Pertanika 7(3), 49–52 (1984)

Factors Affecting Ovipositional Behaviour of *Scutellista cyanea*, an Egg-parasitoid of Hemispherical Scale

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Key words: *Scutellista cyanea; Saissetia coffeae;* egg- parasitoid oviposition; adult longevity.

RINGKASAN

Scutellista cyanea ialah serangga parasitold telur teritip termasuk Skala hemisfera Saissetia coffeae. *Pemangsa bertelur di dalam teritip dewasa. Suhu mempengaruhi bilangan telur yang dikeluarkan oleh parasitoid dan juga jangka masa hidup dewasa. Pada 20°C jangka hidup dewasa ialah purata 80 hari tetapi pada 28°C, hanya 30 hari sahaja. Sebaliknya bilangan telur yang dikeluarkan bertambah dengan kenaikan suhu. Dalam perbandingan di antara dua saiz teritip iaitu yang ukuran panjang lebih daripada 3.5 mm dan yang kurang daripada 2.5mm, keputusan menunjukkan perbezaan yang bermakna ($p<0.05$) didapati kerana bilangan serangga parasitoid yang keluar dari teritip bersaiz lebih daripada 3.5mm adalah banyak. Hubungan di antara ukuran lebar kepala dewasa parasitoid dengan jangka hidup dan bilangan telur yang dikeluarkan ialah r=0.90 dan r=0.93.*

SUMMARY

Scutellista cyanea Motschulsky is an egg parasitoid of many coccids, including the hemispherical scale, Saissetia coffeae. *The adult female parasitoid oviposits in gravid scale,* S. coffeae. *Ambient temperature influences the number of eggs deposited and adult longevity of the parasitoid. The life-span of the adult parasitoid was found to be reduced with an increase in temperature; at 20°C longevity it was 80.0 days while at 28°C it was only 30 days. On the other hand, an increase in temperature within limits would increase the total number of eggs deposited by the parasitoid. In a comparison of two sizes of host-scale i.e. scale >3.5mm in length and <2.5mm in length, the result showed that significantly ($p<0.05$) greater parasitoid progency emerged from host scale of >3.5mm in length. The relationship between head width and adult longevity and between head width and egg production are r=0.90 and r=0.93.*

INTRODUCTION

Scutellista cyanea Motschulsky (Hymenoptera: Pteromalidae) is an egg parasitoid of many scale insects. The adult female oviposits in gravid scales. The parasitoid larva consumes 400-500 scale eggs to complete its development (Saad *et al.*, 1977). A previous study has shown that a constant temperature of 30°C reduced the number of eggs produced by the hemispherical scale, *S. coffeae* (Ibrahim, 1983). Barber (1980) also found positive correlation between length of *S.coffeae* and number of eggs. The parasitoid, *S. cyanea* has been used widely in the biological control of olive scales and soft scales (Quayle, 1911; El-Minshaway *et al.*, 1978); Sinadskii & Kozarzhersicaya, 1980; Luck, 1981). The present investigation was intended to study the effect of temperature and size of hemispherical scale on the oviposition of *S. cyanea.* Such information can be useful in biological control programmes of regions where there is a marked fluctuation in temperatures.

MATERIALS AND METHODS

The host scale, *S. coffeae* were reared on soilless potato sprouts at 26°C and 70% r.h.

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The parasitoid, *S. cyanea* were bred on its host-scale, *S. coffeae*. Two trials were conducted for studying the behavioural response of the parasitoids to its host scale.

Effect of Constant Temperatures

Newly emerged female parasitoids were kept in captivity with male parasitoids in a test tube (diam: 12mm) for 24h. and fed with diluted honey (10%). The mated female was then introduced into a test-tube containing a gravid scale of 3.5mm in length and a thin streak of diluted honey. Ten test-tubes each containing a female *S. cyanea* and a gravid scale were kept at the following temperatures : 20°C, 22°C, 24°C, 26°C and 28°C. Unparasitized scales were offerred daily to the parasitoids until they met the natural death. The parasitized scales were examined for the parasitoid eggs.

