Original Research Article

COMPARATIVE LIFE TABLE OF *APHIS CRACCIVORA* (HEM.: APHIDIDAE) ON BLACKGRAM UNDER LABORATORY CONDITIONS

Abstract

The blackgram aphid, *Aphis craccivora* Koch, is an important pest of *Robinia pseudoacacia* Frisia. The life table parameters of *A. craccivora* were determined under laboratory conduction. The results revealed that in blackgram, the net reproductive rate (17.23 individuals/female), mean generation time (11.73 days) and doubling time (2.868/days) were higher at 30^0 C and lower at 35^0C *viz.,* 11.10, 9.68 and 2.787 respectively. The intrinsic rate of increase (0.249 day) and finite rate of increase (1.282 day) was maximum in 30^0C and minimum in 35^0C *viz.,* 0.242 and 1.273 days respectively in blackgram.

Keywords: *Aphis craccivora*, generation time, intrinsic rate of increase, life table parameters, natural condition

Introduction

Climate change has been recognized globally as the most impending and pressing critical issue affecting mankind and his survival in the 21st century. The last assessment report from the Intergovernmental Panel on Climate Change predicted an increment in mean temperature from 1.10 – 6.40 °C by 2100 AD (IPCC, 2007). Comparing the life table parameters is the most suitable method to study the effect of host plant on insect fitness. Many researchers use demographic parameters for this purpose. Ulusoy and Olmez-Bayhan (2006) studied the performance of cabbage aphid, *B. brassicae* on six different host plants (broccoli, cabbage, mustard, caulifower, turnip, and rapeseed).With this background, the proposed study focuses on the comparative life table of *Aphis craccivora* on blackgram in different temperature condition.

Material and Methods:

Life table studies of cowpea aphid, *Aphis craccivora* Koch. in blackgram

The source of *A.craccivora* colonies were derived from field collected individuals, established and maintained on black gram (VBN 6) and cowpea seedlings (VBN 2) planted in mud pot in insectary at Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai during November 2017. One plant representing each cultivar *viz.,* black gram (VBN 6) variety was sown in polythene plastic pot (9 cm in diameter, 8 cm deep) contained soil composed of clay-loam, sand, coir pith under in the BOD chamber conditions under two

temperature regime of 30 ^{0} C and 35^0 C and relative humidity 60 % respectively throughout the life cycle study. First instar nymphs of aphids were transferred to Petri dishes (15 cm diameter) containing black gram as well as cowpea leaf discs (14 cm diameter) and 1% agar solution. The leaf discs originated from pesticide-free plants that had been cultivated hydroponically. Prior to experimentation, leaf material was disinfected with 1% sodium hypochlorite solution for 5 min, washed with tap water and finally rinsed with distilled water for 10 min. This were done to guarantee the quality of the black gram leaves, which were very sensitive to water loss. Petri dishes placed in BOD incubator adjusted to 30^0 C and 35 ^{0} C.
The experiment designs were used completed randomized block design with 12 replication. Using a camel hair brush, cohorts of 12 first-instar nymphs were individually placed on individual blackgram as well as cowpea plants. Cowpea cultivar leaf disc was replaced daily. Also, observation on moulting, number of progeny and mortality were recorded daily. Generation of pre-adapted adult female aphids. Individual females of each aphid species were transferred to separate Petri dishes (10 cm diameter) containing a blackgram leaf disc and 1% agar solution. The dishes were kept at 30^{o}C and 35^{0}C; 70 ± 10% relative humidity for 6 h, after that the females and all the nymphs, except for one per dish, were removed. The dishes were then incubated in BOD chambers at 30^{o}C and 35^0 C at 70 ± 10% relative humidity and 12 h photophase until they developed into adult aphids, the females of which were then used in the fertility study.

A simple random sampling design was used, which included two temperature variables (30 and 35^o C) and, respectively, 12 repetitions for *A.craccivora.* Female adult aphids were incubated at the appropriate temperature in dishes containing leaf discs, maintained under a 12 h photophase, and were transferred to new dishes when necessary. The pre-reproductive and reproductive periods were evaluated under a stereomicroscope every 24h, and the number of nymphs produced and their longevities were determined at each temperature. Survivorship curve was created by plotting l_x on the *y*-axis and age on the *x*-axis in life table. The *y*-axis is usually logarithmic, i.e., $\log_{10}$ (l_x), to allow comparisons among different studies and species. In other words, log transformations standardize the survivorship curve (Begon*et al*., 1996). The population growth was estimated from the fertility life table using the parameters net reproductive rate (R_0), intrinsic rate of increase (r_m), mean generation (T), doubling time (DT) and finite rate of increase (λ). The data from the field were analyzed in a simple Randomized Block Design by 'F' test for significance as described by Panse and Sukhatme (1958).

