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Some studies on the nymphs of Aiolopus thalassinus F.*

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Özet

Aiolopus thalassinus F. nimfleri üzerinde bazı araştırmalar

Aiolopus thalassinus nimfleri üzerinde Karachi (Pakistan)'da Bitki Koruma Kürsüsü Merkez Laboratuvarlarında yapılan bazı araştırmalarda bu çekirge türünün hem dişilerinin ve hem de erkeklerinin 5 nimf dönemine sahip oldukları saptanmıştır. Erkek ve dişilerin her ikisinde de nimflerin ortalama gelişme süreleri, 1. dönem için 5,5; 2. dönem için 5,2; 3. dönem için 5,8; 4. dönem için 6,4 ve 5. dönem için 8,3 gün olarak bulunmuştur. Laboratuvar koşullarında bu türün, minimum 21 ve maksimum 43 günde gelişmesini tamamladığı tesbit edilmiştir.

16 dönümlük bir alanda nimflerin toplam populasyon yoğunluğunun yaz aylarında daha yüksek olup Temmuz'da 117, Ağustos'ta 119, Eylül'de 99 ve Ekim'de 93 olduğu bulunmuştur. Kış aylarındaki populasyon yoğunluğu ise düşük olup Şubat'ta 16 ve Mart'ta 42 olarak bulunmuştur.

Bu çalışmada ayrıca değişik dönem nimflerin morfolojik karakterleri de incelenmiştir.

Bunlardan başka nimfler arasındaki ölüm oranının, populasyon yoğunluğunun artmasıyla birlikte yükseldiği saptanmıştır. Seks oranı 70 dişi: 30 erkek şeklinde bulunmuştur.

Introduction

Grasshoppers are the potential pests of all plants, trees and crops. They destroy all vegetation with in a region more completely than any other insect pest. At times, they occur in very large numbers in localities particularly favourable to them and cause wide spread devastation. The cause to be a serious pest is that they have great mobility so they migrate from one place to an other in shortest possible time and destruct the crops coming in their way.

The hoppers are seemed to be more epidemic than the adults, because they have no functional wings, so are unable to fly and all the time they are going to eat, hence cause more damage than the adults.

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Aiolopus thalassinus appears in large numbers in Pakistan, particularly in Karachi district and has been collected from cultivated fields, pastures, fallow lands, as well as from desert areas throughout the year. Grasslands, and other fodder and crop areas under alfalfa, berseem, wheat, maize and sorghum seem to be the favourable habitat of the grasshoppers as they are found in large numbers. Occasionally, they are also found occuring in curcurbit fields, such as water melon.

As the grasshopper *A. thalassinus* is of economic importance in Pakistan, so it felt necessary to study some aspects of the nymphs, i. e. nymphal duration, total nymphal instars, sex ratio etc. and forms the subject of the present paper.

Material and methods

The hoppers used in the present studies were the hatchlings from the eggs laid by the field collected adults. The hoppers were reared on alfalfa and maize. Every day fresh food has been given to the hoppers.

To determine the number and duration of nymphal instars in the laboratory, the newly hatched hoppers were reared singly in one-pound jam-jars. Every jar has been given a separate number. The period between hatching and first mouit and between previous and succeeding moulting was considered as the nymphal duration.

The body parts of the hoppers were measured with Vernier-Calliper except first instar and antennae of other instars. The first instar hopper and antennae were measured by micrometer and the number of segments of an antenna were counted under microscope.

To see the effect of population density of the hoppers on their survival ratio, three cages of same size i. e. of two-liter capacity were taken. In each cage 25,50 and 100 hoppers were kept. They were provided proportionate quantity of food i. e. alfalfa and maize. On each day, the observations were taken and the dead hoppers were removed from the cages. Besides, the number of moulted hoppers was also recorded.

In order to find out the sex ratio of hoppers, the one day hatched hoppers were anasthesised with benzene vapour and sexed under microscope. These hoppers were obtained from the parent stock of the grasshopper reared in the laboratory from April to September.

Results and discussion

Number of instars

Several hoppers soon after hatching were sexed and kept singly in a one-pound jam-jars at room temperature. They were provided alfalfa and maize plants to feed upon. Five instars of both sexes were observed and their average durations are recorded in Table 1.

