Effect of Temperature and Host Density on the Rate of Increase of Bracon brevicornis Wesmael

(*Hymenoptera: Braconidae*)

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Introduction

The mass production of a beneficial parasite or a predator in the laboratory is a pre-requisite in the biological method of pest control. In the field the efficiency of a parasite is judged by its capacity to distribute its eggs among the available host population in such a manner that its progeny has the best possible chance of survival. But in the laboratory, the distribution of progeny that has a direct bearing on the rate of increase of population of the parasite is governed by a set of factors such as, host density, area, parasite density, on the one hand and temperature and humidity on the other. By the various factors mentioned above that keep the animal population in a state of balance, the physical factor of temperature is of particular interest in the study of host parasite relationship as it not only affects the rate of development but also the ability of the parasite to contact the hosts, or in other words the searching capacity of the parasite. The efficiency of a parasite and in return its population at any time also depends upon the abundance of the host.

Bracon brevicornis Wesm. an external parasite of the Pink boll worm of cotton (*Pectinophora gossypiella* Saund.) has been reared in the parasite

DOI: 10.21248/contrib.entomol.10.7-8.872-885

laboratory of this Institute and in the present study the effect of two factors viz., host density and temperature was studied on host parasitization and oviposition of the parasite.

FLANDERS (1935) studied parasitization by *Trichogramma evanescens* WESTW. at various host densities ranging from 18—650, and found that with the increase of host density the number of progeny per parasite increased until a maximum was recorded and maintained. SMIRNOV & WLADIMIROW (quoted by GAUSE, 1934) showed by experiments on *Phormia groenlandica* ZETT. and its parasite *Mormoniella vitripennis* (WALK.) that there was a non linear relation between the relative increase of the predator and concentration of the prey. Their finding was further corroborated by DEBACH & SMIDT (1941). SKOBLO (1940) reported that the number of eggs laid by *Microbracon brevicornis* WESM. depended on the number of host larvae available and ranged from five (5) or less to over fifty (50). VARLEY (1941) studied the egg distribution of five chalcid parasites of *Euribia jaceana* HERING and found that parasitism by *Eurytoma curta* WLK. was higher in areas of higher host density. ULLYETT (1945, 1949, 1950) studied the effect of host density on three different parasites viz. *Microbracon hebetor* SAY, *Chelonus texanus* CRESS., and *Cryptus inornatus* PRATT. BURNETT (1951) studied the effects of temperature and host density on the rate of increase of *Dahlbominus fuscipennis* ZETT. and reported that at lower host densities the rate of increase of the parasite was rapid but at higher host densities it tended to level off. The rate of change of parasitization of the host varied as the inverse of the host density. But this relation did not hold good in natural temperatures and there the parasitism varied as the square root of host density (Burnett, 1954).

Material and Methods

Fully grown larvae of *Corcyra cephalonica* STAINTON were given as host to the parasite.

For experimental purposes the parasite's progeny was raised from a single pair obtained from the general culture maintained in the parasite laboratory of the Indian Agricultural Research Institute. Just after emergence single pairs were kept, for mating purposes, in tubes and fed with 10% sucrose solution. After 48 hours the pairs were transferred to individual cages for experiments.

The cages used in the experiments were small jars of various diameters and of a constant height of 2″. After liberating the parasites in the cage it was covered with black muslin cloth held tight by rubber band. Host larvae, cleaned with tipid water and dried, were exposed on the muslin cloth for parasitization. The larvae were prevented from crawling away by means of a glass plate. At the end of 24 hours period, the paralysed and parasitised larvae were collected and the number of parasite eggs on each parasitized host was recorded.

Experiments were carried out at 5 temperatures of 20°, 25°, 30°, 35° and 38° C and at a relative humidity of 70%.

Experiments were conducted in two series. In one series cages with a diameter of 2″ were used and host density was varied from 2—12. In the second series cages with different diameter viz. 2″, 2½″, 3″, 3½″ and 4″ were used and a constant number of 15

DOI: 10.21248/contrib.entomol.10.7-8.872-885

hosts was exposed in all. The second series of the experiments was carried out to find if there was any extra effort on the part of the female parasite to search its environment if the same number of hosts was distributed over a larger area.

