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EFFECT OF TEMPERATURE ON PROCREATION EFFECTIVENESS OF *TEGENARIA ATRICA* C.L. KOCH *(ARANEIDA, AGELENIDAE)*

WPŁYW TEMPERATURY NA EFEKTYWNOŚĆ ROZRODCZĄ *TEGENARIA ATRICA* C.L. KOCH *(ARANEIDA, AGELENIDAE)*

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ABSTRACT. Effect of temperature on effectiveness of procreation of the spider *Tegenaria atrica* C.L. Koch was studied. From the time of insemination females were kept at 18°C, 23°C and 28°C, at optimal moisture content (humidity). They were fed *Acheta domesticus* and *Tenebrio molitor* larvae in excess. The preparation period before laying first cocoon was the shortest at 23°C (79.20 days on average). Rising and lowering of the temperature delayed this to 90.73 and 108.27 days, respectively. The cocoon laying period was the longest at 23°C. In this variant of the experiment the females produced the maximal number of lays (up to 11) and of eggs (up to 643). At 18°C and 28°C the females laid fewer cocoons and the number of eggs in the first lays in relation to their total fertility was slightly higher than at 23°C. It can be concluded that the females of the studied spider delay laying cocoons living in the temperatures higher or lower than optimum to wait for more favourable conditions. However, if the conditions do not change, gonade developement forces them to lay eggs but due to the delay first layings are much greater in relation to their total fertility than at optimal temperature.

The temperature to which the females were exposed at breeding was related to hatching effectiveness. The greatest number of larvae was obtained from the eggs of females living at 23°C (mean 78.97) which, perhaps, proves more effective fertilization.

The results of the experiment indicated that temperatures different than optimal significantly limit procreation effectiveness of *Tegenaria atrica* C.L. Koch which could result in periodical changes in the number of this spider.

INTRODUCTION

Studies on fertility and procreation of spiders being a very philigenetically old and important group of entomophags are still insufficint and sometimes even occasional. Results of experiments carried out so far both in situ and in laboratories indicated considerable differences in procreation effectiveness and length of breeding season in the observed species. This mostly concerns the number of eggs laid during procreation activity and the size of each lay expressed by a number of eggs in cocoon. There are species

of relatively low fertility laying very small cocoons with only one egg as, for example, *Telema tenella* Sim., or two or there eggs as *Oonops pulcher* Temp., *Pholcomma gibbum* Westr and *Pholcidae* (Savory 1928, Holm 1940, Ivanov 1965). Lays of other spiders including many representatives of *Archaeidae*, can contain slightly more, up to nine eggs (Millot, Legendre 1964). In the majority of spiders considered very fertile, creative potential of gonades is much greater and in these cases the cocoons contain several hundred of eggs as, for example in *Argiope bruennichi* Scop. and *Theridium tepidariorum* C.L. Koch (Wiehle 1931, 1937) or about a thousand and more in *Latrodectus tredecingutatus* Rossi (Marikowskij 1956) or *Theraphosa leblondi* (quoted after Mikulska, Jacuński 1968). According to Holm (1940) and Yoshikura (1954) these differences in fertility have a very old origin. As many morphological features they are a result of long changes in philogenesis related to the processes of adaptation of each species and greater spider groups to life in the conditions dictated by the changes in habitat succession.

Analysis of the results of studies carried out so far on spider procreation supports this hypothesis and facilitates pointig out some regularities characterizing fertility of these arthropods. It is possible to state that in the group of species with small body size it is a rule to lay fewer eggs than in case of greater species. However, this rule does not apply to the group of medium and large body size. The other characteristics of spider fertility is related to taxonomy. It is commonly know that philogenetically older species as, for example, *Heptathela sp.* and others from *Haplogynae*, lay usually fewer eggs than progressive species from the *Agelenidae*, *Argiopidae* and *Lycosidae* families (Holm 1940, Yoshikura 1954, Mikulska, Jacuński 1968). The third feature observed in spider procreation is the fact that the habitat of each species can significantly effect their fertility. The individuals leading hidden life style, hiding at breeding season in burrows, under stones, under tree bark and in other, similar places are less fertile than the spiders inhabiting at the same time open spaces, e.g. bishes, trees and flowers (Sevory 1928).

A separate issue is variability of fertility within each species. This is probably decided, as in case of other arthropods, biotic and abiotic conditions of environment, mainly the amount and kind of food, humidity and temperature. The effect of the latter factor on procreation effectiveness of *Tegenaria atrica* C.L. Koch spider was a subject matter of this study, and the procreation effectiveness was defined here not only by the number of eggs laid during breeding season (absolute fertility) but also the number of eggs hatching larvae (phisiological fertility).

The fertility of *Tegenaria atrica* C.L. Koch was initially investigated in 1968 by Mikulska and Jacuński. Next interest in this issue was dut to observed for several years continous fall in the number of this species observed in the viccinity of Bydgoszcz and Toruń. Hence this work is the first attempt at explaining this phenomenon and, simultaniously, starts a research project on the effect of various environmental factors determining fertility of this species.

MATERIAL AND METHODS

The *Tegenaria atrica* C.L. Koch spiders were caught in summer, months (July and August) 1991 in the Viccinity of Toruń. In laboratory breeding a long used method was applied, i.e. the females were kept in 250 cm^3 containers in shaded room at 23°C and relative humidity about 65 %. They were fed ad libitum with larvae of house crickets *(Acheta domesticus* L.) and meal work *(Tenebrio molitor* L.). Every other day boiled water was served for drinking. During breeding ill individuals, those not eating well and poorly adopted to laboratory conditions were eliminated. Only virgin females were selected for experiments which had last cast off in the laboratory and wove regular catching net.