Effect of Host Scale Size

The response of *S. cyanea* to different sizes of gravid scales was studied at 26°C ± 0.5°C. The mated female was offerred a portion of potato sprout (40mm in length) infested with 10 gravid scales of *S. coffeae*. The potato sprout was placed upright in a test-tube (20mm diam) supported by plasticine. The gravid scales were categorised as big and small females. The scale above 3.5mm in length was considered as big and that of 2.5mm and less as small female. The individual female parasitoid was kept with the scales for 24h and supplemented with dilute honey (10%). The following host scales were offerred to the parasitoid.

a. Big scales on the 1st day and small scales on the 2nd day.
b. Small scales on the 1st day and big scales on the 2nd day.
c. Big scales on the 1st and 2nd day.
d. Small scales on the 1st and 2nd day.

These observations were repeated four times for each female parasitoid. Therefore, the individual parasitoid was offerred the various categories of scale for eight consecutive days. Ten replicates were made for each of the above tests. The parasitized scales were incubated at 26°C ± 0.5°C in test tubes (diam: 12mm) for the emergence of adult parasitoids.

RESULTS AND DISCUSSION

The average adult longevity of *S. cyanea* decreased with an increase in temperature (Fig. 1). Thus at 28°C the parasitoid survived for 30 days on a diet of dilute honey (10%). There was a significant difference ($p<0.05$) in adult longevity at 20°C and 28°C but no significant difference was detected between 26°C and 28°C. The life-span of the parasitoids was contrary to the findings of Saad *et al.* (1977) who recorded a shorter longevity with a decrease in temperature.

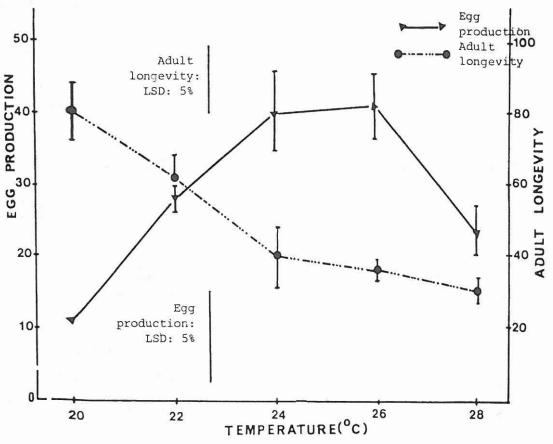

Fig. 1. The effect of temperature on egg production, and adult longevity of S. cyanea.

The total egg production of *S. cyanea* declined with a decrease in temperature (Fig. 1). At a high temperature of 28°C, the egg production declined sharply suggesting that a high temperature had an adverse effect on the egg laying capacity of the females. There was a significant difference ($P<0.05$) in the egg production at 20°C and 28°C. The highest recorded number of eggs was 40.2 at a rearing temperature of 26°C. At an almost similar temperature (25.9°C), Saad *et al.* (1977) recorded only 10.8 eggs.

The relationship between width of head capsule with adult longevity and egg production of the parasitoids reared at 26°C is shown in Fig. 2. The linear regression coeffiecent for adult longevity and egg production are 0.90 and 0.93 respectively. Therefore, the larger females of *S. cyanea* should be utilised in the biological control of *S. coffeae* for they live longer and produce more eggs. The pattern of daily oviposition showed that the parasitoids oviposited immediately after emergence (Fig. 3). The young adult female had mature eggs because they were reported to stay one or two days within the host-scale before emergence (Clausen, 1940). The parasitoids oviposit almost every day and the

number of eggs they produce depends on the rearing temperature. A greater proportion of eggs are oviposited during the first 15 days after adult emergence. Hence, newly emerged parasitoids should be utilised in the biological control of *S. coffeae.*

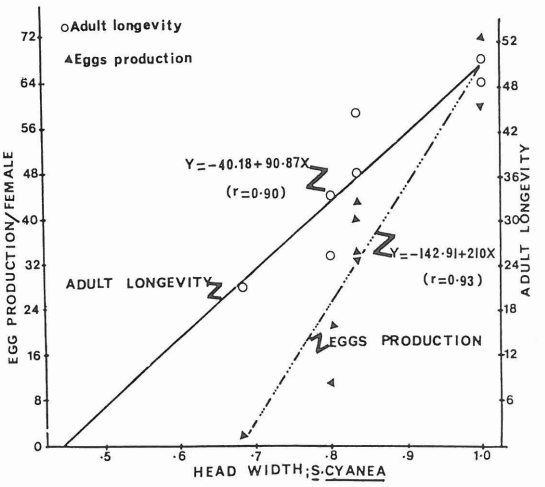

Fig. 2. The relationship between head width, adult longevity and total egg production of S. cyanea.