All the experiments in both the series were replicated six times.

Results

Series I.

In this series the area of search for the female parasite was kept constant and the number of host larvae was varied from 2—12.

It was found that a single female parasite was able to paralyse all the host larvae at the highest density. So no conclusion could be derived as regards searching capacity of the parasite in relation to temperature and host density.

The average number of the eggs laid by a single female at various host densities and temperatures is given in table I and the average effect of temperature and host density on the oviposition of the parasite is summarized in table 1(a).

Table 1. Number of eggs laid, at six host densities and five temperatures, by a single female of *Bracon brevicornis* Wesm.

Host density (No. of hosts)	20°C mean	25° C mean	30° C mean	35° C mean	38° C mean
A(2)	12.66 ± 1.87	8.50 ± 1.7	18.00 ± 4.1	24.3 ± 3.0	17.66 ± 3.4
B(4)	16.00 ± 1.84	10.83 ± 2.7	16.50 ± 3.8	20.5 ± 2.1	17.50 ± 2.8
C(6)	13.33 ± 2.18	10.50 ± 2.7	17.00 ± 4.1	19.83 ± 2.3	14.83 ± 3.5
D(8)	11.33 ± 1.28	13.16 ± 2.8	18.33 ± 4.8	19.66 ± 2.6	13.83 ± 2.0
E(10)	11.83 ± 2.09	13.66 ± 2.0	11.66 ± 3.9	19.16 ± 3.2	13.33 ± 3.9
F(12)	13.00 ± 1.4	9.16 ± 3.9	10.33 ± 2.77	19.00 ± 1.7	11.66 ± 2.0

Table 1(a). Average effect of temperature and host density on oviposition of *Bracon brevicornis* Wesm.

Host density		Temperature	
Treatment	Average No. of eggs laid	Treatment	Average No. of eggs laid
A	16.218	20° C	13.03
B	16.266	25° C	10.97
C	15.098	30° C	15.30
D	15.262	35° C	20.41
E	13.928	38° C	14.80
F	12.630	—	—

DOI: 10.21248/contrib.entomol.10.7-8.872-885

Statistical Analysis

Source of Error	D. F.	SS	MSS	'F' ratio	Value of 'F'	
					5%	1%
Host density	5	296.755	59.351	1.213	2.27	3.14
Temperature	4	1783.415	445.58	9.113**	2.43	3.45
Density × temp.	20	555.058	27.75	0.56	1.64	2.00
Error	150	7338.167	48.92	—	—	—
Total	179	9973.395	—	—	—	—

** Significant at 1%
SEm Temp. = ± 1.165
CD at 1% = 4.297

The results show that host density had no significant effect on the oviposition of the parasite during the given time period and conditions of the experiment.

Temperature and host density did not show any combined effect on the oviposition of the parasite.

At 35° C significantly more eggs were laid as compared to other temperatures. There was no significant difference between the number of eggs laid at 30° C, 38° C, and 20° C; and 38° C, 20° C and 25° C. Though the difference at 20° C and 25° C was not significant yet the less number of eggs laid at 25° C as compared to 20° C indicates an anomaly. It might be due to the great variability usually found in insect oviposition behaviour as it can not be ascribed to the effect of temperature. The fall in the number of eggs laid at 38° C was because of the very nearness of lethal temperature for the parasite. It was observed during the experiments the parasite, died without depositing any eggs, at 40° C.

The percentage of hosts utilized at various temperatures and host densities is given in table 2 and the average effect of temperature and host density on the ability of the parasite to utilize the hosts for oviposition is shown in table 2 (a).