After the adaptional period lasting up to 14 September the females were kept to secure maximal insemination, for one day, subsequently with several males. From 16 September, the breeding containers with females were placed, for the laying period, into three thermostates with constant temperatures of: 18°C, 23°C and 28°C. Twenty five females were exposed to each temperature. Form this set, 15 individuals were examined with respect to fertility and the remainig ten constituted a reserve for anatomical investigations during which phisiological state of the gonades was checked. Egg cocoons were taken from the breeding containers on the day of laying while they were cut and the eggs were released only on the next day since the embryos are more resistant to mechanical damage after serveral hours long incubation. The eggs from each lay were counted and then placed in the thermostate at 23°C on Petri dishes. The number of hatched larvae was established at the moment of embryogenesis termination.

Sections of the females for anatomical studies were carried out in the Ringer liquid, and for tissue stiffening, if need arised Bouin liquid was applied by dripping it into the preparation. The eggs for microscopic observations were candled in a drop of paraffin oil.

Singular lays and cocoons were not included in calculating mean values and in diagrams.

RESULTS

At 18°C

The egg laying period for the females kept at this temperature lasted up to 126 days (mean: 69.64). The first lays appeared on 12 and 13 December, and the last one on 17 April next year (Tab. 1). The number of cocoon laid by each female was relatively low and ranged from one to six The maximal number of cocoons was achieved only by one female. The others were less fertile and laid five (3 females), four (5 females), three (4 females), two (2 females) and one (1 female) cocoon.

The total number of eggs laid by a female during the whole procreation season ranged from 28 to 213. The largest cocoons were observed at first lay. On average they contained

Table 1. Date of laying cocoons and the number of eggs in each lay of *Tegenaraia atrica* C.L. Koch kept at 18°C

N° of a female	Lay											
	1		2		3		4		5		6	
1	12.XII	48	12.I	42	3.II	43	27.II	31				
2	13.XII	35	23.XII	27	18.I	38	10.II	27	1.III	19	28.III	21
3	13.XII	37	5.I	25	7.II	23						
4	14.XII	47	3.II	40								
5	18.XII	59	5.I	32	27.I	37	24.III	32				
6	27.XII	28	16.I	35	14.II	30						
7	28.XII	54	13.I	41	11.II	28	9.III	23	9.III	24		
8	5.I	52	28.II	37								
9	7.I	48	1.III	29	27.III	17						
10	10.I	67	27.I	52	24.II	40	22.III	43	17.IV	11		
11	10.I	28										
12	11.I	78	23.I	54	14.II	27	18.III	27				
13	13.I	43	30.I	50	2.III	35	27.III	21				
14	18.I	54	1.II	60	27.II	38	24.III	17				
15	5.II	28	1.III	20	21.III	23						
mean number of eggs in lays	47.07		38.86		31.58		27.63		18.00			

47.07 eggs. The subsequent lays yielded smaller and smaller cocoons. The third lay mean calculated from three values (Tab. 1, Fig. 1) was only 18 eggs. Mean time between lays ranged from 21.67 to 26.17 days (Tab. 2, Fig. 2).

The largest number of larvae hatched from the eggs laid in this experimental variant by the most fertile female was 173 which was 81.22 % (Tab. 3). Generally the most larvae hatched from the first lay eggs. Mean hatching effectiveness was here 83.29 %. In the further part of procreation cycle, hatching percentage lowered gradually to 55.56 in the fifth lay (Tab. 4).

The females kept at that temperature were little mobile. They spent most of the time on a web stretched near bottom of breeding boxes. Follicles of the first two cocoons were

