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Some studies on the water requirement for egg development of Aiolopus thalassinus F.*

by

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Özet

Aiolopus thalassinus F.'un yumurta gelişmesinde gerekli olan su miktarları üzerinde araştırmalar

Aiolopus shalassinus 'un yumurta gelişmesinde gerekli olan su miktarları laboratuvarda incelenmiştir. Laboratuvarda 1 günlük yumurtalar 24 saat süreyle suya daldırılarak tutulduğunda bunların açılmadığı, buna karşılık diğer guruplardaki yumurtaların aynı süreyle suya daldırıldığında açıldıkları saptanmıştır.

Bu durumlarda yumurtaların çevrelerindeki suyu absorbe ettikleri ve ağırlığının gittikçe fazlalaştığı bulunmuştur. Ağırlık bakımından artış, 0.0016 gr.'dan 0.0037 gr.'a çıkma şeklinde görülmüştür. Kuluçka süresinin ilk 2 gününde ağırlık artışı düşük olup sırasıyla %12.5 ve %37.5 olmuştur. Fakat 3. gününde bu oran en yüksek düzeye (%97.75) ulaşmıştır. 6. ve 9. günlerde yumurta ağırlığında bir değişiklik saptanmamıştır. Yumurtaların ağırlık bakımından sabit hale gelmesinden 1 gün önce ve sonra çok az bir artış görülmüş olup bu oran %6.25 oranında olmuştur. 7. gün istisnai bir durum göstermiş ve bu günde bu artış %12.50 olarak saptanmıştır. Yumurta gelişmesi için gerekli maddelerden birinin su olduğu şüphesizdir. Yumurtanın açılabilmesi için, yumurta ağırlığının en az %35'i kadar su absorbe etmesi zorunludur.

Introduction

Many insects eggs absorb water during the incubation period. It is the typical of the eggs of Acrididae (Uvarov, 1966) and of many other insects that there is a period of rapid water uptake early in develop-

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ment. However, the eggs of ***Timethis*** sp. only were found to develop without contact with soil moisture and they failed to develop if they were kept in contact with water (Shulov, 1952 b). Parker (1930) had also recorded a higher percentage of eggs of ***Camnula pellucida*** hatch when they were placed in moderately damp soil than under very wet or dry soil. In ***Schistocerca gregaria*** maximum water uptake at 30°C occur during the fourth and fifth days of incubation (Hunter - Jones, 1964). The eggs of ***Schistocerca gregaria*** were found developing at 20°C to 33°C if during 3 to 5 days following oviposition they absorb sufficient contact water to permit katatrepsis. These eggs normally absorbed water about their own initial weight. At 27°C the water intake was slow during the first four days. A rapid gain in weight begins on the fifth day, when the embriyo was in the stage of late anatrepsis, the rate of increase being great during the beginning of katatrepsis. The maximum weight of an egg that develop normally was about 27 mgs. but some eggs of 16 mgs. might also hatch under conditions of contact moisture (Shulov, 1952 a). Furthermore, he stated that in the absence of contact water, the embriyo of ***S. gregaria*** developed until late anatrepsis and remained alive in this stage for two weeks; but in then required contact water, if further development was to take place. Although the quantity of water imbibed by contact was usually high, it was possible for eggs that they imbibed only a small quantity in the first three days to complete their development and then hatched.

Ashall (1960) observed that the eggs of ***S. gregaria*** required water to develop, and during the first five days absorbed water was equalled to their own weight. If they do not absorb water, they will not hatch. While Shulov and Pener (1959) found that the increased water absorption began between 3rd. and 4th. day (at 27°C) after oviposition.

As the grasshopper ***Aiolopus thalassinus*** is a creature of arid and semiarid zones and in Pakistan its peak period starts during the rainy season. Therefore some studies on the water requirement for egg development of ***A. thalassinus*** were carried out in the laboratory and forms the subject of the present paper.