Table 2. Percentage of hosts utilized for oviposition by *Bracon brevicornis* Wesm. at 6 host densities and 5 temperatures

Host density (No. of hosts)	20° C	25° C	30° C	35° C	38° C
A(2)	75.0	83.3	83.3	91.6	91.6
B(4)	54.1	45.8	79.1	66.6	70.8
C(6)	33.3	41.6	58.3	44.4	33.3
D(8)	20.8	35.4	43.7	41.6	37.5
E(10)	18.3	35.0	30.0	43.3	33.3
F(12)	25.0	23.6	27.7	30.5	29.1

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Table 2(a). Average effect of temperature and host density on host utilization

Host density		Temperature	
Treatment	% host utilized	Treatment	% host utilized
A(2)	84.96	20° C	37.75
B(4)	63.28	25° C	44.11
C(6)	42.18	30° C	53.68
D(8)	35.80	35° C	53.00
E(10)	31.98	38° C	49.26
F(12)	27.18	—	—

Statistical Analysis

Source of Error	D. F.	SS	MSS	'F' ratio	value of 'F'	
					5%	1%
Host density	5	12356.00	2471.20	52.50**	2.71	4.10
Temperature	4	1068.56	267.14	5.675**	2.87	4.43
Error	20	941.55	47.07	—	—	—
Total	29	14366.11	—	—	—	—

SEm Temp. = ± 2.8
C. D. at 1% = 11.27

SEm host density = ± 3.068
C. D. at 1% = 12.34

Both host density and temperature showed a significant effect on host utilization by the parasite.

As the host density increased the percentage of host utilized fell rapidly and at the higher host densities there was no significant difference between the percentage of hosts utilized. This gave an indication that after a certain density the number of host utilized by the parasite became constant.

At 20°C significantly less number of hosts was utilized as compared to the percentage of hosts utilized at 30°, 35° and 38°C. But there was no significant difference between the percentage of hosts utilized at 20°C and 25°C. The least number of hosts utilized at 20°C most likely indicated the inability of the parasite to contact the host.

Table 3. Number of eggs laid, at six host densities and five temperatures, on the hosts parasitized by *Bracon brevicornis* Wesm.

Host density (No. of hosts)	20° C mean	25° C mean	30° C mean	35° C mean	83° C mean
A(2)	9.416	5.666	10.750	13.500	9.750
B(4)	9.016	5.316	5.233	10.083	6.400
C(6)	7.016	3.450	4.716	7.833	7.016
D(8)	7.166	4.450	4.766	6.383	4.660
E(10)	6.430	3.933	2.933	4.666	4.083
F(12)	4.383	1.933	3.050	5.310	3.716

DOI: 10.21248/contrib.entomol.10.7-8.872-885

The data obtained on the distribution of progeny on the hosts utilized are given in table 3 and the average effect of temperature and host density on the distribution of the progeny by the parasite are given in table 3 (a).

Table 3(a). Average effect of temperature and host density on distribution of progeny by *Bracon brevicornis* Wesm.

Host density		Temperature	
Treatment	Average eggs per host	Treatment	Average eggs per host
A(2)	9.816	20° C	7.283
B(4)	7.209	25° C	4.125
C(6)	6.016	30° C	5.241
D(8)	5.485	35 °C	7.971
E(10)	4.409	38° C	5.937
F(12)	3.678	—	—

Statistical Analysis

Source of Error	D. F	SS	MSS	'F' ration	value of 'F'	
					5%	1%
Temperature	4	340.76	85.190	8.200**	2.43	3.45
Host density	20	724.24	144.850	13.948**	2.27	3.14
Host density × temp.	20	165.90	8.300	0.8	—	—
Error	150	1557.88	10.385	—	—	—
Total	179	2788.78	—	—	—	—

SEm for Temp. = ± 0.537
CD at 1% = 1.981
SEm host density = ± 0.588
CD ta 1% = 2.169

When a female was supplied with two hosts the number of eggs laid on each host parasitized was significantly more as compared to other densities. There was no significant difference in the number of eggs per host when 4, 6 or 8; 6, 8 or 10; and 8, 10 or 12 hosts were supplied.

At 35°C and 20°C significantly more eggs were laid on each host as compared to the number of eggs per host at 25°C and 30°C. There was no significant difference between the number of eggs laid on each host at 20°C and 38°C.

Series II.

In this series the absolute number of hosts given to a female parasite for parasitization was kept constant at 15 and the density of the host was varied by changing the area of the experimental cages. Five different densities obtained were 0.185, 0.24, 0.33, 0.47 and 0.74 hosts per square centimeter.