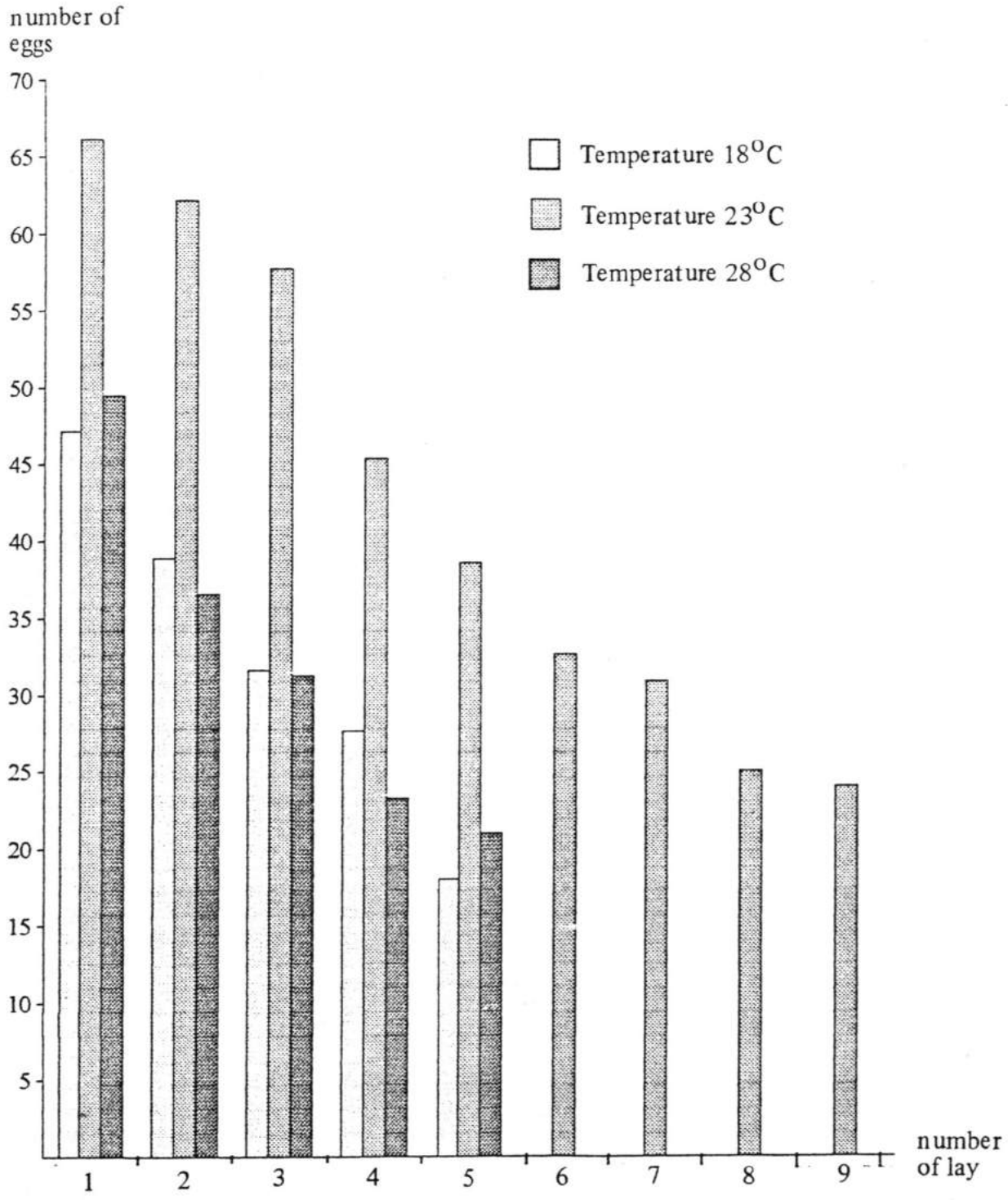

Fig. 1. Mean number of eggs in *Tegenaria atrica* C.L. Koch lays at 18°C, 23°C, 28°C

Table 2. Mean time between lays in *Tegenaria atrica* C.L. Koch at 18°C, 23°C, 28°C

Tempe-rature	Time between lays							
	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9
18°C	25.71	26.17	26.13	21.67	–	–	–	–
23°C	7.07	8.29	12.15	16.92	15.73	17.33	18.00	19.00
28°C	20.67	22.58	26.22	24.80	–	–	–	–

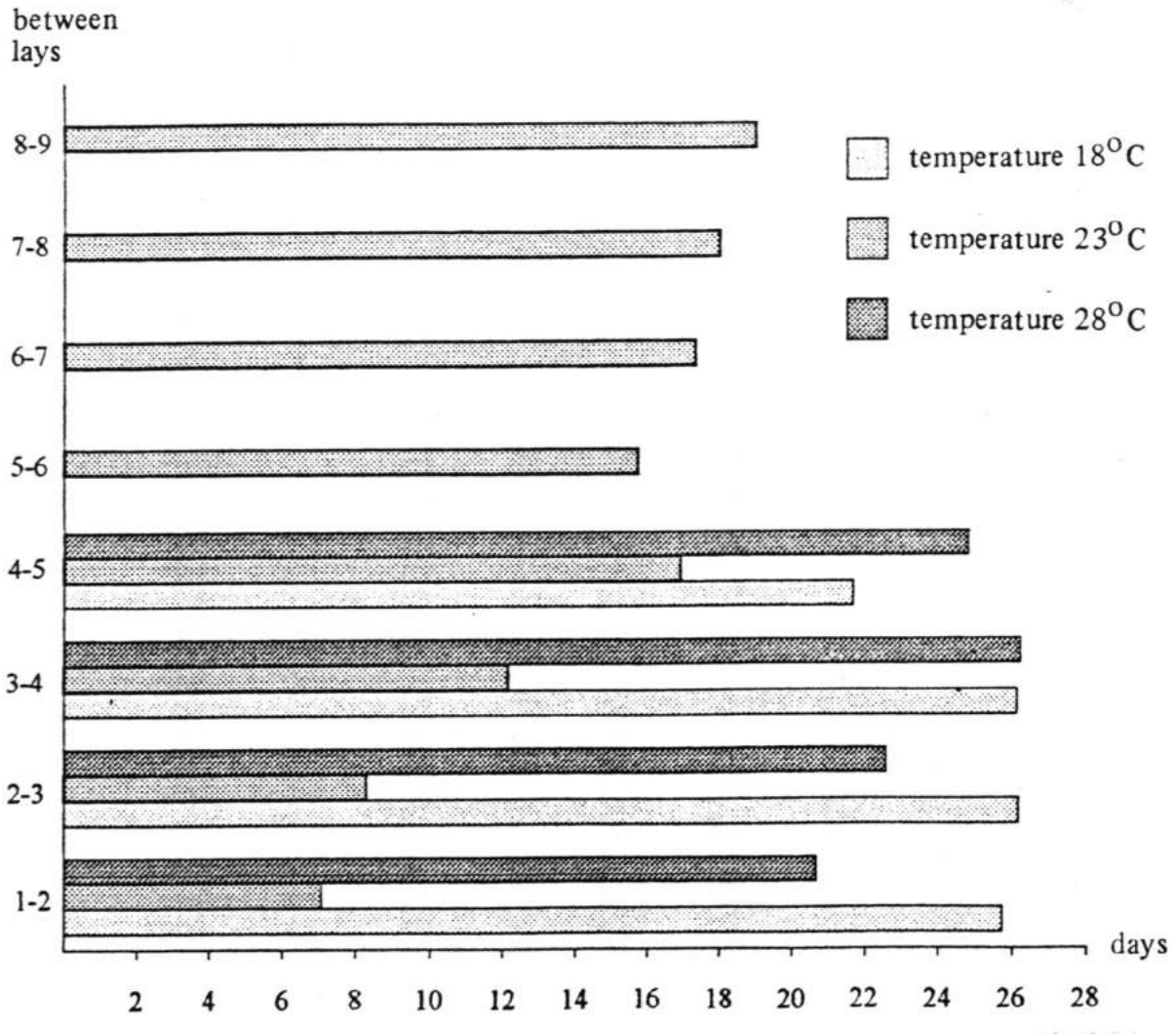

Fig. 2. Mean time between lays in *Tegenaria atrica* C.L. Koch at 18°C, 23°C, 28°C

