Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(3): 38-41

Received: 20-03-2018
Accepted: 23-04-2018

Dr. Hokuma Kuliyeva
Prof, Baku State University,
Faculty of Zoology, Azerbaijan

Correspondence
Dr. Hokuma Kuliyeva
Prof, Baku State University,
Faculty of Zoology, Azerbaijan

Photoperiodical adaptation of the Azerbaijan population of *Idaea degeneraria* Hubn. (*Lepidoptera, Geometridae*)

Dr. Hokuma Kuliyeva

Abstract
The ecological and physiological characteristics of the Azerbaijan population of a small brown-marked geometer (Portland Ribbon Wave) *Idaea degeneraria* Hubn. have been subjected to research for the first time. It has been determined that under the constant temperature of 25^0C ($\pm 1^0$C) and humidity of 45-50%, duration of the development of a caterpillar phase does not depend on the length of daylight hours. Photoperiod affects the date of ecdysis and dynamics of a caterpillar's weight: quantitative reaction on the photoperiod is more obvious in longday versions of 18 and 24 daylight hours a day. It has been established that the date of caterpillar-pupal metamorphosis, percentage of pupas, as well as the date of fly out of moths and the duration of imago as to the first day of flight, do not depend on photoperiod conditions for caterpillar maintenance. Early flight and high percentage (30%) of moths have been observed under 12-hour photoperiod, while the minimum number of moths was observed under the regime of 8-hours of daylight (1.25%).

Keywords: *Idaea degeneraria, Lepidoptera, Geometridae,* photoperiodical adaptation, ecology and physiology

1. Introduction
One of the largest families of higher heteroceriid lepidopterous is the Geometrids, playing an important role in various terrestrial biocenosises. Many species of Geometrids at the state of caterpillars are the dangerous pests for agricultural farms, forestry and green plantation and they propagate massively. At the same time, moths of Geometrids participate in pollination of flowering plants, while some rare species deserve being included into the Red Books and subjecting to protection measures.
It should be mentioned that heteroceriids (*Geometridae* fam.) belongs to the groups ecological-physiological features of which have almost not been studied. Until our research (Kuliyeva & Ibragimov, 2007; Kuliyeva, 2009) [5, 6] the literature on the Absheron peninsula contained only extremely fragmentary, mainly faunistiic data (Piriyev, 1989; Kerimova, 1997) [7, 9]. Besides, it has been mentioned that *Idaea degeneraria* Hubn. (*Sterrhinae* subfam.), usually grows in one or two generations. It gets adapted to the changes of the surrounding environment very quickly, despite the fact that it prefers hot and dry climate (Martinez, 2008; Erkan, 2009) [4, 8].
Under control of photoperiod there are growth rates of larvae, duration of development, accumulation of reserve substances, fecundity, cold resistance, therefore in this article the results of experiments on studying of the photoperiodical adaptation of the given species. This information is necessary for refinement role of photoperiod in the regulation of the seasonal development cycle of *Idaea degeneraria.*

2. Materials and Methods
A moth caught on the walnut tree (*Corylus ovellana*) in the Goradil settlement on 06.07.2010 served as an input material for launching this experience. Then, after the capture of the moths to the light and determination of the species, we obtained necessary butch of eggs for setting this study (2012-2017). Each caterpillar was maintained in separate entomological test tubes (20 pieces in each version). Since the moment of coming out from the eggs, the caterpillars were grown up in 6 options of the day light length (0, 4, 8, 12, 14, 18 and 24 hours). The caterpillars under the natural lightning were used as control. All options, including the control one, were kept under the constant temperature of $25^0(\pm 1^0)$ and humidity 45-50%.

In all cases the pupas were transferred to the identical conditions of constant lightning. Every 3 days physiological indicators were recorded, while weighing of pupas took place on the 2nd day after pupation. All digital data have been processed using variation-statistic method (Plochincky, 1970) [10].