DOI: 10.21248/contrib.entomol.10.7-8.872-885

In these experiments also the female parasite was able to paralyse almost all the host given for parasitization. However, at the lowest host density (0.185 hosts per square centimeter) the parasite left the maximum number of hosts unparalysed at 20° C and 38° C. This indicates that at these two temperatures the ability of the parasite to contact its host is impaired a little.

The average number of eggs laid by a single female is shown in table 4 and the average effect of temperature and host density on the oviposition of the parasite is given in table 4 (a).

Table 4. Number of eggs laid, at five temperatures and five host densities, by a single female of *Bracon brevicornis* WESM.

Host density larvae/sq. cm	20° C mean	25° C mean	30° C mean	35° C mean	38° C mean
D_1 (0,185)	6.33	14.50	16.50	23.00	15.33
D_2 (0.24)	9.33	14.83	15.83	17.50	11.50
D_3 (0.33)	8.83	14.00	16,66	15.66	12.66
D_4 (0.47)	10.16	21.16	24.00	16.33	10.00
D_5 (0.74)	13.16	11.83	11.16	18.16	10.00

Table 4. (a) Average effect of temperature and host density on the oviposition of *Bracon brevicornis* WESM.

Host density		Temperature	
Treatment	Av. no. of eggs laid	Treatment	Av. no. of eggs laid
D_1	15.132	20 °C	9.562
D_2	13.798	25 °C	15.264
D_3	13.562	30 °C	16.830
D_4	16.330	35 °C	18.130
D_5	12.862	38 °C	11.898

Statistical Analysis

Source of Error	D.F	SS	MSS	'F' ratio	Value of 'F'	
					5%	1%
Temperature	4	1506.09	376.52	12.71**	2.44	3.47
Host density	4	229.98	57.47	1.94	2.44	3.47
Host density × temp.	16	436.84	27.30	0.92	—	—
Error	125	3702.84	29.62	—	—	—
Total	149	5875.66	—	—	—	—

SEm Temp. = ± 0.314
CD at 1% = 1.161

DOI: 10.21248/contrib.entomol.10.7-8.872-885

As in the first series, here also, host density did not show any effect on the oviposition of the parasite.

Temperature showed significant effect on the egg laying capacity of the parasite. At all the temperatures significantly more eggs were laid in relation to one an other, the maximum was laid at 35°C.

Again no combined effect of temperature and host density was observed on the oviposition of the parasite. Each effects the egg laying independently of the other.

Table 5 shows the percentage of the hosts utilized for oviposition at each density and temperature. The average effect of temperature and host density of the parasite to utilize the paralysed hosts is given in table 5 (a).

Table 5. Percentage of hosts utilized for oviposition by *Bracon brevicornis* WESM. at various host densities and temperatures

Host density larvae /sq. cm.	20°C	25°C	30°C	35°C	38°C
D_1 (0,185)	11.1	21.1	23.3	30.0	22.2
D_2 (0.24)	16.6	21.1	20.0	31.1	24.1
D_3 (0.33)	12.2	24.4	27.7	28.8	21.1
D_4 (0.47)	10.0	30.0	28.8	28.8	14.4
D_5 (0.74)	22.2	23.3	24.4	25.5	20.0

Table 5(a). Average effect of temperature and host density on host utilization by *Bracon brevicornis* WESM.

Host density		Temperature	
Treatment	% hosts utilized	Treatment	% hosts utilized
D_1	21.54	20 °C	14.42
D_2	22.64	25 °C	23.98
D_3	22.84	30 °C	24.84
D_4	22.40	35 °C	28.84
D_5	23.08	38 °C	20.42

Statistical Analysis

Source of Error	D.F	SS	MSS	'F' ratio	value of 'F' 5%	value of 'F' 1%
Temperature	4	587.370	146.840	8.68**	3.01	4.77
Host density	4	7.016	1.754	—	—	—
Error	16	270.580	16.910	—	—	—
Total	24	864.966	—	—	—	—

SEm Temp. = ± 1.83
CD at 1% = 7.588

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Host density had no significant effect on the number of hosts utilized by the parasite. Thus the distribution of the host population in space (where the area was within the search of the parasite) had no effect on its utilization.