Table 3. Procreation effectiveness of a *Tegenaria atrica* C.L. Koch females at 18°C, 23°C, 28°C

N° of a female	Temperature								
	18°C			23°C			28°C		
	Total number of eggs	N° of hatched eggs	% of hatches	Total number of eggs	N° of hatched eggs	% of hatches	Total number of eggs	N° of hatched eggs	% of hatches
1.	164	135	82.32	530	440	83.02	156	99	63.46
2.	167	110	65.87	291	273	93.81	121	94	77.69
3.	85	65	76.47	339	283	83.48	94	63	67.02
4.	87	83	95.40	79	74	93.67	206	146	70.87
5.	160	112	70.00	643	575	89.42	125	111	88.80
6.	93	59	63.44	255	254	99.61	186	125	74.40
7.	170	141	82.94	391	337	86.19	110	75	68.18
8.	89	55	61.80	234	221	94.44	57	34	59.65
9.	94	48	51.06	116	116	100.00	140	110	78.57
10.	213	173	81.22	183	166	90.71	67	58	86.57
11.	28	15	53.57	366	327	89.34	65	48	73.85
12.	186	141	75.81	477	422	88.47	204	126	61.76
13.	149	93	62.42	354	306	86.44	161	128	79.50
14.	169	104	61.54	345	298	86.38	88	49	55.68
15.	71	43	60.56	217	186	85.71	224	145	64.73

Table 4. Procreation effectiveness of *Tegenaria atrica* C.L. Koch at 18°C

Lay	Number of eggs in a cocoon			Mean % of hatched eggs
	Max.	Min.	Mean	
1	78	28	47.07	83.29
2	60	20	38.86	73.71
3	43	17	31.58	57.52
4	43	17	27.63	62.44
5	21	11	18.00	55.56

woven slowly but with great care. In later lays it happened sometimes that external part of cocoon did not cover all eggs. The spiders did not mask cocoon folliciles.

At 23°C

In this experimental variant the laying period lasted up to 144 days (mean 78.87). The first lays appeared on 19 and 20 November and the last ones in the middle of April next year. The number of cocoons laid by the spiders at that temperature ranged from two to eleven (Tab. 5).

The minimal number of eggs laid by a female during the whole procreation period was 79 and the maximal one 643 eggs. The greatest mean number of eggs laid in one cocoon was observed in the first lay. It was 66.07 eggs. In the subsequent lays the cocoons were smaller and smaller. The mean number of eggs in the sixth lay fell to 32.64 and in the ninth to 24 eggs (Tab. 2, Fig. 2). Mean time between the lays at this temperature was significantly varied and longer with the procreation time. The second cocoons appeared, on average, already after 7.07 days while the interval between the last ones was 19 days.

The maximal number of larvae hatched from the eggs laid by the most fertile female at this temperature was 575 which, in proportion to all eggs laid by her, was 89.42 % (Tab. 3).

Hatching effectiveness in this experimental variant was very high. In the first four lays it exceeded 95 %. Later it decreased gradually, so in the ninth lay it was only 48.39 % (Tab. 6).

The spiders kept in this experimental variant were very active. They alwas repaired all damages to their webs and wove cocoons with great care but only to the fifth or sixth lay. Most cocoons were carefully masked directly aftery laying with food remains and sand grains brought by the females from the bottom of breeding boxes.

At 28°C

The laying period lasted up to 139 days (mean 63.87). The first cocoons appeared on 17 November and the last ones on 5 April next year (Tab. 7). The number of lays per female ranged from two to seven. However, the maximal number had only one female. In this experimental variant the females laid relatively small cocoons. The minimal number of eggs laid by a female was 57 and the maximal one 224. The greatest mean number of eggs was observed in the first lay – 49.40 eggs (Tab. 7, Fig. 2). Then the mean values lowered gradually reaching the number of 21 in the fifth lay.

Mean time between the lays was very regular – from 20.67 to 26.22 days (Tab. 2, Fig. 2).

The maximal number of larvae obtained from the eggs laid by the most fertile female in this experimental variant was 146 at 206 laid eggs, i.e. 70.87 %.

Table 5. Date of laying cocoons and the number of eggs in subsequent lays in *Tegenaria atrica* C.L. Koch at 23°C