3. Results

As a results of the observation over the material (photo) it was determined that little female brown-marked geometer (swing of wings is 22 mm) has much brighter color of the front pair of wings in comparison with males (swing of wings is 17 mm).

Photo: Imago and caterpillar of the Azerbaijan population of a small brown-marked geometer

Egg mass of a female (0.6 mm) do not stick together on the substrate, but rather fall of in the shape of light-color pink grains of sand on the soil (in the experiments, on the bottom of the test tube). The hatched caterpillars (0.5-0.8 sm) initially eat dandelions (*Taraxacum officinale)*, knotgrass (*Polygonum aviculare)*, mintcorn *(Mentha arvensis)* and some alfalfa (*Medigago sativa)*. Later, adult caterpillars migrate to the fruit trees (peach, plum, apple, cherry, quince, apricot). In the end of the phenological observations it has been determined that this species grows in the Azerbaijan (Absheron peninsula) in 2,5 generations: I generation since 08.06 till 25-31.07 (average daily temperature of the air is 25-30.5^{0}C, humidity 50-60%), II generation since 05.08 till 26-30.09 (average daily temperature of the air is 32-18^{0}C, humidity 45-75%), III generation since 01-03.10 till the escape of adult caterpillars and pupas for wintering (average daily temperature of the air is 21-17^{0}C, humidity 60-80%).

It has been set that the length of the daylight does not substantially affect the duration of the caterpillar stage: no drastic variations have been detected between short day (4, 8, 12 hours) and long day (14, 18, 24 hours) photoperiods. Despite the identical lightning conditions, the caterpillar stage was longer for 5-6 days in the control (14.0-12.2 hours) in comparison with 12- and 14-hour photoperiods (table 1).

It has been determined that the conditions of lightning substantially influence the date of ecdyses and the dynamics of the caterpillar's weight (Table 1, Figure 1). Important variations were received in the growth of the caterpillar between the second and third ages: 2 days under 18 hours and 13 days under 4 hours.

Under the regime of 12 hours additional ecdyses at the IV age of the caterpillar was observed (table 1). Regularity of sharp increase of the caterpillar's weight on the second day after the hatching was detected: in comparison with the control this addition comprises 58.6-93.1% depending on the photoperiod. Under the 12-hour photoperiod this regularity remains till the end of the caterpillar phase of development.

Table 1: Impact of the length of a day on the physiological indicators of a geometer *Idaea degeneraria (material: the date of hatching 08.08; temperature is 25^{0}C, humidity – 60%)*

Indicators	Control: 14-12.2 hour	0 h	4 h	8 h	12 h	14 h	18 h	24 h
Duration of the caterpillars phase, days	37	38	35	33	32	31	35	37
Date ecdysis and age* of a caterpillars	18.08(II*) 29.08(III*) -	18.08(II*) 25.08(III*) -	18.08(II*) 31.08(III*) -	20.08(II*) 26.08(III*) -	18.08(II*) 26.08(III*) 29.08(IV*)	19.08(II*) 26.08(III*) -	29.08(II*) 31.08(III*) -	29.08II* 6.09 III* -
Average mass of a caterpillar, mg	2.9±0,10(II) 29.5±1,2(III) -	5.6±0,1(II) 19.4±0,1 -	5.2±0.26(II) 29.9±1.3 -	5.6±0.22(II) 12.4±1.1 -	5,5±0.21(II) 17.6±0.3 37.2±1.3	4.8±0.31(II) 12.1±1.0 -	4.6±0.0(II) 31.8±2.7 -	5.4±0.13 45.8±2.0 -
Length of caterpillar, mm	0.5±0.00(II) 11.2±0.1(III) -	0.7±0.01II 12.5±0.5 -	0.7±0.05(II) 16.6±0.2(III -	0.8±0.01(II) 14.3±0.9(III -	0.8±0.03(II) 12.3±0.4(III 16.7±0.4(IV	0.73±0.0(II) 13.6±0.8(III -	0.7±0.0(II) 15.2±0.6 -	0.73±0.0 17.4±0.5 -
Date of pupation and quantity, %	15.09; 80.0	16.09; 75.0	13.09; 100.0	11.09; 87.5	10.09; 100.0	11.09; 100.0	13.09; 79.0	15.09; 100.0
Average weight of pupas, mg	45.0±2.07	40.5±2.9	42.0±3.9	29.7±1.9	37.9±1.5	32.3±2.8	37.0±2.3	38.0±2.2
Date of flight and % as to the first day	26.09; 25.0	27.09; 14.2	24.09; 20.0	24.09; 1.25	23.09; 30.0	24.09; 10.0	24.09; 4.0	25.09; 10.0
Mortality, %	21.0	25.0	0.0	12.5	0.0	0.0	71.0	0.0

