Academic Journal of Entomology 3 (2): 65-68, 2010
ISSN 1995-8994

Effect of Temperature and Prey Abundance on Mass Rearing of Spider *Lycosa pseudoannulata* (Boesenberg and Strand), Araneae, Lycosidae under Laboratory Condition

C.R. Satpathi

Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya,
P.O. Mohanpur, Dist, Nadia, West Bengal, India, 741252

Abstract: Quantitative relationship between the temperature and the speed of development of the eggs of a spider *Lycosa pseudoannulata* (Boesenberg and Strand) showed that the maturity of egg increased as the temperature raised up to 28°C. Above this temperature the speed of development decreasedrapidly as the temperature rises up to 36°C. Beside this the mortality of spiders varied inversely with feeding rate but few individuals matured at specific feeding schedule. The characteristics of growth of spider as related to food quantity revealed that at least one rice moth, *Corcyra cephalonica* Staint every second day or one mosquito *Aedes aegypti* (L) per day would be required in early instars (I, II, III) and four rice moths *C. cephalonica* or five mosquito as *A. aegypti* in the latter instars (IVth and Vth). A linear relationship was also found between the number of prey consumed per individual and the percent of spider survived to adulthood.

Key words:

INTRODUCTION

Wolf spider *Lycosa pseudoannulata* (Boesenberg and Strand) is an important predator of rice insects. They colonize in fields early and prey on pests before the latter increase to damaging levels. They do not make any webs, but attack their prey directly. Adult feed on a range of insect pests including stem borer moths of rice. Spiderlings also attack plant hopper and leaf hopper nymphs in the rice field [1]. As wolf spider is a predator, it can be effectively used as biological control agent. Sometimes the demand is so sudden and large that there is a wide gap between the predator and prey incidence in the field. The present paper reports on the factors affecting on artificial rearing of wolf spider *Lycosa pseudoannulata* (Boesenberg and Strand) under the laboratory condition.

MATERIALS AND METHODS

The eggs were laid by the mother of *Lycosa pseudoannulata* (Boesenberg and Strand) which were reared in two plastic containers with sufficient food of mosquito and ricemoth adult separately at a constant temperature 20°C and then transferred to 14 different temperatures 17.5 to 36°C within half an hour of being laid. The duration of egg stage was determined by hour. The quantitative relationship between the temperature and speed of development of eggs of *Lycosa pseudoannulata* (Boesenberg and Strand) were studied in the laboratory at Regional Research Station, Kalimpong and Chakdaha under Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India.

The following equation was used for calculating the relation between temperature and speed of development of the spider as follows [2].

$$1/Y = K/(1 + e^{a-bx})$$

Where 1/Y represent the reciprocal of the time required for the complete development to be achieved at a given temperature 'x', 'a', 'k' and 'b' are constants, 'k' defines the upper asymptote towards which the curve is tending, 'b' defines the slope of curve and 'a' relative to 'b' fixes its position along 'x' axis.

To study the effect of prey abundance on mass rearing of spider single spiderling was placed in test tubes providing them with (i) rice moth (*Corcyra cephalonica* Staint) adult and (ii) mosquito, *Aedes aegypti* (L.) adult kept under six different groups of

Corresponding Author: C.R. Satpathi, Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, P.O. Mohanpur, Dist. – Nadia, West Bengal, India - 741252. E-mail: csatpathi2003@yahoo.co.in.

10 spiders each and designated as series A, B, C, D, E, F, G and H as mentioned in Table 2 and 3. Spiderling starts to feed within 24 hours of emergence from egg sac. The prey insects were reared in the laboratory and placed alive in test tube with spider at 25°C temperature and 60% relative humidity. Preys were also supplied to the various groups according to the schedule described in Table 2.