Table 1. Duration of different stages of *A. thalassinus* hoppers

Stage	Number of hoppers	Average duration (in days)	Range	
			Minimum	Maximum
Ist Instar	70	5,5	3	9
2nd Instar	37	5,2	4	8
3rd Instar	23	5,8	4	8
4the Instar	12	6,4	4	9
5th Instar	10	8,3	6	9
Duration of nymphal life			21	43

On examination of Table 1, it could be seen that the average duration of first, second and third instar was 5,5; 5,2 and 5,8 days respectively. These instars were taking almost equal time to moult. But the average duration of fourth instar was 6,4 days which was comparatively more than those of early instars. However, the last nymphal instar took the longest period of 8,3 days to become an adult.

Besides, several individual variations in the duration of moulting of hoppers were noted. Majority of them could not complete the life cycle. Hardly 10 percent survived. However, the survivors also showed variation in the duration of their life. Some of the hoppers took a minimum period of 21 days to be come adults and others took maximum period of 43 days to complete the nymphal life. There was no significant variation in the rate of development of male and female hoppers. Chesler (1938) and Dovnar-Zalpol'skii (1926) had also observed that the number of nymphal instars to be always five in both the sexes of this species. Similarly *Aiolopus savignyi* had five instars in both sexes (Joyce, 1952). However, variations in the number of nymphal instars were found occurring in other grasshoppers, such as *Chrotogonus robertsi* the number of nymphal instars in male was five to six and in female five to seven (Latif and Haq, 1951), and in *Acrida pellucida* the number of nymphal intars in male hoppers was six and in female hoppers seven to eight (Hafez and Ibrahim, 1953).

Chesler (1938) found that the total period required to complete hopper development and acquire wings was 64 days, but in the present studies it varied from 21 to 43 days. This variation might be due to the effect of temperature and geographical conditions. While in *A. savingnyi* total duration was 35 to 51 days (Joyce, 1952).

Grasshopper life and nymphal instars are affected by the temperature. Parker (1930) found that there were six nymphal instars in *Melanoplus mexicanus mexicanus* when reared at 22°C and 27°C. while only five instars when reared at 32°C and 37°C. But in *Cannula pellucida* there were always five instars at all temperatures. However, in the present studies, it was fo-

und that *A. thalassinus* had always five instars in both the sexes at all temperatures.

Field population studies of the hoppers

In Pakistan, particularly in Karachi the *A. thalassinus* is available throughout the year and gives about four overlapping generations per annum. To see their population in the field, weekly collections of different stages of the grasshopper were made from the area of about four acres cultivated under different crops and the results are presented month wise in Table 2.

Table 2. Field population of *A. thalassinus* hoppers

Months	Nymphal instars					Total nymphs	Average population per square	Mean temperature (C°) during the month
	I	II	III	VI	V			
November 1971	21	4	37	52	5	99	9,9	25.0
December 1971	3	17	26	4	18	68	6,8	20,6
January 1972	0	33	3	16	15	67	6,7	27,7
February 1972	1	4	0	2	9	16	1.6	20,2
March 1972	6	14	3	7	12	42	4,2	26,3
April 1972	3	15	18	5	16	57	5,7	27,6
May 1972	25	13	15	20	18	91	9,1	31,1
June 1972	24	16	13	15	17	85	8,5	31,4
July 1972	15	25	18	28	31	117	11,7	31,3
August 1972	13	24	32	36	14	119	11,9	29,2
September 1972	16	28	14	26	15	99	9,9	29,4
October 1972	9	13	20	27	24	93	9,3	29,1
Total	136	206	199	218	194			
Mean	11,33	17,17	16,58	18,17	16,17			
Minimum	0	4	0	2	5			
Maximum	25	33	37	36	31			

From Table 2 it would be seen that the total population of nymphs was highest during the summer months, such as 117,119,99 and 93 population of the insect during July, August, September, and October respectively and lowest during winter months such as 16 and 42 insect population during February and March respectively. Contrary to that the highest population of first, second, third, fourth and fifth instar hoppers was 25,33,37,36, and 31 during May, January, November, August and July respectively. Similarly the lowest population of the insect was 0,4,0,2 and 5 during the months of January, February, February, February and November respectively.

The experimental results indicate that the lower temperatures of winter months discouraged the built up of grasshopper population while the high temperatures of summer encouraged it. It was due to some of the facts that low temperatures elongate, while high temperature decreased the incubation period. Meanwhile, a natural mortality of some individuals may occur which might decimate the population. Besides, the eggs incubated at 14° and 16°C. could not hatch (Baloch and Soomro, 1976) which means that there was no addition of individuals to the population and therefore the population of *A. thalassinus* hoppers was lower in winter and higher in summer.