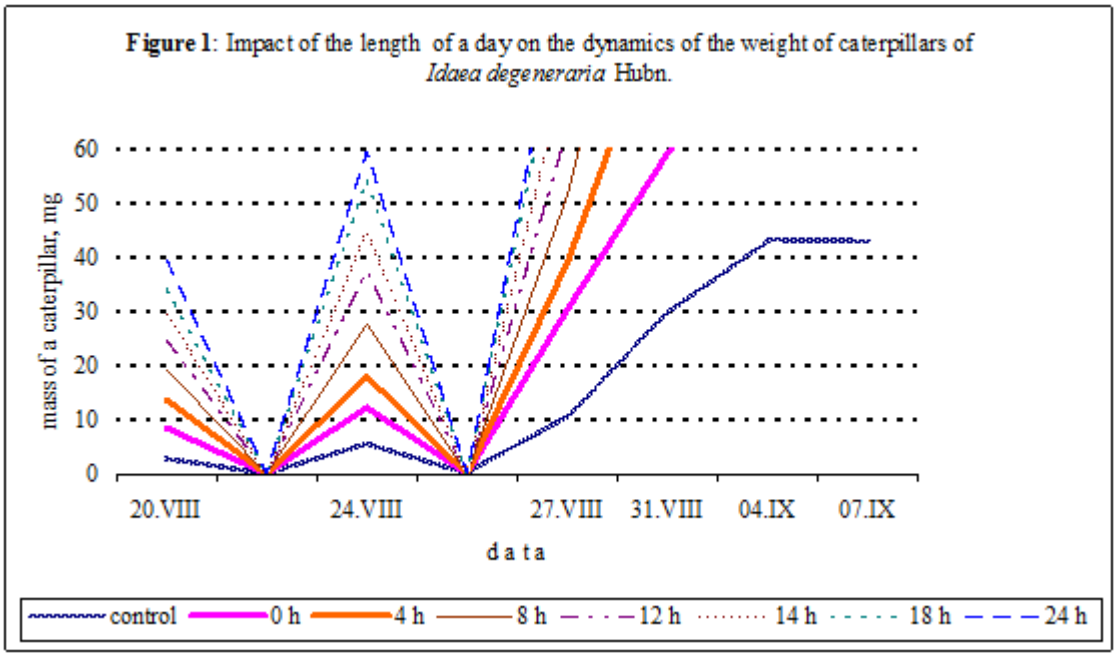

Figure 1: Impact of the length of a day on the dynamics of the weight of caterpillars of *Idaea degeneraria* Hubn.

4. Discussion and Conclusion

As it is seen from the experimental data given in the table, there are no major differences between the short-day (4, 8, 12 h) and long-day (14, 18, 24 h) photoperiods. Nevertheless, it should be mentioned that against the background of constant temperature and humidity, under regular variability of the day light length (between 14 and 12,2 hours of daylight a day) inhibition of the development takes place which affects the duration of the caterpillars phase in the control regime (5-6 days).