N° of a female	Lay																					
	1		2		3		4		5		6		7		8		9		10		11	
1	19.XI	72	2.XII	91	9.XII	84	20.XII	65	31.XII	67	10.I	35	20.I	28	7.II	31	25.II	33	21.III	24		
2	20.XI	93	27.XI	58	7.XII	46	23.XII	38	3.I	31	12.II	25										
3	24.XI	68	29.XI	52	11.XII	57	28.XII	36	13.I	33	28.I	42	19.II	27	14.III	24						
4	24.XI	48	4.XII	31																		
5	26.XI	108	1.XII	94	6.XII	87	17.XII	92	28.XII	67	10.I	54	23.I	43	6.II	27	23.II	30	14.III	18	12.IV	23
6	2.XII	56	7.XII	61	16.XII	60	4.I	42	17.II	36												
7	3.XII	56	10.XII	54	19.XII	68	23.XII	50	16.I	47	27.I	31	15.II	32	7.III	26	1.VI	27				
8	3.XII	59	9.XII	64	15.XII	43	23.XII	27	11.I	24	24.I	17										
9	3.XII	47	14.XII	38	22.XII	31																
10	6.XII	38	12.XII	52	20.XII	44	30.XII	30	15.I	19												
11	7.XII	74	13.XII	81	19.XII	77	30.XII	52	12.I	34	24.I	27	18.II	21								
12	7.XII	102	12.XII	84	20.XII	71	2.I	48	14.I	44	1.II	51	19.II	37	5.III	18	24.III	22				
13	12.XII	70	19.XII	63	27.XII	54	8.I	37	22.I	34	5.II	29	23.II	37	16.III	18	1.VI	12				
14	19.XII	52	27.XII	61	6.I	53	19.II	48	2.II	39	18.II	27	5.III	34	21.III	31						
15	23.XII	48	28.XII	47	7.I	32	20.I	24	4.II	26	28.II	21	16.III	19								
Mean number of eggs in lays	66.07		62.07		57.64		45.31		38.54		32.64		30.89		25.00		24.00					

Table 6. Procreation effectiveness of *Tegenaria atrica* C.L. Koch at 23°C

Lay	Number of eggs in a cocoon			Mean % of hatched eggs
	Max.	Min.	Mean	
1	108	38	66.07	97.98
2	94	31	62.07	98.17
3	87	31	57.64	96.28
4	92	24	45.31	95.93
5	67	19	38.59	86.25
6	54	17	32.64	68.80
7	43	19	30.89	65.83
8	31	18	25.00	53.14
9	33	12	24.80	48.39
10	24	18	21.00	52.38

Hatching effectiveness in the first lays was rather high. Larvae were hatched from 83.27 % of eggs. Later in the season the hatching percentage lowered gradually to 41.90 % in the fifth (Tab. 8).

The spiders kept at that temperature were little active. Most often they stayed on a web placed in the highest place of the breeding box trying, from time to time, to get out. Most cocoons were poorly protected with thread. Cocoon follicle consisted of only one layer in many cases. Sporadically, the females laid eggs directly on catching web. The spiders were reluctant to repair webs destroyed during cocoon removal.

Table 7. Date of laying cocoons and the number of eggs in subsequent lays in *Tegenaria atrica* C.L. Koch kept at 28°C

N° of a female	Lay													
	1		2		3		4		5		6		7	
1	17.XI	57	29.XI	31	17.XII	37	12.I	19	2.II	12				
2	23.XI	48	2.XII	50	23.XII	23								
3	23.XI	34	15.XII	21	27.XII	22	17.I	17						
4	27.XI	80	13.XII	37	29.XII	34	21.I	12	17.II	15	16.III	11	5.IV	17
5	5.XII	47	20.XII	42	7.I	17	11.II	19						
6	7.XII	51	23.XII	44	9.I	26	24.I	20	18.II	27				
7	18.XII	43	5.I	40	8.II	27								
8	18.XII	45	27.I	12										
9	23.XII	52	16.I	37	2.II	34	26.II	17						
10	23.XII	40	3.II	27										
11	27.XII	34	18.I	31										
12	29.XII	57	17.I	46	5.II	38	27.II	39	24.III	24				
13	29.XII	50	14.I	53	7.II	52	2.IV	26						
14	3.I	41	27.I	28	15.III	19								
15	7.I	62	22.I	49	19.II	46	7.III	40	2.IV	27				
mean number of eggs in lays	49.40		36.53		31.25		23.22		21.00					

Table 8. Procreation effectiveness of *Tegenaria atrica* C.L. Koch at 28°C

Lay	Number of eggs in a cocoon			Mean % of hatched eggs
	Max.	Min.	Mean	
1	80	34	49.70	83.27
2	53	12	36.53	73.54
3	52	17	31.25	63.38
4	40	12	23.22	55.02
5	27	12	21.00	41.90

DISCUSSION

As results from the experiments, temperature had a significant and comprehensive effect on all stages of breeding of *Tegenaria atrica* C.L. Koch. The first signs of this effect were observed already in the initial stage of their procreative activity being expressed by shortening or prolonging of the preparation period starting at insemination and terminating with laying of the first cocoon. At 23°C, considered to be optimal for procreation of the studied spider, the preparation period was the shortest and lasted on average 79.20 days. Keeping the females at 28°C, i.e. in the temperature higher than the optimum by 5°C, brought about prolongation of this period on average to 90.73 days. Even greater delay was observed when the spiders were kept at 18°C. In that case the first cocoons were obtained only after, on average, 108.27 days (Fig. 3). These data indicate that the females kept after insemination in thermal conditions other than optimum can delay laying of the first cocoon by 14.56 % at 28°C and by 36.70 % at 18°C, assuming the time from the optimal temperature as 100 %. A question can be asked here – what was the cause of this delay? The females post mortems indicated that only in the spiders kept at 18°C there was a slight delay in maturing of eggs cells seen as delayed or uneven growth of oocytes in both ovaries. Hence, it can be supposed that the prolongation of the preparation time before laying the first cocoon was due to the females waiting for more favourable thermal conditions.

The length of the main part of procreation season, i.e. laying egg cocoons, was also related to environment temperature (Tab. 9, Fig. 3). From the experiments resulted that this process took the longest time (mean 78.87 days) at the optimal temperature. In the thermal conditions varying from the optimum, the females shortened this time. At 18°C it lasted, on average, 69.64 days, and at 28°C only 63.87 days. Comparing the mean time of the preparation stage till laying of the first cocoon with the length of laying period, it should be stated that they were similar only at the optimal temperature. In the remaining variants of the experiment the laying time was always shorter than the preparation stage (Fig. 3).

