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INTRINSIC RATE OF INCREASE (r_m) OF *APHIS GOSSYPII* GLOVER INFESTING BRINJAL PLANTS

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Abstract

Context: Intrinsic rate of natural increase (r_m) of *Aphis gossypii* is important factor to know the actual increase of population which is governed by physical factors of environment.

Objectives: The aims of this study were to determine the intrinsic rate of natural increase (r_m) of *A. gossypii* which is the basic knowledge of IPM program.

Materials and Methods: The nymphal duration, pre-reproductive period, reproductive period, fecundity, longevity, etc. were observed within the glass chimneys. The newly born nymphs were considered as F_1 generations. Similarly, the first progeny of F_1 generation were released in other glass chimneys to have F_2 generation. In this way, F_3, F_4 and F_5 generations were obtained. Data for duration between birth of a nymph and its first laid progeny (d) and number of progeny (M_d) per female were recorded. Altogether data of 8 replications were considered for the calculation of intrinsic rate of natural increase (r_m) of *A. gossypii* infesting brinjal plants.

Results: Intrinsic rate of natural increase (r_m) value was highest (0.322 ± 0.005) for the F_1 generation, followed by F_2 (0.317 ± 0.003) and it was lowest (0.303 ± 0.002) for F_5 generation. Temperature influenced the r_m significantly ($r= 0.903$, $p<0.05$). Dew point also influenced the r_m of *A. gossypii* significantly (0.882 $P<0.05$). Relative humidity played insignificant role ($r= 0.428$) on the r_m of *A. gossypii*.

Conclusion: The results obtained in this study are essential to know the actual populations increase which important to pest control.

Key words: *Aphis gossypii*, brinjal, intrinsic rate of increase.

Introduction

Innate capacity for increase depends upon its fecundity, longevity, and speed of development and these are measured by the birth rate and survival rate in a population (Andrewartha and Birch 1954). The rate at which a population increases in size, *i.e*. the change in population size over a particular period of time is known as the intrinsic rate of increase (r_m), which is used in insect population biology to determine how environmental factors affect the rate at which pest populations increase (Jahn *et al.* 2005).

Leather and Dixon (1984) mentioned that irrespective of its size as an adult, an aphid that has achieved a high growth rate is likely to be able to maintain a high reproductive rate and a high rate of increase (r_m). It is extremely important to determine r_m for particular aphid species in a particular environment because the r_m value is different for various aphid population on separate host plants (Landin and Wennergren 1987). Intrinsic rate of increase are also affected by biotic factors such as different host plants, cultivars, plant quality and plant growth stage (Kerns *et al*. 1989).

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A number of researchers studied on the intrinsic rate of natural increase of aphids out of which few are: Mathew and Gregg (2004), Bayhan *et al*. (2006), Kuo *et al.* (2006), Zamani *et al.* (2006), Kumar *et al*. (2007) and Trine and Susanne (2007). In Bangladesh, a little work has been done on this aspect. From literature it is known that only Karim *et al.* (2001) worked on this aspect (r_m) on *Aphis gossypii*. Accordingly, for further information attempt was made to carry out experiment on this aspect.

Materials and Methods

Experimental design: Experiments were carried out at the research fields of the Institute of Biological Sciences, University of Rajshahi. Forty earthen tubs (40 cm height and 40 cm diameter) were prepared by soil and bio-fertilizer for planting healthy brinjal seedling (variety shingnath). Five tubs with plants were enclosed by fine nylon mosquito nets which served as experimental plants for the aphids. Adult *A. gossypii* (apterous) were collected from the nearest fields and were released on the experimental plants.

In order to record the data for life cycle of *A. gossypii* the methodology of Das and Chakrabarti (1985) was followed with some modifications. Special type of detachable platforms were made by the hard board and set below the twigs or leaves of the experimental plants. For each platform, tetrapods were made according to the required heights of the plants. Adhesive tapes were used to keep the twig / leaf on the centre of hard board. Glass chimneys were placed on the hardboard so that a micro-chamber around the twig/ leaf was created. The open top of each glass chimney was enclosed temporarily by a piece of fine cloth to protect from the entry of unwanted insects. Only one female *A. gossypii* was released in each chimney.