It should be indicated that the lightning conditions affects the date of ecdyses and dynamics of the caterpillar's weight to a considerable degree (figure). Particularly, the variations were detected during growth of caterpillar in the second and third ages: minimally 2 days less than 18 hours and maximally 13 days under 4 hours. While comparing these obtained data with the dynamics of the weight of the caterpillar's weight during this period of growth (29.10) it is possible to notice sharp increase of weight under all regimes (table, figure). There is no doubt that namely the weight of a caterpillar plays important role in regulation of the date of the ecdyses. Namely, the caterpillars with the weight less than 40.0 mg were not able to stand metamorphosis. Besides, under the 12-hour regime difference between the ecdyses as to the third and fourth ages comprised 3 days, while the maximum variation of 13 days under the photoperiod of 4 hours is linked to the minimal weight of a caterpillar – 8.7±0.24 (27.08). Thus, it should be indicated that the most minimal weight was observed under the twenty-four hour lightning with caterpillars until ecdyses as to the third age – 6.0±0.17 (t_d=9.3 under the level of probability β>0.99).

Usually, the number of ecdyses in insects depends on external factors (conditions). Various quality of terms of secretion of activation hormones (protorakotrop hormones) shows that alongside with photoperiod regulation of ecdyses other mechanisms linked to the conditions of nutrition and accumulation of caterpillars' weight also play certain role (Burov, 1983; Rauschenbach, 1990) [11, 3]. It has also been mentioned in the literature that under the photoperiod with the duration of 12-hours of daylight secretion of protorakotrop hormone with the larva of tobacco hornworm in the penultimate age starts on the second night after the ecdyses at the IV age. This means that appearance of the additional age of the caterpillars of a little brown-marked geometer under 12-hour photoperiod can be explained with the increases of this activation hormone in this period.

It is known that affect of short-day photoperiods to some insects leads to the significant growth impaiment and segregation of the entire population into two groups: slowly and rapidly growing. For this reason, quantity photoperiod reaction is characterized in some species with fast growth in younger ages and slow growth in the last age. In other species, on the contrary, there is a progressive increase at the last age and very slow development of caterpillars at younger ages (Abdinbekova & Achmedov, 1981; Tyschennko & Qasanov, 1983; Achmedov, 1992) [1, 2, 12].

According to the results of this research (table) caterpillars of brown-marked geometer have quantity reaction to the affect of photoperiod is more obvious in long-day versions of 18 and 24 hours: increase of the weight of caterpillars from long-day versions over short-day (4, 8, 12 hours) reaches 8.9 mg, which comprises 29.5% from average weight of caterpillars under the conditions of a short-day. Indicated differences are highly reliable (t_d=7.7 under the level of probability β>0.99). It has been detected that 4-hour photoperiod stimulates the weight of caterpillars at the pronymph phase which creates average increase of weight in comparison with other regimes for – 10.3 mg (control), 1.8 mg (0 h), 7.8 mg (12 h), 7.1 mg (14 h), 6.6 mg (18 h) and 7.5 mg (24 h) accordingly (table).

The most remarkable one among the data included into the picture is the regularity of sharp increase of the weight on the second day after hatching from eggs: in comparison with the control weight add consists 93.1% (0 h), 79.3% (4 h), 93.1% (8 h), 89.7% (12 h), 65.5% (14 h), 58.6% (18 h), 86.2% (24 h) accordingly (table). Under the 12-hour photoperiod discovered regularity remains till and end of caterpillar phase (37.2±1.32 mg in the fourth age). Particularly, significantly increases for 61.5% (t_d= 16.8 under the level of probability β>0.997).

Thus, obtained data on the weight of caterpillars allowed to determine that under the constant temperature of $25^0(\pm1^0C)$ and humidity of 45-50% clear link to the photoperiod conditions is not observed in caterpillars of the second age and weight of caterpillars fluctuates comparatively weakly (from 4.6 to 5.6 mg). While the average weight of adult caterpillars (of III and IV age) is significantly higher (from

12.1 to 46.8 mg) and much strongly changes in various photoperiods. Maximum weight of caterpillars of this geometer was observed under the conditions of 24 hours of daylight a day (45.8±2.02 mg), while minimum under 14 hours of daylight (12.1±1.02 mg).