RESULTS AND DISCUSSION

The data in Table 1 showed that speed of development of eggs increased as the temperature raised about 28°C. Above this temperature, the speed of development decreased rapidly as the temperature raised up to about 36°C. The 6 observed values for percent development per day at temperature ranging from 21.5 to 26°C are mostly identical to the calculated value. The difference between the observed and calculated values shows that deviations of any of the points from calculated value does not exceed 4.57% of the appropriate calculated value. The greatest 0.0010 at 24°C, it is 0.25% of the calculated value. The root mean square deviation between the observed and calculated values Σ√(observed-calculated) is 0.00814 which is 2.15 times of calculated value at 24°C. The effect of temperature on hatching of spider egg was studied by Dondle [3], who found that there were two peaks in numbers of active spiders annually, a small one in the spring and a much larger in late summer. The late-summer peak appeared very late in August or early September in Ottawa, Canada, which resulted from hatching of eggs of the majority of species. The autumnal decline was associated with the movement of spider to over winter nitches. Weese [4], Elliott [5], Vite [6] suggested that this may be the normal trend in arboreal spiders in the North temperate zone of Canada. The spring peak appeared during June and was attributed mainly to an influx of spiders from over wintering niches on tree trunks and on the ground. A small amount of this increase was attributed to the hatching of eggs of a few minor species that over winter in this stage. Turnbull [7] reported that immature stage of *Lycosa* reached greatest abundance for a short period in July, just after peak of egg hatch in Wytham wood, Berks, England. Adults of *L. pullata* (Cl.), *L. lugubris* were very conspicuous in ground zone in the spring, when females were observed sunning their egg sacs on exposed surface.

Table 1: The development of eggs of *Lycosa pseudoannulata* (Boesenberg and Stand) in relation to temperature

Tempe-rature (^{0}C) (A)	Observed time in hour (B)	Percent develop-ment per day (D)	Calcu-lated value of time/hour (E)	Calcu-lated value of percent develop-ment / day (F)	Observed-calcu-lated times (B-E)	Observed calculated value of%. develop-ment
17.50	504.00	0.1984				
19.50	336.00	0.2976				
20.00	284.50	0.3514	269.57	0.3709	+ 14.93	-0.0195
21.0	274.10	0.3648	281.17	0.3729	+5.98	-0.00821
21.5	268.00	0.3731	267.40	0.3740	+0.60	-0.0009
22.0	266.48	0.3752	266.68	0.3750	-0.20	-0.0002
23.0	265.00	0.3773	263.84	0.3790	+1.16	-0.0017
23.5	264.54	0.3780	264.54	0.3780	-	-
24.0	263.12	0.3800	263.84	0.3790	-0.72	+0.0010
26.0	262.00	0.3816	261.04	0.3831	+0.96	-0.0015
28.0	261.00	0.3831	258.30	0.3871	+2.70	-0.0040
30.0	263.00	0.3800	255.60	0.3912	+7.50	-0.0112
32.0	264.00	0.3781	252.94	0.3954	+11.49	-0.0173
36.0	268.12	0.3729	-	-	-	-

Table 2: Mortality of *Lycosa pseudoannulata* (Boesenberg and Strand) supplied rice moth (*Corcyra cephalonica* Staint) as per schedule at 25^{0}C temperature and 60 to 70% relative humidity

		Percent mortality at different instars					
Series	Feeding Schedule (Average number / day) Y = a + bX	I	II	III	IV	V	% survived to adulthood
A	One rice moth per 3 days (Average 0.33/day)	50	65	65	70	65	2.0
B	One rice moth per 2 days (Average 0.50/day)	30	30	60	70	65	3.0
C	One rice moth per day (Average 1.0 / day)	30	20	25	30	35	20.0
D	Two rice moths per day (Average 2.0/day)	35	20	25	15	30	25.0
E	Three rice moths per day (Average 3.0/day)	30	25	25	15	30	20.0
F	Four rice moths per day (Average 4.0 / day)	30	20	10	5	5	45.0
G	Five rice moths per day (Average 5.0 / day)	30	25	10	5	5	42.0
H	Ten rice moths per day (Average 10.0 / day)	35	20	15	8	8	40.0

Table 3: Mortality of *Lycosa pseudoannulata* (Boesenberg and Strand) supplied with mosquito