Temperature showed significant effect on host utilization. The number of hosts utilized at various temperatures had the same trend as the oviposition at various temperatures. There was no significant difference between the percentage of hosts utilized at 35°, 30° and 25°C; 30°, 25° and 38°C; and 38° & 20°C.

Table 6 and 6 (a) show the effects of temperature and host density on the distribution of the progeny by the parasite.

Table 6. Number of eggs laid, at five host densities and five temperatures, on the hosts parasitized by *Bracon brevicornis* Wesm.

Host density hosts/sq. cm.	20° C mean	25° C mean	30° C mean	35° C mean	38° C mean
D^1 (0.185)	4.350	4.366	6.750	5.716	4.666
D^2 (0.24)	3.566	4.816	5.685	3.933	3.050
D^3 (0.33)	6.016	4.016	4.233	3.800	4.350
D^4 (0.47)	7.666	4.783	5.616	4.333	5.316
D^5 (0.74)	3.933	3.350	2.800	4.850	4.000

Table 6(a). Average effect of temperature and host density on the distribution of progeny by *Bracon brevicornis* Wesm.

Host density		Temperature	
Treatment	Av. eggs per host	Treatment	Av. eggs. per host
D_1	5.169	20 °C	5.105
D_2	4.210	25 °C	4.266
D_3	4.483	30 °C	5.017
D_4	5,543	35 °C	4.526
D_5	3.785	38 °C	4.276

Statistical Analysis

Source of Error	D.F	SS	MSS	'F' ratio	Value of 'F'	
					5%	1%
Temperature	4	19.32	4.83	0.84	2.54	3.47
Host density	4	61.04	15.26	2.65*	2.44	3.47
Host density × temp.	16	105.63	6.60	1.15	1.72	2.15
Error	125	718.19	5.75	—	—	—
Total	149	904.18	—	—	—	—

* Significant at 5% SEm host density = ± 0.438 CD at 5% = 1.226

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Host density affected the distribution of progeny to some extent. The larger number of eggs per host at D_1 could either be due to the impairment of the faculty of distribution of eggs or at both the treatments D_1 and D_4 it was because of the general variability in the oviposition behaviour of the parasite.

Temperature in this case did not show any effect on the distribution of progeny by the parasite.

Discussion

It is evident from the results that the egg laying capacity in this parasite, in a unit time under the conditions of the experiments, is not controlled by scarcity or abundance of the host but by the physiological conditions of the parasite. In both the series of experiments the statistical analysis does not show significant difference in the number of eggs laid at various host densities. The obvious conclusion is that the female parasite lays more or less a constant number of eggs during the given time period under the conditions of the experiment. But a study of the table 1(a) indicates that there is a regular trend. Though the results are not statistically significant, but there is a general decline in the number of eggs laid from the lower to the higher densities. It seems the explanation offered by ULLYETT (1945) in the case of *Microbracon hebetor* SAY could very well be applied to this case also. He concluded from his observations that the parasite first searched the whole environment to paralyse all the hosts present in the environment and then oviposited upon them. He further stated that at high host densities much time was spent in search and paralysation of the hosts, but at low densities greater time was utilized for oviposition.

In the second series, except at D_4, there is again a general decline in the number of eggs laid from lower to higher densities. Two explanations can be feasible for this. As the hosts are spread over a larger area the parasite probably discountinues its search for host only when it is satisfied that there are no more hosts to be paralysed and then starts ovipositing. At the higher densities when the area of search is small its instinct to paralyse all the hosts in the area is stronger and thus a larger part of the time available is spent in this process than in egg lying. It is also possible that the greater number of eggs at D_1 and D_4 is because of the great variation in the oviposition of the parasite.

It is clear that the absolute number of hosts in the environment and not the host densities affects the utilization of host by the parasite. In the second series no significant difference is obtained in the number of hosts utilized. This is also a result of physiological needs, during the given time period. When the potential number of hosts available is greater than the needs of the parasites, no further rise in utilization is observed. The optimum number in the present case seems from 10 to 15.