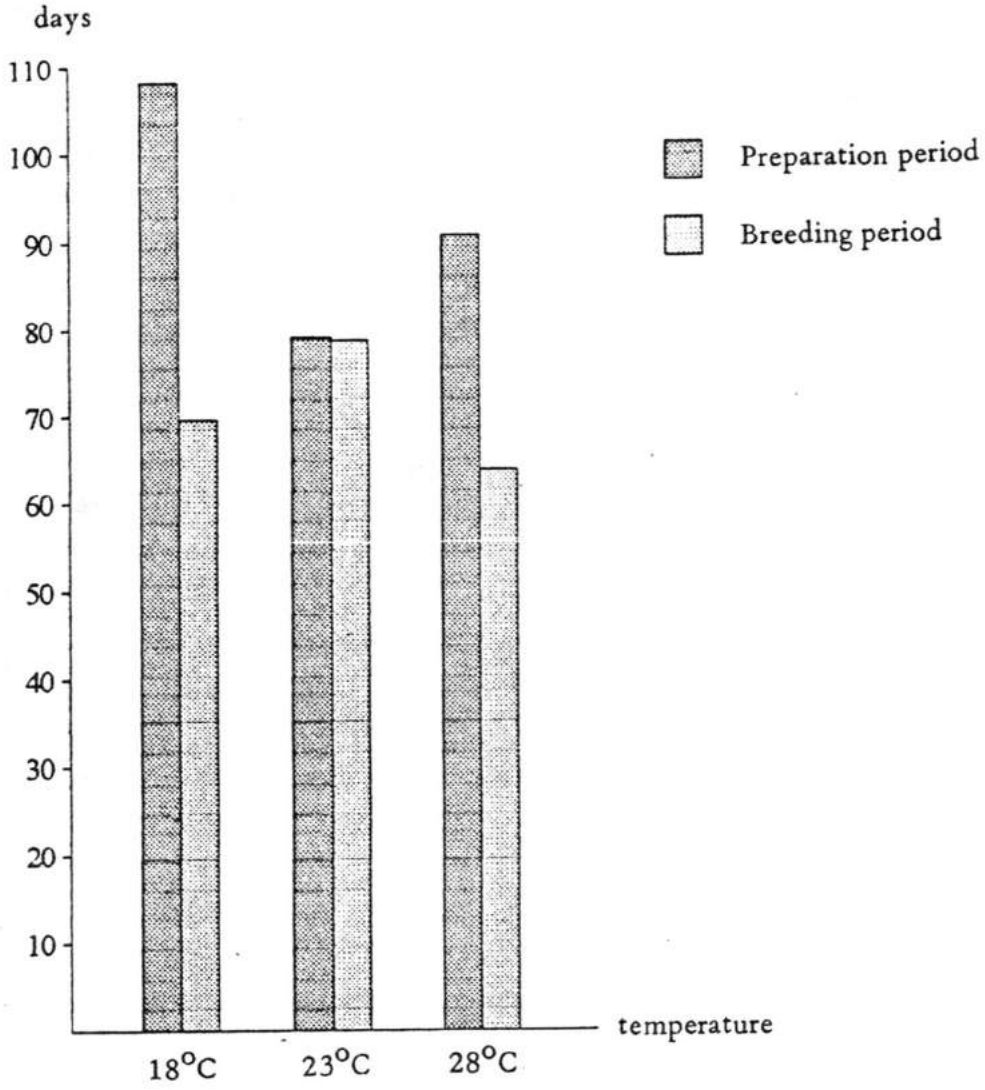

Fig. 3. Mean time of the preparation period and breeding of *Tegenaria atrica* C.L. Koch at 18°C, 23°C, 28°C

Table 9. Procreation time and procreation effectiveness of *Tegenaria atrica* C.L. Koch at 18°C, 23°C, 28°C

Temp.	Procreation time		N° of eggs laid by a female			Mean % of eggs hatched
	Total	Mean	Max.	Min.	Mean	
15°C	126	69.64	213	28	128.33	69.63
23°C	144	78.87	643	79	321.33	90.05
28°C	139	63.87	224	57	132.40	71.38

Temperature also affected the number of lays and the number of eggs in a cocoon. The results indicated that at 18°C and 28°C, each female produced fewer cocoons, and the number of eggs in subsequent lays, in relation to total fertility of each individual, was always slightly higher than at the optimal temperature. This finding confirms earlier suggestions that females are able to delay laying period waiting for more favourable thermal conditions. However, if they did not come, the developement of gonades eventually forces the spiders to lay eggs. Then, due to delay in procreation activity, the number of cocoons is lower, and the number of eggs in the first lays, in relation to the total fertility is much higher than at the optimal temperature.

Mean time between subsequent lays also depended on thermal conditions of breeding. Relatively the smallest differences were noted for the extremal temperature, i.e. at 18°C and 28°C, where cocoons appeared, on average, at the intervals of over twenty days. At the optimal temperature, mean time between lays was shorter and ranged from 7 to 19 days (Tab. 7, Fig. 2).