As a result of this research in was detected that the date of caterpillar-pupae metamorphosis and percentage of pupas of the geometer *Idaea degeneraria* do not depend on photoperiod. Besides, our attempt to find out the photoperiod regulation of the weight of pupas of this geometer species also resulted in negative outcome. It was revealed that the difference of average weight of pupas under the conditions of short-day (36.5±2.40 mg) and long-day (35.8±2.45 mg) consists only 0.7 mg and statistically is not reliable (t_d= 0.21; t_d<t_{st}).

It was determined that the date of flight of moths and percentage if imago on the first day of flight also do not depend on photoperiod conditions of maintenance of caterpillars: early flight and high percentage of specimen (30.0%) was observed under 12-hour photoperiod, while the minimal percentage of flying out moths was observed in the version of 8 hours of daylight (1.25%). During this research it was revealed that little brown-marked geometer is also characterised with high percentage of survival rate (table). Only in the 18-hour version low survival rate observed (death of specimen 71.0%).

Thus, as a result of this research it was determined that geometer of *Idaea degeneraria* Hubn. and *Tephrina arenacearia* Den. et Schiff. (Kuliyeva, 2009) [5] more obviously reacts on affects of the length of daylight hours in terms of quantity in the caterpillar phase of growth. Photoperiod conditions of maintenance of caterpillars do not affect the growth of pupas and the process of flying out the moths. Probably, regulation of the seasonal cycle of the geometers growth (*Geometridae* fam.) is based on the seasonal system of photoperiod adaptations, while the revealed quantity reaction determines possibility of wintering of caterpillars in adult ages in the soil.

5. References

1. Abdinbekova AA, Achmedov RM. The features of the photoperiodical adaptation of specific species *Noctuidae (Agrotinae*) in Azerbaijan. In: The Questions of General Entomology, UES, Nauka, Leningrad, 1981; 63: 166-168.
2. Achmedov RM. Ecological-physiological basis of the forecasting of dynamics population of the *Noctuidae* and *Leptinotarsa decemlineata* Say. In Azerbaijan. Baku, 1992.
3. Burov VN. The mechanisms of the hormonal regulation of the ecdysis and metamorphosis. In: The hormonal regulation of development of the insects. Nauka, Leningrad, 1983; 64: 44-64.
4. Erkan Ilker. Lepidoptera, Moths. Lepidoptera Species by Scientific Name in Family Groups. 2009.
5. Kuliyeva H.F. The photoperiodic reactions of the Absheron population *Tephrina arenacearia* Den. et Schiff. (*Lepidoptera, Geometridae).* In: Int.Conf. Ecology, Evolution and Systematic of the Animals. Ryazan, Russia, 2009.
6. Kuliyeva HF, Ibragimov FO. Specific features of *Tephrina arenacearia* Den. et Schiff. (*Lepidoptera, Geometridae)* biology and physiology in the north-east regions of Azerbaijan. News of Baku University, series of natural sciences. 2007; 3:51-60.
7. Kerimova IQ. Bioecological abilities of parasites *Meteorus versicolor* Wesm. and *Rogas rossicus* Kok. (*Braconidae)* and their role in regulation of *Tephrina arenacearia* Den. et Schiff. (*Lepidoptera, Geometridae).* Baku, 1997.
8. Martinez Matilde. Insectariums virtual.90, Espană, 2008.
9. Piriyev AA. Geometrids (*Geometridae*) – dangerous pests for alfalfa in Absheron peninsula. In: III Sci.Sess.Entomol.of Dagestan, Makhachkala, 1989: 81-84.
10. Plochinsky NA. Biometria. 1970; 40-55.
11. Rauchenbach I.Y. The neuroendocrine regulation of development of the insects in the conditions of stress. Nauka, Novosibirsk, 1990.
12. Tyshenko VP, Qasanov OQ. Comparative studies on photoperiodic regulation of diapause and weight of Lepidoptera pupae. Zoology Journal, 1983, 52(1): 63-68.