		Percent mortality at different instars					
Series	Feeding Schedule	I	II	III	IV	V	% survived to adulthood
A	One mosquito per 3 days (Average 0.33 day)	55	60	75	100	-	-
B	One mosquito per 2 days (Average 0.50 days)	35	50	45	70	65	2.00
C	One mosquito per 3 days (Average 1.0 / day)	20	25	20	30	30	25.00
D	Two mosquitoes per days (Average 2.0 / day	20	20	15	30	20	30.00
E	Three mosquitoes per day (Average 3.0 / day)	20	20	10	30	20	32.00
F	Four mosquitoes per day (Average 4.0 / day)	25	20	10	25	20	30.00
G	Five mosquitoes per day (Average 5.0/day)	20	20	10	5	5	50.00
H	Ten mosquitoes per day (Average 10.00 / day	20	25	12	5	5	45.00

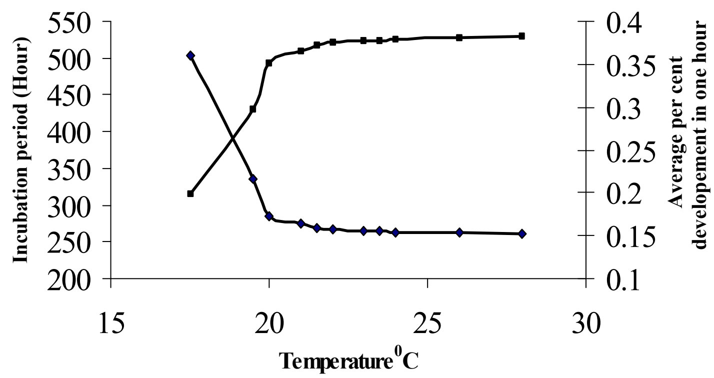

Fig. 1: Observed points on the temperature time curve (closed circle) and the temperature velocity curve (open circle) for the eggs of *Lycosa pseudoannulata* Boesenberg and Strand.

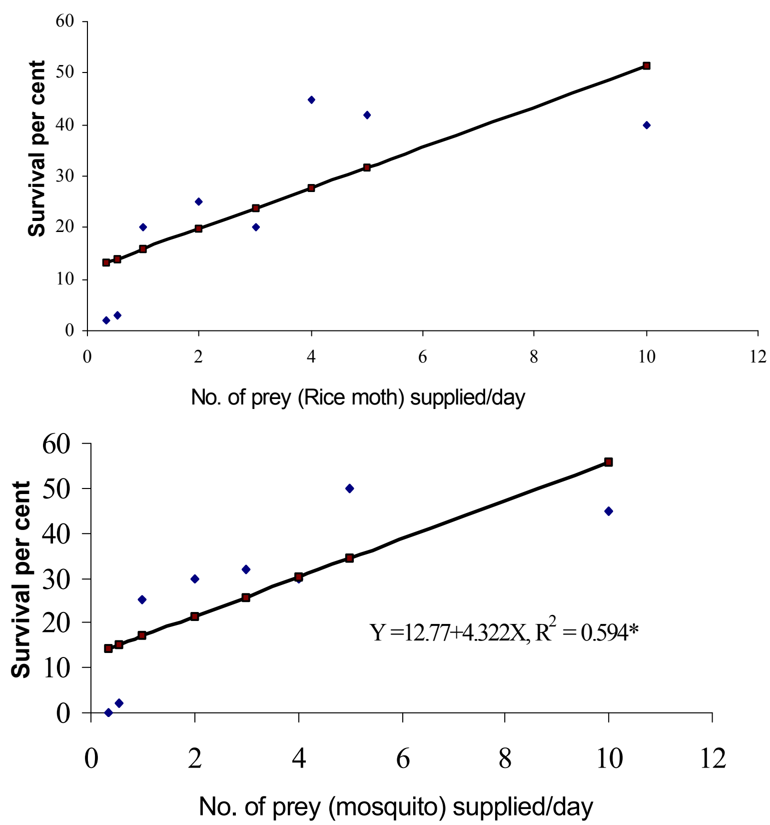

Fig. 2: Linear relationship between prey consumption and survival of spider

The observed data in Table 4.16 are presented graphically in Figure 1. The curve describes the trend of speed of development of eggs from the lowest temperature at which complete development to hatching occurs to the peak (27.5°C). The 11 observed value for present development per day, at temperature ranging from 21.5°C to 28°C are a good fit to the calculated curve.