Temperature affected effectiveness of hatching in each lay. The greatest number of eggs hatching larvae was obtained from the females laying cocoons at the optimal temperature. This particularly concerned the first four lays, where hatching ration exceeded 95 %. In the subsequent lays the effectiveness gradually decreased. In all, the mean hatching ratio in this experimental variant was 90.05 %. At the remaining temperatures the spiders were less fertile, and the hatching effectiveness was also lower. The latter observation is very interesting. It would seem that with the spiders generally laying smaller number of eggs the hatching percentage should be high since fewer eggs were to be fertilized. However, the opposite turned out to be true. Observation of eggs in paraffin oil, which were not hatched, indicated that at extremal temperatures the number of infertile eggs increased. The reason for this is unknown. The explanation could be obtained through examination of the contents of semen containers. The lower number of fertilized eggs can be related to lower mobility or increased mortality of sperms at these thermal conditions.

The experiments indicated that the temperature to which the *Tegenaria atrica* C.L. Koch females were exposed during breeding was the factor clearly affecting fertility of this species. The highest absolute fertility (the number of hatches larvae) appeared at the spiders kept at the optimal temperature (23°C), where, on average, it was 321.33 (at the extremal values 643 and 79 and 285.20 (575 and 74), respectively. It results form that, that from about 90 % of eggs larvae were hatched which indicated large effectiveness of fertilization. In other experimental variants the procreation effectiveness was considerably lower. At 18°C the absolute fertility was, on average, 128.33 (213 and 28) and the phisiological one 91.80 (173 and 15). The mean hatching ratio reached almost 70 % (69.63 %). Similar results were obtained while keeping the spiders at 28°C. In this case absolute fertility was, on average, 132.40 (224 and 57), and the phisiological one 94.07 (146 and 34). The mean hatching ratio reached the value of 71.38 % (Fig. 4).

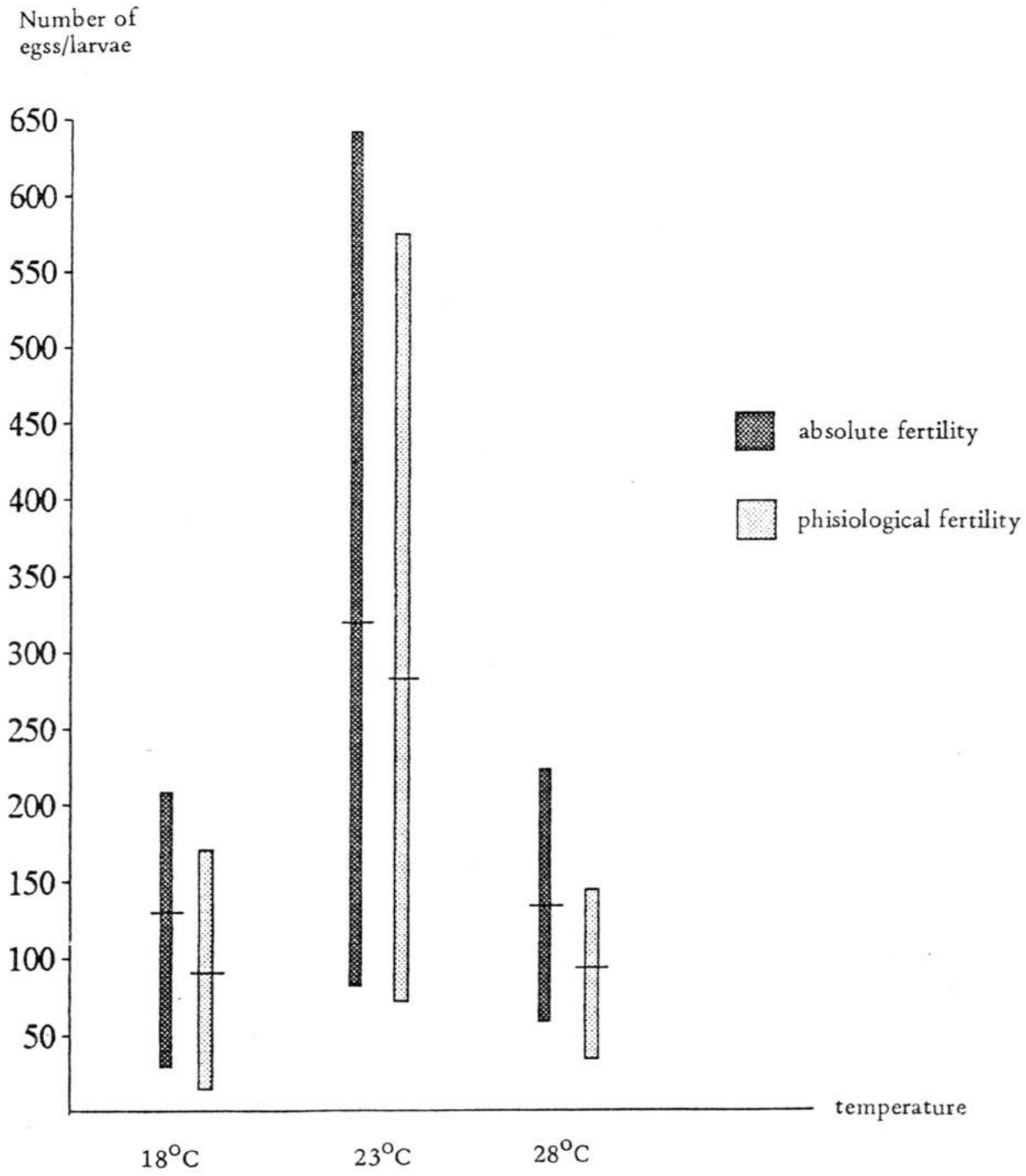

Fig. 4. Absolute and phisiological fertility of *Tegenaria atrica* C.L. Koch at 18°, 23°C, 28°C

Taking into account all the experimental results it should be concluded that *Tegenaria atrica* C.L. Koch propagates most effectively at 23°C, considered by Mikulska and Jacuński (1968) to be the optimum for this species.

