean	Range
Spring	1	13-9-06	26-9-06	13	19	13 to 26
	2	11-9-06	27-9-06	16		
	3	9-10-06	28-10-06	19		
	4	8-11-06	31-12-06	23		
	5	6-11-06	2-12-06	26		
Summer	1	11-6-07	25-6-07	1	18	14 to 23
	2	8-6-07	23-6-07	15		
	3	21-7-07	9-8-07	17		
	4	15-8-07	4-9-07	20		
	5	14-8-07	6-10-07	23		
Autumn	1	21-4-07	27-4-07	6	7	6 to 8 days
	2	11-4-07	18-4-07	7		
	3	19-5-07	26-5-07	7		
	4	9-5-07	16-5-07	7		
	5	7-5-07	15-5-07	8		

Table 2: Oviposition period of *Hyalomma* tick in different seasons under Lahore conditions

Season	Female #	Oviposition began	Oviposition stopped on	Oviposition period in d	Mean
Spring	1	26-9-06	5-10-06	10	12
	2	27-9-06	8-10-06	11	
	3	28-10-06	8-11-06	11	
	4	31-12-06	14-1-07	14	
	5	2-12-06	17-12-06	15	
Summer	1	25-6-07	4-7-07	9	11
	2	23-6-07	3-7-07	10	
	3	9-8-07	19-8-07	10	
	4	4-9-07	15-9-07	11	
	5	6-10-07	19-8-07	13	
Autumn	1	27-4-07	7-5-07	9	11
	2	18-4-07	27-4-07	9	
	3	26-5-07	5-6-07	10	
	4	16-5-07	28-5-07	12	
	5	15-5-07	29-5-07	14	

Table 3: Incubation period of ova of *Hyalomma* tick in different seasons under Lahore conditions

Season	Female #	Oviposition began	Hatching began on	Incubation period in days	Mean	Range
Spring	1	26-9-06	11-10-06	15	20	15 to 26
	2	27-9-06	24-10-06	17		
	3	28-10-06	18-11-06	21		
	4	31-12-06	23-1-07	23		
	5	2-12-06	28-12-06	26		
Summer	1	25-6-07	6-7-07	11	16	11to 22
	2	23-6-07	5-7-07	12		
	3	9-8-07	26-7-07	17		
	4	4-9-07	24-8-07	19		
	5	6-10-07	29-8-07	22		
Autumn	1	27-4-07	7-5-07	10	15	10 to 20
	2	18-4-07	30-4-07	12		
	3	26-5-07	12-6-07	17		
	4	16-5-07	4-6-07	19		
	5	15-5-07	4-6-07	20		

Table 4: Effect of constant temperature and varying humidity on preoviposition period

Sr #	**Relative Humidity on 30^0C**	**Number of Females**	**Preoviposition period in days** Mean	Range
1	52%	10	4	3-6
2	72	10	4	3-5
3	79	10	4	3-5
4	83	10	4	3-5
5	91	10	4	3-5
6	100	10	4	

Table 5: Effect of constant humidity and varying temperature on preoviposition period

Sr #	**Temperature at 85% Humidity**	**Number of Females**	**Preoviposition period in days** Mean	Range
1	10^0C	4	Nil	Nil
2	15	4	25	20-30
3	20	4	10	8-12
4	25	4	7	6-8
5	30	4	3	2-4
6	32	4	3	2-4
7	34	4	3	2-4
8	36	4	3	2-4

Table 6: Effect of constant temperature and varying humidity on oviposition period

Sr #	**Relative Humidity on 30^0C**	**Number of Females**	**Oviposition period in days** Mean	Range
1	52%	5	10	9-12
2	72	5	10	8-13
3	79	5	10	9-12
4	83	5	10	9-12
5	91	5	10	8-13
6	100	5	10	8-13

Table 7: Effect of constant humidity and varying temperature on oviposition period

Sr #	**Temperature at 85% Humidity**	**Number of Females**	**Oviposition period in days** Mean	Range
1	10^0C	5	Nil	Nil
2	15	5	17	20-30
3	20	5	17	15-20
4	25	5	13	12-15
5	30	5	9	8-10
6	32	5	7	6-8
7	34	5	5	4-6
8	36	5	5	4-6

Discussion

The highest prevalence (12%) of *Hyalomma* ticks followed by 8.1% *Boophilus*, 5% *Haemaphysalis*, and 3.1% *Rhipicephalus* was observed. The findings are in accordance with reported infestation of similar genera of ticks on Friesian cattle in district Kasur, Punjab (2). The results also coincided with another report where *Hyalomma, Boophilus, Rephicephalus* and *Haemaphysalis* genera infested domestic animals (1). The species of *Hyalomma* were also reported as 28.2% (1269/4500) in cattle and 14.7% (662/4500) in buffaloes in Faisalabad district of Pakistan (10). Seven species of ticks i.e. *Rhipicephalus sanguineus*, *Boophilus microplus*, *B.annulatus*, *Hyalomma (A) anatolicum, H. marginatum marginatum, H. aegyptium* and *Dermacentor marginatus* were identified (10). The incidence of ectoparasites in cattle in Northern areas of Pakistan was recorded as *H. aegypticum, H. (A.) anatolicum, B. microplus* and *Hypoderma lineatum* (11). Our results were not in accordance with other study which reported five species of Ixodidae ticks infesting different animals (cow, buffalo, goat and sheep) (12). The authors reported that *Haemaphysalis (H.) sulcata* and *H. (A.) anatolicum* occurred throughout the year; however, the infestation of *H. (H.) sulcata* was more common than that of *H. (A.) anatolicum*. They also reported that high density of ticks were recorded in the month of August, September, and October, when the mean temperature was (27^0C) and relative humidity as 84%. The rearing of ticks on rabbits showed that adult *H. (A.) anatolicum* ticks infected with *Theileria annulata* (Hissar strain) were incubated at 36°C or fed on rabbits (13). The authors confirmed that fed ticks would be more suitable for sporozoite production for infection of cattle and production of stabilate. The effect of temperature as reported in the present study was in accordance with Walker et al. study who reported the effect of temperature on the transtadial transmission of *T. annulata* in *H. (A.) anatolicum* (14). They reported that variation in temperature (4–40°C) had a significant effect on moulting rate of the ticks and transmission of theilerial parasites from nymphs to resultant adults. The temperatures above 40°C and below 12°C prevented moulting.

In conclusion, during the present study highest prevalence (12%) of *Hyalomma* ticks followed by 8.1% *Boophilus*, 5% *Haemaphysalis*, and 3.1% *Rhipicephalus*. The effect of temperature and humidity on various developmental stages of *Hyalomma* was studied and it was found that moderate temperature and humidity greatly enhanced the developmental stages.

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