Material and methods

The females of ***A. thalassinus*** often deposited their pods in the cultivated fields, sometimes being irrigated with canal water. To investigate the effect of water immersion on the development of eggs, twelve batches of different age groups, that is 0,1,2,3,4,5,6,7,8,9,10 and 11 days old egg were kept for 24 hours in the water, and then transferred to 32°C. The hatching date of the eggs was recorded.

To see the water requirement of developing egg, two batches of twenty eggs per batch were weighed daily on an automatic electric Analytical Balance (Sauther 44) with four decimal places of a gram. These eggs were incubatet at 38± 1 °C and were removed daily for about 10 minutes for weighing, after which they were returned to the incubator. Daily in the morning the weight of eggs were recorded and continued for 10 days of incubation period.

In order to find out the minimum water requirement for development of the eggs of the grasshopper, a preliminary trial was made in which a batch of 20 eggs was kept in the chamber having 100 percent relative humidity. These eggs were kept in an incubator at 32°C for hatching. They were not allowed to contact with moisture. It was found that the eggs did not hatch. Subsequently another trial was made, in which four batches each one of five freshly laid eggs were kept in petridishes as below:

Conditions

Batch

1. Eggs with no contact with moisture, placed in a chamber adjusted at 100 percent relative humidity.
2. Eggs with contact with moisture for first 24 hours (immediately after laying); and then placed in a chamber adjusted 100 percent relative humiditiy.
3. Eggs with contact with moisture for first 48 hours (after laying); and then placed in a chamber adjusted at 100 percent relative humidity.
4. Eggs with contact with moisture for first 72 hours (after laying); and then placed in a chamber adjusted at 100 percent relavite humidity.

The eggs of batch 1, 2, 3 and were weighed on 0, 1, 2 and 3 days after laying on electric balance and then hatching was noted after 13 days incubation period.

Results and Discussion

Effect of immersion of eggs in water.

The females were found depositing egg pods in the cultivated field which is at times irrigated with canal water, immersing everything including the eggs. In order to investigate the effect of water immersion on the development of eggs, an experiment was carried out. A

batch of 10 eggs of different age groups, such as 0,1,2,3,4,5,6,7,8,9,10 and 11 days old were kept immersed in water for 24 hours under room temperature, along with eggs not immersed in water. Later these eggs were kept as usual in petridishes for incubation at 32°C. The results are presented in Table 1.

Table 1. Effect of water immersion on the development of *Aiolopus thalassinus* eggs

Age of eggs in days	Number of eggs kept immersed for 24 hrs.	Total incubation period in days at 32 °C.	Number of eggs		Percentage hatched
			Hatched	Unhatched	
0	10	—	0	10	0
1	10	13	6	4	60
2	10	13	7	3	70
3	10	13	5	5	50
4	10	13	4	6	40
5	10	13	10	0	100
6	10	13	9	1	90
7	10	13	9	1	90
8	10	13	9	1	90
9	10	13	9	1	90
10	10	13	10	0	100
11	10	13	10	0	100
0 (Control)	0	13	10	0	100

From Table 1, it could be seen that the fresh eggs did not hatch at all. (Probably this age group seemed to be susceptible to immersion as it might be causing drowning of the embryo). Eggs of the other age groups developed and hatched in 13 days, as the eggs hatched in the control. However, there is an indication that the one to four days old eggs were somewhat affected by the water immersion. One day and two days old eggs had the higher percentage of hatching viz 60 and 70 percent respectively; while three and four days old eggs had the lower percentage of hatching that is 50 and 40 percent respectively. It seems that the latter stages were somewhat susceptible to water immersion.

Since the hoppers of ***A. thalassinus*** are mostly the pests of the cultivated crops, and also there can be a possibility of their epidemics, they might be partially controlled by irrigation water. So it may be recommended that the fields may be irrigated after majority of the grasshoppers have laid the eggs, that is, the age of the egg is from zero to four days only.

Water requirement of the developing eggs of *Aiolopus thalassinus*.

Two batches (of 20 eggs per each batch) were weighed daily on an automatic electric balance with four decimal places of a gram. These eggs were incubated at 38 ± 1°C and were removed daily for about ten minutes for weighing after which they were returned to the incubator. Daily in the morning, the weight of eggs were recorded and continued for 10 days of incubation. The data is presented in Table 2.

