

Elimination of egg-diapause in „*Acrida bicolor*, (Thunb.) (Orthoptera, Acridiidae)

By

Salâhattin OKAY

(*Department of Zoology, University of Ankara*)

Özet : Müellif birkaç senedenberi *Acrida bicolor* (Thunb.) (Orthoptera, Acridiidae) türünün yumurtaları üzerinde çalışarak, bunların laboratuvarda açılma şartlarını araştırmıştır.

Henüz bırakılmış yumurtalar yüksek ve uygun bir sıcaklık derecesinde nekadar müddetle bırakılırsa bırakılsın açılmazlar. Daha sonra yapılan denemelerde, yumurtalar bir süre yüksek sıcaklıkta kaldıktan sonra (ilk enkübasyon), düşük suhnete maruz bırakılmış ve bundan sonra nihai enkübasyona geçilmiştir.

Bu yıla kadar yapılan incelemelerde, yumurtalar alçak sıcaklıkta (0° civarında) yeter sürede bırakılmadığından açılmamıştır.

Bu yıl tekrar edilen denemelerde alçak sıcaklıkta geçen süre çok daha uzatılmış ve yumurtaların açılması sağlanmıştır. Açılan yumurta nisbeti düşük sıcaklıkta geçen süreye bağlı olarak artar. Bu çekirge türünün yumurtalarında tespit edilen mecburi diyapozun diğer Acridiidae türlerinde görülen diyapozla mukayese edilebilmesi için, daha fazla incelemelere ihtiyaç vardır.

Henüz yumurtadan çıkmış larvalar az çok kahverengi renkte ve üniformdur. Yeşil pigment takriben 48 saat sonra ve birinci deri değişmesinden evvel meydana gelir.

I — Introduction

The author tried to hatch for some years the eggs of *Acrida bicolor* (Thunb.) in the laboratory. But this has failed until the present year because of an inadequate time of exposure of the eggs to low temperature.

The grasshopper, *Acrida*, occurs in nearly all parts of Turkey. It has one generation a year. Around Ankara the eggs are laid in the soil during September and October. But laying may continue until November in the laboratory. They hatch usually during the second half of June in the field (Okay, 1956). So

the eggs spend nearly nine months in the soil. This long period is not due to low temperatures during the cold season. When the newly laid eggs are kept in moistened soil at a favorable high temperature for a long period, emergence is not observed. This seems to indicate that an obligatory egg-diapause exists in *Acrida*.

An obligatory diapause was observed in some species of Acridiidae, as *Circotettix* (Carothers, 1923) and *Austriocetes* (Andrewartha, 1943).

II — Method

The eggs, which it was attempted to hatch in the laboratory, were obtained from specimens collected around Ankara. The grasshoppers were allowed to lay eggs either in 4×10 cm. metal cylinders or in $20 \times 30 \times 13$ cm. wooden boxes. But they often laid anywhere in the cage. The eggs could not be removed from the pod easily and without damaging them, even if left in water for a long time. The pods were, therefore, used and buried in a mixture of sand and soil. It was moistened from time to time.

From five to ten pods were used for each experiment. The number of eggs in a pod varies from a few to twenty five or thirty.

III — Results

A — Eggs kept at 25°C.: Newly laid egg-pods were, on several occasions, kept at 25°C. up to eight months in an incubator. None emerged. Some pods remained alive even after 240 days. Dead eggs became flaccid and were usually attacked by mould whereas viable eggs remained turgid and free from mould.

B — Eggs exposed to low temperature: The first experiments on the exposure of eggs to low temperature were of short duration. Newly laid eggs were kept at 25°C. for two or four weeks then exposed to 1°C. They were, then, incubated at 25°C. for two months. None emerged (Table I).

TABLE I

Pods used	Preliminary period at 25°C. (weeks)	Exposed to low temp. (days)	Incubated at 25°C. (days)	Hoppers emerged	Pods still alive
6	2	15	60	0	3
8	2	30	60	0	6
6	4	15	60	0	4
8	4	30	60	0	5

The following year the egg-pods were divided into two parts. Both were kept out-of-doors after a preliminary period of four weeks at 25°C. It will be seen in Table II that the number of emerged hoppers is much higher in the eggs exposed to low temperature for 120 days than those so exposed for 60 days.