The experiment was designed to assess the effect of the feeding on the survival of *L. pseudoannulata* (Boesenberg & Strand) in each of the instar as well as to determine the quantity required. To achieve this, the feeding schedules were selected such that the lowest amount would be inadequate for survival of the spider. It was determined that at least one rice moth *C cephalonica* every second day or one mosquito *A aegypti* per day in the latter (IV and Vth) instar (Table 2). Two to three per cent of the spider survived to adulthood on diet of one rice moth every second day and virtually 20 to 25% and 40 to 45% spider matured on minimum 1 to 4 rice moth per day respectively.The mature spiders were a provided with required food and subsequently allowed for mating with male for further multiplication in laboratory.

From Table 2 it was found that at the lowest feeding schedule (one rice moth/3 days) morality was high from the first instar onward. It was observed that rarely 2% of *L pseudoannulata* was able to survive on short rations. As diets were progressively increased to one rice moth every second instar but again it faced the shortage of food from third instar onward. When the diets were increased to 4.0 moths per day mortality decreased after 3rd instar. The spiders died when maximum food up to 10 moths per day was made available. The death probably resulted from the ill effects of the decaying of the moths not eaten by the spiders.

It is evident from table 3 that very few (2%) spider survived to adulthood on a diet of one mosquito every second day and virtually 25 to 30% as well as 45 to 50% spiders matured on a minimum of 2 and 5 mosquitoes per day respectively. Thus the minimum feeding rate required for survival in each instar can also be estimated from different levels of food.

At the lowest feeding schedule (one mosquito per 3 days) the spider survived to third instar but with the increase of diet up to one mosquito per day, maximum mortality appeared at 4th instar as given in table 4.16. As the feeding progressively increased, mortality decreased up to 5% until at the highest feeding rate (5 mosquitoes per day) only 5% spiders died in the 5th instar. The spider died when 10 mosquitoes per day was available.

In Fig. 2, for each of the immature stage, a regression line was fitted to plotted points. This relationship implied that as development proceeds from stage to stage the slopes of the regression lines decreased, indicating that the efficiency of food intake for development decreased as the spider mature.

ACKNOWLEDGEMENT

The author is grateful to the Director of Research, BCKV, West Bengal, India; for providing fund & other facilities to carry out the experiment.The author is also grateful to Dr Koushik Chakraborty for giving the constructive suggessiion to prepare the manuscript.

REFERENCES

1. Shepard, B.M., A.T. Barrion and J.A. Litsinger, 1987. Helpful Insects, Spiders and Pathogens IRRI, Philippines pp: 38-49.
2. Davidson, J., 1944. On the relationship between temperature and rate of development of insect at constant temperature, J. Anim. Ecol., 13: 26-38.
3. Dondale, C.D., 1958. Note on population densities of spiders (Araneae) in Nova Scotia apple orchards. Can: Ent., 90: 111-113.
4. Weese, A.O., 1924. Animal ecology of an Illinois elm-maple forest. Illinois Biol. Monogr., 9: 351-437.
5. Elliott, F.R., 1930. An ecological study of the spiders of the beech-maple forest. Ohio. J. Sci., 30: 1-22.
6. Vite, J.P., 1953. Utersuchungen iiber die Okologischeund forstliche Bedeutung der Spinner in walde Z.Angew. Ent., 34: 313-334.
7. Turnbull, A.L., 1960. The spider population of a stand of Oak (*Quercus robur* L.) in Wythan Wood Berks, England. The Canadian Entomologist, XCII (2): 111-124.