The weight of freshly laid eggs was considered as an initial weight of eggs. The rise in weight of eggs on the succeeding days was considered as gain in weight. This was due to absorbtion of water and changes taking place in egg. Further, the percentage gains in weight were calculated and presented in Table 2 and shown in Fig. 1.

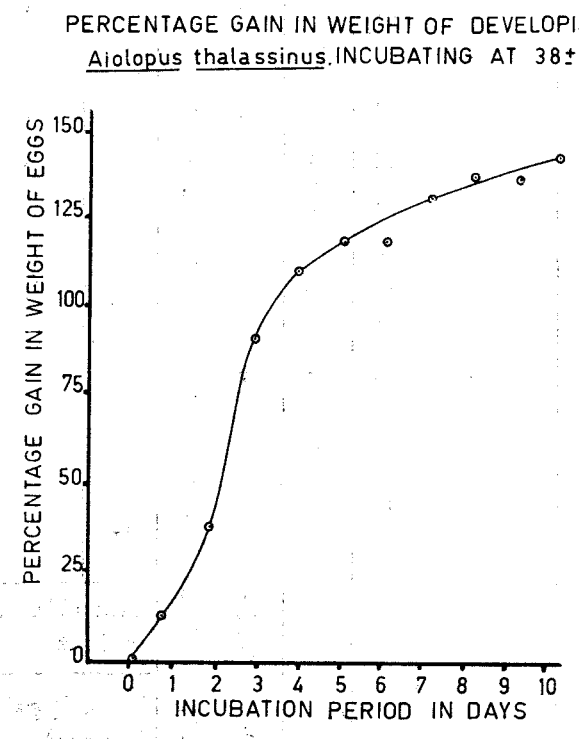

Fig. 1. Percentage gain in weight of developing eggs of ***Aiolopus thalassinus*** incubating at 38± 1 °C.

Table 2. Showing the average daily weight changes (Grams) in the eggs of ***Aiolopus thalassinus*** due to water absorption from the surrounding moist soil at 38°C

Batch No.	No. of eggs	Average weight (grams) on total incubation period											Net gain in weight	Total % gain
		0	1	2	3	4	5	6	7	8	9	10		
1.	20	0.0016	0.0017	0.0022	0.0028	0.0032	0.0033	0.0033	0.0036	0.0037	0.0037	0.0037	0.0021.	13
2.	20	0.0016	0.0019	0.0022	0.0034	0.0037	0.0037	0.0037	0.0039	0.0039	0.0039	0.0041	0.0025	15
Mean		0.0016	0.0018	0.0022	0.0031	0.0034	0.0035	0.0035	0.0037	0.0038	0.0038	0.0039		
Percentage of again in weight on each day over an initial weight		0	12.5	37.5	93.75	112.5	118.75	118.75	131.25	137.5	137.5	143.75		
Percentage of rise in weight of succeeding day over the egg weight of previous day.			12.5	25.00	56.25	28.75	6.25	0	12.5	6.25	0	6.25		

It is clear from Table 2 and Fig. 1 that there was significant rise in weight in the initial stages of eggs after laying. The rate of gain in weight during first two days of incubation was somewhat low, that is 12.5 and 37.5 percent, gain in weight on first and second day. However, on third day the percentage weight gained was highest of all, that is 93.75 percent. After slight rise in weight on fourth day, the egg weight became almost constant. On the sixth day, there was no change in the egg weight. It is interesting to note that the egg weight remained constant on sixth and, ninth day. A day before and after the constant condition, there was a little rise in egg weight, that is only 6.25 percent, excepting the egg weight of seventh day which was 12.5 percent. A gradual rise of egg weight on succeeding day over the egg weight on previous day indicates an absorption of water, which is just needed for a gradual metamorphic changes of embryo to develop into a first instar nymph.