Morphological description of different instars of *A. thalassinus*

It is clear from Table 2 that all the nymphal stages of *A. thalassinus are* mostly available throughout the year. To be familiar from each stage some morphological description of different instars of the grasshopper are given below.

First instar (Fig. 1)

Eyes grey, brown barkings (as dots) along the head, thorax and abdomen. Mandibles at the tip black and brown at the base. Antennae eleven segmented and filiform (no brown dots on the anterior and posterior tentorial pits and on the subgenal suture and lower post occipital suture present as reported by Chesler, 1938)

The head orthognathous, from the vertex a white line extending mid-dorsally all along the body and ending at the tip of the abdomen.

Long regularly arranged dark dots along the anterior and posterior edges of the pronotum and the posterior edges of the meso-and meta thorax. Brown dots on pro-and mesothoracic legs. Two grey transverse bands towards the inner side of hind femur and tibia. Distal joint of tibia black.

Anterior edge of the pronotum slightly convex, while the posterior straight. The pronotum incised and curved. The lateral margins of the meso-and metathorax slightly extended and curved.

Two lines with dark brown dots running throughout the either sides of the abdomen to the last segment. Cerci developed.

The measurements of whole body and some body parts have been presented in Table 3.

Second instar (Fig. 1)

Eyes dark grey, antennae 12-13 segmented. Pronotum almost covering mesonotum. The rounded and extended lateral edges of the pronotum forming the wing rudiment paler and differentiated from the rest of the segments. The measurements have been shown in Table 3.

Third instar (Fig. 1)

Eyes dark grey to slightly brown. A whitish band or stripe running medially dorsally from prothorax up to the last segment of abdomen. Body with brown markings. Mandibles black at tip and brown at the base. Antennae 15 - 18 segmented. Tegminal rudiments lying along triangular, wing rudiments. Dark bands and long brown dots on hind femur. Black patches on both lateral sides of distal end of hind femur.

Valves of ovipositor in females and subgenital plate in males developed. Further measurements have been shown in Table 3.

Fourth instar (Fig. 1)

Eyes dark brown. Metathorax slightly rounded posteriorly and curved concavely at posteriolateral side. No brown dots on the meso-and metanotum on dorsal side. Wing rudiments well developed, turned backwards, upwards and covering the first abdominal tergite but do not meet in middle lines. The longitudinal veins of forewing prominent. Tegminal rudiment leaf shaped, extending to the first abdominal segment and is covered by the wing rudiment. The ridges surrounding the tympanal organ differentiated. The measurements of fourth instar have been given in Table 3.

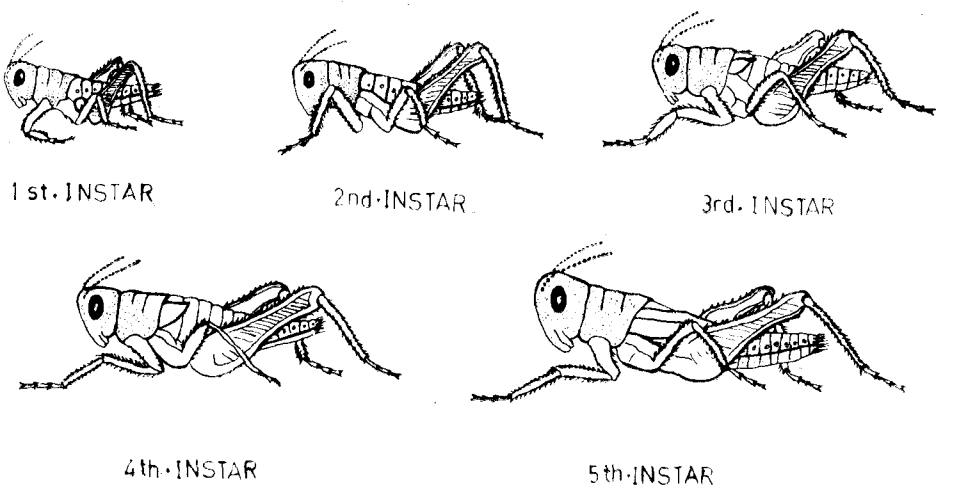

Fig. 1 Different nymphal instars of *A. thalassinus*

Fifth instar (Fig. 1)

Eyes greyish brown, similar colour also slightly present on genae. Dark brown dots on thorax, abdomen and vertex. Female larger in size than male. Wing rudiments extending to the fifth abdominal segment. Further measurements are presented in Table 3.