All the observations, *viz*. the nymphal duration, pre-reproductive period, reproductive period, fecundity, longevity, etc. were recorded from the aphids reared within the glass chimneys. Accordingly, to record the instarwise duration about 30 apterous females were kept within 30 glass chimneys. The experiments were repeated five times.

Calculation of intrinsic rate of natural increase (r_m): Wyatt and White (1977) postulated an equation for the calculation of intrinsic rate of natural increase (r_m) for aphids. In the present study r_m was calculated according to the equation: $r_m = c(\log_e M_d)/d$, where, c = correcting constant, d = duration between birth of a nymph, and its first laid progeny, M_d =number of progeny produced in an equal time. The numbers of progeny (M_d) were considered until the parent aphids were 2 days old. Correcting constant (c) is 0.735 (Wyatt and White 1977). Altogether data of 8 replications were considered for the calculation of intrinsic rate of natural increase (r_m) of *A. gossypii* infesting brinjal plants.Temperature, relative humidity and dew point were recorded regularly from the Meteorology Station, Rajshahi.

Results

The mean r_m of *A. gossypii* for five generations on brinjal plants along with physical factors of the environment, *i.e*., temperature, relative humidity and dew point are shown in Fig. 1. From Fig. 1, it may be observed that r_m value is highest (0.322 ± 0.005) for the F_1 generation, followed by F_2 (0.317 ± 0.003) and it is lowest (0.303 ± 0.003) for F_5 generation. In order to examine the impact (if any) of physical factors of the environment, *i.e*., temperature, relative humidity and dew point on r_m *of A. gossypii*, the degree of relationships between them were calculated by working out `r' values separately. These 'r' values along with regression equations are given in Fig. 2. and 3.

It may be observed that the temperature influenced the r_m significantly ($r= 0.903$, $p<0.05$). Dew point also influenced the r_m of *A. gossypii* significantly (0.882, $p<0.05$). Regression equations for these variables have been done calculated and the slope of the equation suggests that temperature and dew point influenced the r_m of *A. gossypii* directly. Relative humidity did not influence significantly ($r= 0.428$) the r_m of *A. gossypii*.

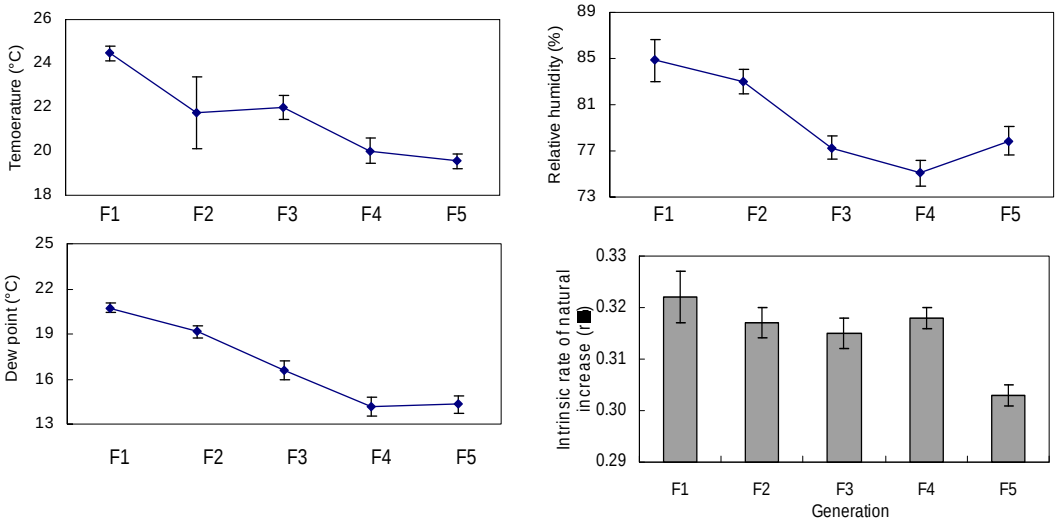

Fig. 1. Intrinsic rate of natural increase (r_m) of *A. gossypii* for five generations along with temperature, relative humidity and dew point.