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When the number of hosts in the environment is 12 or more there is no significant difference between the number of eggs laid on the hosts utilized. In the treatments of the second series the difference is barely significant (at 5% level). So when the potential number of hosts is beyond the needs of the parasite the egg distribution tends to be more or less uniform. In series I the largest number of eggs is laid on a single host in the experiment where only two hosts are supplied to the parasite and as the number of hosts increases the difference between the average number of eggs laid on each host at various treatments tends to be non-significant. This shows that the parasite can not restrain itself from egg laying and the urge for egg deposition is so great that the whole quota of eggs maturing within 24 hours is deposited on the hosts available.

In case of *Bracon brevicornis* a good number of parasitic larvae can develop on a single host, though the resulting progeny will be much smaller than the normal one. Thus the parasite offsets the results of the scarcity of the host to the next generation. This behaviour of the parasite at low host densities is an important factor in maintaining a balance between host and the parasite populations. "Without such a compensating factor the host population would be destroyed very rapidly, involving in turn a corresponding destruction of the parasite" (ULLYETT, 1945).

In this particular case it is evident that the total daily egg production and hence the increase in parasite population per unit time, is therefore limited by the habits and functional adaptations of the species. From the study of literature, on the work done, it seems that by observing the ovipositional behaviour of various parasites it might become possible to put them into various catagories eg., the parasites in which there is a constant number of eggs maturing during a given time period; others in which there is a regular maturing of ova during the life time of the parasite (cf. ULLYETT, 1945, 1949 and 1949; b). There are other parasites which have got the ability to reabsorb the ova if there are no hosts available or the number of hosts is scarce (FLANDERS, 1950). Thus the physiological conditions of a parasite regulate the oviposition responses and uncrease in population in relation to host density.

To study discrimination exercised in egg laying behaviour of the parasite the data obtained on the distribution of progeny are tabulated as regards frequency of distribution of the eggs. Table 7 and 8 show that, except where two hosts are supplied to a single female, the mode is constant throughout at 2—3 eggs. In treatment D_2 in the series II though it is at 4—5 eggs per host, but for all practical purposes it cannot be reckoned as a deviation much off the point. It is seen that when the number of hosts supplied is 10 or more, less and less number of hosts fall in the groups other than the neighbouring groups of the mode. Thus for all practical purposes the parasite does show a restraining faculty for the best distribution, and hence the survival of the progeny.

DOI: 10.21248/contrib.entomol.10.7-8.872-885

Table 7. Frequency distribution of eggs by *Bracon brevicornis* Wesm.
Series I

No. of eggs per host	Number of hosts					
	A(2)	B(4)	C(6)	D(8)	E(10)	F(12)
0	9	41	99	151	196	255
1	5	6	6	9	12	19
2—3	5	21	19	21	37	34
4—5	3	15	17	18	22	25
6—7	9	11	10	17	11	9
8—9	8	8	8	10	7	4
10—11	5	5	9	7	3	5
12—13	2	1	4	3	3	1
14—15	6	4	2	1	1	1
16—17	4	3	—	—	—	—
18—19	2	—	—	—	—	—
20—21	—	—	1	—	—	—
22—23	—	1	—	—	—	—
24—25	—	—	—	—	—	—
26—27	—	1	—	—	—	—
28—29	—	—	—	—	—	—
30—31	—	—	—	—	—	—
32—33	2	—	—	—	—	—

Table 8. Series II

No. of eggs host	Density of host per sq. cm.				
	0.185	0.24	0.33	0.47	0.74
	Number of host				
0	300	326	324	329	331
1	18	26	11	16	25
2— 3	25	23	42	29	33
4— 5	24	29	27	27	24
6— 7	12	12	14	14	13
8— 9	10	5	6	9	4
10—11	3	5	3	5	4
12—13	2	—	—	4	1
14—15	—	1	—	2	—
16—17	2	—	—	1	—
18—19	—	1	—	—	—
20—21	1	—	—	—	—

From the results it is postulated that the number of hosts to be given for parasitization to a single female, to obtain best results in rearing, is from 10—15 in the environments selected. But when more females are put in a rearing cage the host per parasite ratio is bound to play a part and further studies on parasite density and host parasite ratio would give a complete picture.