TABLE II

Pods used	Preliminary period at 25°C. (weeks)	Kept out-of-doors (days)	Incubated at 25°C.	Hoppers emerged
10	4	60	until hatching	12 (two pods)
10	4	120	» »	102 (seven pods)

Hatching began on the 29 th day and continued over several days. But all eggs of a single pod hatched nearly simultaneously. The hoppers came to the surface of the soil while still in their embryonic cuticle which was shed a few moments later.

Freshly emerged hoppers are uniform. The upper part of the body is reddish-brown and the lateral parts grey. The underpart of the body is pale yellow or colourless. The green pigment was absent at emergence. The pigment appeared after 48 hours and sometimes earlier after feeding on growing grass in 20×40 cm. celluloid cylinder heated with a 100-watt bulb. Thus the green pigment was formed before the first moult. The first larval stage was very short, varying between four and five days. The male adults began to appear in heated cylinders on the 26 th day and the females a few days later and both continued to emerge over several days.

IV — Discussion

According to the preliminary experiments described above, the egg-diapause in *Acrida bicolor* seems to be obligatory like that found in *Circotettix* (Carothers, 1923) and *Austriocetes* (Andrewartha, 1943). Around Ankara the grasshopper, *Acrida*, is single brooded or univoltine and most probably in all parts of Turkey. The fact that hatching has not yet been observed at a favorable high temperature even after eight months seems to indicate that all eggs have a diapause. This point, however, needs further investigation to ascertain whether some of the eggs develop without being exposed to low temperature as in *Melanoplus* (Burdick, 1937).

Duration of the exposure to low temperature is of primordial importance in the elimination of the diapause. An inadequate period of exposure (15-30 days) cannot break the diapause even after four weeks of preliminary incubation

The eggs which hatched were kept out-of-doors up to 120 days after a preliminary incubation. The winter was more or less severe during this year (1955-56) and the temperature was during several nights (25-30 times) well below zero. But it is quite possible that the diapause may be eliminated after the same period of exposure to a temperature varying between 0° and 10°C as in other species of Acridiidae.

The newly hatched hoppers are more or less brown and the green pigment is absent as in freshly emerged *Dixippus*, *Mantis* and *Lacusta*. The green pigment may be formed before the first moult as in *Dixippus* and rarely in *Mantis* (Jovanic, 1953).

V — Summary

1 — Preliminary experiments carried out on the eggs of the grasshopper *Acrida bicolor* (Thunb.) indicate that they do not hatch when kept at 25°C. The diapause seems to be obligatory.

2 — Diapause is eliminated in the eggs which are exposed to low temperature after a preliminary incubation at 25°C.

3 — Duration of the exposure to low temperature is of primordial importance in the elimination of the diapause.

4 — The newly emerged hoppers are of the same colour. The green pigment, which is absent at emergence, appears before the first moult.

References

- 1 — ANDREWARTHA, H. G. Diapause in the eggs of *Anstriocetes cruciata* Sauss. (Acrididae) with particular reference to the influence of temperature on the elimination of diapause. Bull. ent. Res. (1948), **34**, 1-17.
- 2 — BURDICK, H. C. The effects of exposure to low temperature on the developmental time of embryos of the grasshopper *Melanoplus differentialis* (Orthoptera). Physiol. Zool. (1937), **10**, 156-170.
- 4 — CAROTHERS, E. E. Notes on the taxonomy, development and life history of certain Acrididae (Orthoptera). Trans. Amer. Ent. Soc. (1928), **49**, 7-24.
- 4 — JOVANCIC, L. Genèse des pigments tégumentaires de la Mante religieuse et d'autres animaux. Leur rôle biologique et physiologique. Bull. Biol. Fr. Bel. (1953), **87**, 92-104 (Thesis).
- 5 — OKAY, S. The effect of temperature and humidity on the formation of green pigment in *Acrida bicolor* (Thunb). Arch. int. Physiol. Bio. (1956), **64**, 80-91.

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