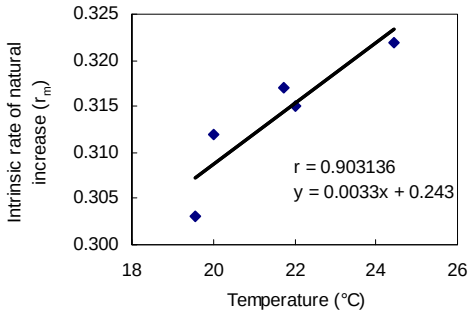

Fig. 2. Relationship between intrinsic rate of natural increase (r_m) of *A. gossypii* and temperature.

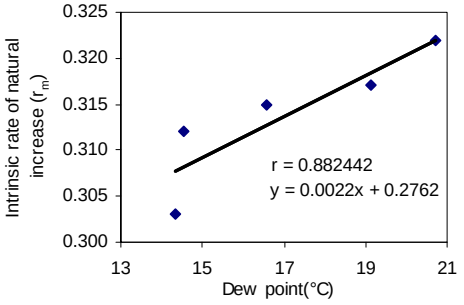

Fig. 3. Relationship between intrinsic rate of natural increase (r_m) of *A. gossypii* and dew point.

Discussion

Komazaki (1983) reported the r_m of *A. gossypii* on citrus, which was maximum (0.32 aphids/ per day) at 19.8°C. This species belongs to a low temperature adapted group. Shi (1985) observed the life history of *A. gossypii* in Shanghai, China and reported the r_m as 0.22 and increase index was 1.246/day. Nozato (1988) studied r_m of *A. gossypii* on *Veromoca persica*. The increase rates (r) per day were as follows: 0.0051 and 0.0657 at 5°C and 10°C during day and 0.0935, 0.1923 and 0.3786 at 5°C, 10°C, and 20°C during night respectively. Shinoda and Tanaka (1987) calculated the lowest (0.080 to 0.110) r_m for *A. gossypii* on melon and highest (0.358 to 0.260) on honeydew and akikei reared on *Cucumis melo*. Murai and Tsumuki (1996) reared *A. gossypii* on cucumber at different temperatures. Liu and Hwang (1991) studied the life table of *A. gossypii* in China and reported the r_m of the said aphid as highest, 0.338 at 25 °C (LD 10:14) and 0.262 at 20 °C (LD 14:10), and lowest 0.265 at 25 °C (LD 14:10) and 0.185 at 20 °C (LD 6:18). Kocourek *et al*. (1994) observed the r_m, which varied from 0.019 to 0.028 with the increase in temperature for *A. gossypii*. Kersting *et al*. (1999) and Xia *et al*. (1999) recorded more or less similar r_m values of *A. gossypii*, which were 0.384 and 0.386 on cotton at 25°C respectively. Karim *et al*. (2001) reported the r_m of *A gossypii* ranged from 0.303

(23.55°C) to 0.371 (18.5°C) on brinjal plant at Rajshahi, Bangladesh. Zamani *et al.* (2006) worked on cotton aphid, *A. gossypii* infesting *Cucumis sativus* L. in Tehran, Iran at six constant temperatures (10, 15, 20, 25, 30 and 35°C) and reported that as temperature increased, the r_m followed a typical asymmetrical dome-shape pattern, with maximum value of 0.419/day at 25°C.

From the above findings it could be seen that present r_m values of *A. gossypii* are more or less similar to those of other workers. However, some minor variations are there, which can be explained as the impact of some other physical factors of the local environment.

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