Some morphological characters, such as colour and size of the nymphs vary from the description given by Chesler (1938). This variation might be due to temperature and some other environmental factors such as food and locality. Similarly Parker (1930) stated that the grasshoppers reared at high temperature tended towards light ground colours with contrasting markings, while low temperatures produced coloured individuals.

Table 3 : Measurements of various parts of the bodies of five nymphal instars of *A. thalassinus* (mm)

Measurements		I	II	III		IV		V	
				Male	Female	Male	Female	Male	Female
Average body length		3.90 ±0.19	5.90 ±0.41	7.70 ±0.37	8.40 ±0.66	8.80 ±0.54	11.50 ±1.13	7.50 ±0.60	11.50 ±0.21
Average lenght of femur		2.60 ±0.17	3.30 ±0.14	4.30 ±0.80	4.60 ±0.16	6.40 ±0.61	7.50 ±0.47	8.50 ±0.39	9.10 ±0.38
Average length of antenna		0.82 ±0.28	1.50 ±0.10	1.80 ±0.09	1.90 ±0.10	2.50 ±0.14	3.00 ±0.35	4.10 ±0.11	4.20 ±0.28
Number of segments in antenna	Minimum	11	12	15	15	21	20	22	22
	Maximum	—	13	17	18	21	21	23	25
Ving rudiments	Length	—	—	—	—	1.80 ±0.15	2.20 ±0.31	5.60 ±0.15	5.60 ±0.15
	Width	—	—	—	—	0.95 ±0.09	1.18 ±0.11	2.30 ±0.09	2.40 ±0.17
Tegminal rudiments	Length	—	—	—	—	2.20 ±0.05	2.80 ±0.29	6.10 ±0.22	6.40 ±0.29
	Width	—	—	—	—	0.60 ±0.04	1.70 ±0.30	1.00 ±0.06	1.20 ±0.12

Effect of population density of the hoppers on their survival ratio

During the laboratory studies it was observed that a high percentage of mortality occurred particularly in the early stages. It was therefore felt necessary to investigate if the population density had any effect on the survival ratio of the hoppers of *A. thalassinus*. The hoppers were reared in cages and results of their survival are presented in Table 4.

Table 4. Effect of population density of *A. thalassinus* hoppers on their survival ratio.

Cage No.	Population Density	Percentage Mortality During Nymphal Duration					Mortality	Pencentage
		I	II	III	IV	V	Percentage	Survival
1.	25	28	24	36	0	0	88	12
2.	50	52	34	10	0	0	96	4
3.	100	70	15	10	4	0	99	1

It could be seen from Table 4 that many hoppers died during their first, second and third stage. However, mortality also occured in the fourth stage when the density of hoppers was 100. The hoppers which survived through third stage could moult to adults. Further more, it could be seen that in the same size cage, the hoppers with different population densities, such as 25,50 and size cage, the hoppers with different population densities, such as 25,50 and 100 were kept and were provided similar conditions except variation in per individual hopper space. It was observed that the survival percent in case of above mentioned densities was 12, 4 and 1 percent respectively. From this study it would be concluded that the population density had greater effect on the survival percentage of the hoppers.

Sex ratio among the hoppers of *A. thalassinus*

About 700 hoppers were acquired from the laboratory stock of the grasshopper. When these hatchlings were sexed it was found that out of 700 hoppers 490 were females and only 210 males, that is 70 pencent females and 30 percent males.

Summary

Some studies on the nymphs of *Aiolopus thalassinus* were carried out in the laboratories of the Central Department of Plant Protection Karachi, Pakistan. Five nymphal instars in both sexes of this grasshopper has been recorded. The rate of development in both male and female was averagely 5,5; 5,2; 5,8; 6,4; and 8,3 days for first, second, third, fourth and fifth instars respectively. The total minimum period of hopper development was found to be 21 days and maximum 43 days under laboratory conditions.

The total population of nymphs was highest in summer months such as 117,119,99 and 93 population of the insect during July, August, September and October respectively and lowest during winter months such as 16 and 42 insect population during February and March respectively.

The morphological description of different nymphal stages were also discussed.

Mortality percentage of hoppers increased with an increase in their population density. The sex ratio of hatchlings was 70 females: 30 males.

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