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The studies on temperature show that the parasite does lay a maximum number of eggs at 35° C, but at this temperature, if the frequency tables be a guide, the faculty to distribute the progeny in the best possible way is impaired (table 3 (a)). The investigations at this Institute on the fecundity and longevity of the parasite (unpublished) have shown that the best progeny is obtained when only 4 parasite grubs develop on a single host. At lower temperatures also this behaviour of the parasite is impaired.

Acknowledgement

We are greatful to Dr. E. S. Narayanan, Head of the Division of Entomology, for providing the facilities and his keen interest in this piece of research.

Summary

1. Host density had no significant effect on oviposition of the parasite and it laid more or less a constant number of eggs under the conditions of the experiments and in the given time period.

2. Host utilization did not depend upon the density of the host but upon absolute number of hosts available to the parasite in a given universe (this being within the limits of its search).

3. A female parasite distributed its progeny to the very best advantage when the number of hosts in the environment was 10—15.

4. The efficiency for distribution of the progeny to the best advantage upon the hosts available was impaired and greater super-parasitism occurred when the host number supplied was very low.

5. The physiological conditions of the parasite and not the host density controlled the rate of increase of the parasite per unit of time.

6. At 35° C maximum number of eggs was laid by the parasite but the faculty to distribute them efficiently was impaired.

7. 25—30° C was the optimum temperature for best distribution of the progeny.

Zusammenfassung

1. Die Wirtsdichte hatte keinen wesentlichen Einfluß auf die Eiablage des Parasiten. Es wurden unter experimentellen Bedingungen im gegebenen Zeitraum mehr oder weniger konstante Mengen von Eiern abgelegt.
2. Die Annahme des Wirtes zeigte keine Abhängigkeit von der Wirtsdichte, wohl aber von der absoluten Zahl der dem Parasiten innerhalb seines Suchbereiches zugänglichen Wirte.
3. Ein weiblicher Parasit verteilte seine Nachkommenschaft mit dem besten Erfolg, wenn die Anzahl der Wirte in seiner Umgebung etwa 10—15 betrug.
4. Der Nutzeffekt einer möglichst günstigen Verteilung der Nachkommenschaft wurde verringert und mehr Fälle von Superparasitismus traten auf, wenn die Anzahl der verfügbaren Wirte sehr niedrig war.
5. Die physiologischen Bedingungen, denen der Parasit unterworfen war, und nicht die Wirtsdichte regelten die Vermehrungsrate des Parasiten pro Zeiteinheit.
6. Bei 35° C war die Zahl der vom Parasiten abgelegten Eier zwar am größten, ihre erfolgreiche Unterbringung jedoch beeinträchtigt.
7. Bei 25—30° C liegt die optimale Temperatur für die beste Verteilung der Nachkommenschaft.

DOI: 10.21248/contrib.entomol.10.7-8.872-885

Резюме

1. Плотность рассеяния хозяев не оказало существенного влияния на откладку яиц паразитом. В экспериментальных условиях в данный период откладывалось более или менее константное количество яиц.
2. Прием хозяина не зависел от плотности расселения хозяев, а от абсолютного числа доступных паразиту хозяев.
3. Паразитирующая самка распределяла свое потомство с наилучшим успехом, если количество доступных ей хозяев в ее окрестности составляло 10—15.
4. Эффективность максимально благоприятного распределения потомства уменьшилась и случаи суперпаразитизма встречались чаще, когда количество доступных хозаев было очень низкое.
5. Не плотность расселения хозяев регулировала размножение паразита в единицу времени, а физиологические условия, которым был подвергнут паразит.
6. Хотя при 35° C количество яиц, отложенных паразитом, было самое большое, успешное размножение их было затруднено.
7. Оптимальной для наилучшего распределения потомства оказалась температура 25—30° C.

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*) From summary, as original was not available.

DOI: 10.21248/contrib.entomol.10.7-8.872-885