Results and Discussion

In blackgram, the net reproductive rate (17.23 individuals/female), mean generation time (11.73 days) and doubling time (2.868/days) were higher at 30^0 C and lower at 35^0C *viz.*, 11.10, 9.68 and 2.787 respectively. The intrinsic rate of increase (0.249 day) and finite rate of increase (1.282 day) was maximum in 30^0C and minimum in 35^0C *viz.*, 0.242 and 1.273 days respectively in blackgram. These findings are comparable with James and Kaihong (1999) who reported the developmental periods of immature stages of citrus aphid, *Toxopter citricida* ranged from 63.1 d at 8^oC to 5.5 d at 30^oC. The lower developmental threshold for the brown citrus aphid immature was estimated at 6.27^oC. The upper temperature threshold of 31.17^oC for development of nymph was determined from a nonlinear biophysical model. The percentage of survivorship of immature stages varied from 81 to 97 % within the temperature range of 8-30^oC. However, survivorship was reduced to 29 % at 32^oC. The average longevity of adult females ranged from 60.0 d at 10^oC to 6.5d at 32^oC. The average progeny per female was 52.5 at 20^oC and 7.5 at 32^oC. The largest intrinsic rate of increase (Per capita rate of population growth) r_m (0.3765) occurred at 28^oC. Populations reared at 10 and 32^oC had the smallest intrinsic rate of increase (r_m) values of 0.0588 and 0.0960, respectively. The mean generation time of the population ranged from 51 d at 10^oC to 8 d at 32^oC. The optimal range of temperature for population growth was 20 to 30^0C.

Reference

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Table 1. Age specific life table of *Aphis craccivora* Koch.onblackgram (cv.VBN 6) at two temperature regimes

Age (Days)(x)	Survival no.		Survivorshipl_x		dn_x		mn_x		No. of off springsm_x		l_xm_x		xl_xm_x		e^ -rcx	
	30°C	35°C	30°C	35°C	30°C	35°C	30°C	35°C	30°C	35°C	30°C	35°C	30°C	35°C	30°C	35°C
0	30	30	1.00	1.00	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
1	30	30	1.00	1.00	2	3	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.75
2	28	27	0.93	0.90	4	6	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.56
3	24	21	0.80	0.70	2	2	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.42
4	22	19	0.73	0.63	1	3	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.31
5	21	16	0.70	0.53	8	3	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.23
6	13	13	0.43	0.43	2	3	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.17
7	11	10	0.37	0.33	1	1	121	111	11.00	11.10	4.03	3.70	28.23	25.90	0.10	0.13
8	10	9	0.33	0.30	2	2	125	116	12.50	12.89	4.17	3.87	33.33	30.93	0.07	0.10
9	8	7	0.27	0.23	2	3	137	45	17.13	6.43	4.57	1.50	41.10	13.50	0.05	0.07
10	6	4	0.20	0.13	1	3	78	34	13.00	8.50	2.60	1.13	26.00	11.33	0.04	0.05
11	5	1	0.17	0.03	0	0	56	27	11.20	27.00	1.87	0.90	20.53	9.90	0.03	0.04
Total							**517**	**333**	**64.83**	**65.92**	**17.23**	**11.10**	**149.20**	**91.57**		

x = Age of the insects in days; **lx** = Number surviving at the beginning of each interval, out of 30; **dnx** = Number dying during the age interval, out of 30; **qx** = Mortality rate at the age interval x; **mx** = eggs produced per surviving individual at each stage; **lxmx** = eggs produced per original individual at each stage.

Table 2. Life history parameters of *Aphis craccivora* Koch.on blackgram (cv. VBN 6) at two temperature regimes

Parameters	Values*	
	30^0 C	**35^0 C**
Age of first oviposition (days)	7	7
Age of 50% mortality (days)	6	7
Age of last oviposition (days)	11	11
ɛngth of oviposition (days)	5	4
Net Reproductive Rate(R_0)(No. of individuals/female)	17.23	11.10
Intrinsicrate of natural increase(r_m) (day^{-1})	0.242	0.249
Finite rate of increase(λ) (day^{-1})	1.273	1.282
Mean generation time(T) (days)	11.73	9.68
Doubling time(t) (days)	2.868	2.787

*****Unreplicated

Table 3. Logistic relationship between age and probabilities of survival of *Aphis craccivora* Koch. on blackgram (cv.VBN 6) at two temperature regimes

Sl.No.	Temperature ^oC	'a'(50% mortality/days)	'b'(Intercept)	R^2value
1	30	6	1.253	0.858
2	35	7	1.232	0.907