CONCLUSIONS

It was found that in *Tegenaria atrica* C.L. Koch temperature affects:

1. lenght of procreation time since increasing and decreasing temperature with respect to the optimal one shortens reproduction season,
2. lentght of the preparation stage from starting laying of eggs. and the temperature lower than the optimal one prolonges this time more than the higher temperature,
3. the number of cocoons laid by a female, which decreases in the temperatures lower than higher than the optimum,
4. mean time between each lay; in the lower and higher temperatures this time is about 3 ora 3.5 times longer as compared to the optimal thermal conditions,
5. total number of laid eggs (absolute fertility); deviations from the optimal temperature by $\pm$ 5°C decrease absolute fertility by over 2.4 times,
6. number og eggs hatching larvae (phisiological fertility); the females kept at breeding time at temperatures varying from the optimum it decreased by about 20 %.

Moreover, it was proven thatt:

1. no significant anatomical changes are observed in the females kept in the conditions different than the optimum which can confirm hypothesis that the spiders are able to delay laying eggs while waiting for favourable thermal conditions;
2. temperature affects etological aspects of procreation as expressed by the speed and carefulness of weaving cocoons, web repair and masking cocoons;
3. procreation effectiveness of the studied spider was the highest at 23°C which is considered to be an optimum. Deviations from this temperature limit procreation which can affect periodical changes in the number of this spider in the natural environment.

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WPŁYW TEMPERATURY NA EFEKTYWNOŚĆ ROZRODCZĄ *TEGENARIA ATRICA* C.L. KOCH *(ARANEIDA, AGELENIDAE)*

STRESZCZENIE

Przeprowadzono obserwacje nad wpływem temperatury na efektywność rozrodczą pająka *Tegenaria atrica* C.L. Koch. Samice od chwili zaplemnienia przetrzymywano w temp. 18°C, 23°C i 28°C przy optymalnej wilgotności. Karmiono w nadmiarze larwami *Acheta domesticus* i *Tenebrio molitor.* Okres przygotowawczy do złożenia pierwszego kokonu był najkrótszy w temp. 23°C i wynosił średnio 79,20 dnia. Podwyższenie i obniżenie temperatury opóźniło moment złożenia pierwszego kokonu odpowiednio do 90,73 i 108,27 dnia. Okres składania kokonów trwał najdłużej w temperaturze 23°C. W tym wariancie doświadczenia samice dały maksymalną liczbę złóż (do 11) i maksymalną liczbę jaj (do 643). W temperaturze 18°C i 28°C samice składały mniej kokonów, a liczba jaj w pierwszych złożach w stosunku do ich całkowitej płodności była nieco wyższa w temp. 23°C. Wynika z tego, że samice badanego pająka, przebywające w czasie rozrodu w temperaturze niższej i wyższej od optimum, opóźniają okres składania kokonów wyczekując na bardziej sprzyjające warunki. Jeżeli jednak to nie nastąpi, to rozwój gonad zmusza je do składania jaj, ale w związku z opóźnieniem tego procesu pierwsze złoża są w stosunku do całkowitej płodności znacznie większe niż w temperaturze optymalnej.

Temperatura działająca na samice w okresie rozrodu miała związek z efektywnością wylęgu. Najwięcej larw uzyskano z jaj samic przebywających w temp. 23°C (średnio 78,97) co, być może, świadczyło o efektywniejszym zapłodnieniu.

Wyniki doświadczeń wykazały, że temperatury odbiegające od optimum ograniczają wyraźnie efektywność rozrodczą *Tegenaria atrica* C.L. Koch, co może wpływać na okresową zmianę liczebności tego pająka.

ВЛИЯНИЕ ТЕМПЕРАТУРЫ НА ЭФФЕКТИВНОСТЬ ПЛОДОВИТОСТИ *Tegenaria atrica* C. L. Koch (*Araneida, Agelenidae*)

РЕЗЮМЕ

Проводилисъ набюдения за влиянием температуры на эффективность плодовитости *Tegenaria atrica* C. L. Koch. Самок с момента оплодотворенияа держали в темнературе 18°Ц, 23°Ц и 28°Ц при оптимальной влажности. Их кормили чрезмерно личиками *Acheta domesticus* и *Tenebrio molitor*. Подготовительный период для закладывания первого кокона был самый короткий при температуре 23°Ц продолжался в спеднем 79,20 дня. Повышение и понижение температуры замедляло момент закладывания первого кокона соответсвенно к 90,73 и 108,27 дням. Самый долгий период создания коконов выступал при температуре 23°Ц. В этом варианте исследошаниа самки давали максимальное число отложений (до 11) и максимальное число яиц (до 643). При температуре 18°Ц и 28°Ц самки закладывали меньше коконов, а число яиц по отношению к полной их плодовитости, в первых отложениях оказалось несколько выше, чем при температуре 23°Ц. Отсюда следует, что самки испытуемого паука, пребывающие во время размножения в температуре выше и ниже, чем оптимум, замедляют период закладывания коконов, ожидая более благоприятных условий. Однако, если это не наступает - развитие гонад заставляет их складывать яйца. Но, в связи с замедлением этого процесса, первые отложения по отношению к полной плодовитости, являются значительно выше, чем при оптимальной температуре.

Температура, воздействующая на самок в период размножения, имеет связь с эффективностью выводности. Больше всего личинок получилось из яиц самок, пребывавших в температуре 23°Ц (в среднем 78,97) что, быть может, свидетельствовало о Более эффективном оплодотворении.

Результаты исследований показали, что температуры отходящие от оптимум, четко ограничают эффективность плодовитости *Tegenaria atrica C. L. Koch*, что может влиять на периодическое изменение численности этого паука.