Similarly the grasshoppers eggs have been reported to absorb soil moisture during incubation period (Khalifa, 1957). In ***S. gregaria*** maximum water uptake at 30°C occur during the fourth and fifth days of incubation (Hunter - Jones, 1964) and at this stage the weight of egg increases by about 140 percent. After this there is no noticeable change in weight, and it is generally believed that there is no further uptake of water (Shulov, 1952 a; Hunter - Jones 1964), This was further confirmed by Shulov and Pener (1963) that the eggs of ***S. gregaria*** were unable to imbibe water as vapour from the air but only as liquid. If the eggs imbibed sufficient amount of water during pre-incubation period from wet sand and did not loose much during the period spent at the given relative humidity, that changing occurred within the normal period of the development. So some five days of pre-incubation were sufficient for such direct development when the eggs were transferred in 100 percent relative humidity but some 17 days of pre-incubation were needed for hatching in zero percent relative humidity. While Shulov and Pener (1959) found that the increased water absorption began between third and fourth day (at 27°C) after oviposition. In agreement with these reports ***A. thalassinus*** eggs were found absorbing water moisture for their development and hatching. Contrary to that, Shulov (1952 b) reported that only the eggs of ***Timethis*** sp. did not absorb water moisture for their development, but rather they failed to develop and hatch if they came in contact with soil moisture.

Minimum water requirement of eggs of *Aiolopus thalassinus* for their development and successful hatch.

It could be seen from Table 3 that batch one, eggs did not gain weight and there was also on hatching. However, the other batches

two, three and four gained weight was 22.5, 35.3 and 100 percent respectively. Although the eggs of the batch two gained a slight weight, they did not hatch. However, 60 and 80 percent of the eggs of batch three and four were recorded respectively.

Table 3. Minumum water requirement for successful incubation of ***Aiolopus thalassinus*** eggs.

Batch No.	Number of eggs per	Average weight of eggs (gms) after water moisture contact for different period in hours				Percentage increase in eggs weight	Percentage of eggs hatched
		0	24	48	72		
1.	5	0.0065	—	—	—	0	0
2.	5	0.0071	0.0087	—	—	22.53	0
3.	5	0.0068	0.0077	0.0092	—	35.30	60
4.	5	0.0065	0.0076	0.0085	0.013	100.00	80

In ***S. gregaria*** (Shulov, 1952 a) reported that it was possible for eggs that they imbibed only a small quantity of water in the first three days to complete their development and then hatched. Ashall (1960) stated that the eggs of ***S. gregaria*** required water to develop, and during the first five days absorbed water was equalled to their own weight. If they do not absorb water, they will not hatch. While Haque and Jaleel (1970) reported that desert locust eggs were able to hatch even after absorbing water moisture at least 23.8 percent of their body weight. Similarly in the present studies it was found that during incubation period, ***A. thalassinus*** eggs imbibed water almost equal to 143.7 percent of their body weight. i.e. the initial weight. The eggs were found to hatch by absorbing at least a minimum quantity of water equal to about 35 percent of initial weight of the eggs. The results of Salt (1949) also agree with the present studies. He stated that the total intake of water in the eggs of ***Melanoplus bivittatus*** was about 60 percent of their original weight, and that about 88 percent of the total absorption occured during anatrepsis, the initial stage of the embryonic development.

Summary

Some studies on the water requirement for egg development of ***A. thalassinus*** were carried out in the laboratory. It was observed that one day old eggs when immersed in water for 24 hours failed to hatch, however the other age group eggs could hatch although immersed for 24 hours.

The eggs were found absorbing water moisture from the surrounding and increased in weight. The increase in weight was from 0.0016 gms. to 0.0037 gms. The rate of gain in weight during first two days of incubation was somewhat low, that is 12.5 and 37.5 percent respectively, but on third day the percentage weight gained was highest of all, that is 93.75 percent. It was also observed that the egg weight remained constant on sixth and ninth day. A day before and after the constant condition, there was a little rise in egg weight, that is only 6.25 percent, excepting the egg weight of seventh day which was 12.5 percent.

As the water was essentially needed for development of the eggs, and as such at least the water, equal to 35 percent of the egg weight was necessary to be absorbed by the egg for hatching.

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