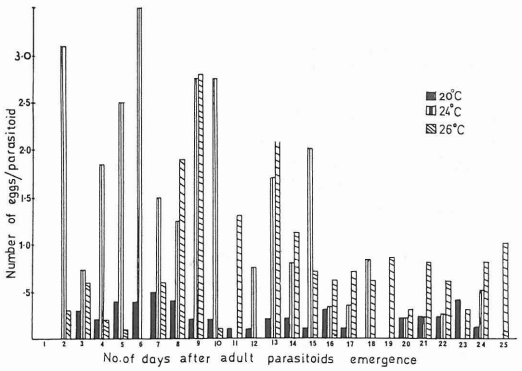

Fig. 3. The pattern of daily oviposition of S. cyanea *at different constant temperatures for 25 days. Based on 20 individuals at each temperature.*

The female of *S. cyanea* oviposited within adult scales of different sizes (Table 1). The parasitized eggs could be differentiated from the scale eggs for they were bigger and shiny white. The eggs of *S. coffeae* were small and pinkish in colour. The number of parasitoids that emerged from big scales (3.5mm in length) was significantly higher ($p<0.05$) than those from small scales (2.5mm in length). The relatively low number of parasitoids from small scales could be due to small scales having fewer eggs for the parasitoids' larval development. Though, both sexes emerged from the small host scales, the trend suggests that more females emerged from bigger scales (Fig. 4).

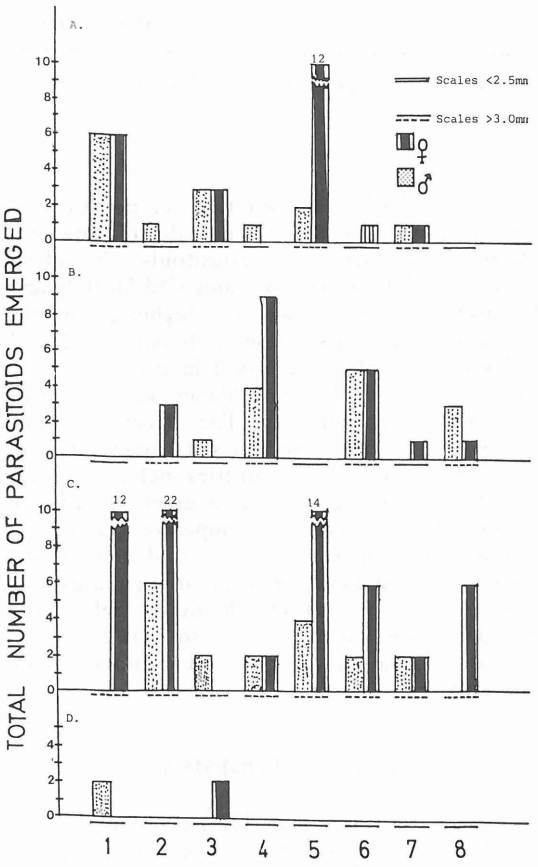

Fig. 4. Patterns of emergence of S. cyanea *from different length of gravid* S. coffeae *at 26°C. (A) Alternating of big and small scales, (B) alternating of small and big scales, (C) consecutively big scales and (D) consecutively small scales. Figures above bar denote the number of emerged parasitoids.*

TABLE 1
Mean number of *S. cyanea* adults emerging from different sizes of *S. coffeae* at constant temperatures of 26°C for eight consecutive days.

Female parasitoid offered	Mean + s.e.	LSD (3.14)	Sex radio Male : Female
Big scale alternating with small scale	3.4 + 0.79	b	0.7 : 1
Small scale alternating with big scale	3.3 + 0.96	b	0.65: 1
Big scale only	8.2 + 2.8	a	0.28: 1
Small scales only	0.4 + 0.17	b	1: 1

[1] Means with the same letters are not significantly different at the 5% level by LSD. (Least Significant difference).

These findings suggest that temperature and size of gravid scales influence the rearing of *S. cyanea*. Therefore, the parasitoids should be reared at 26°C on gravid scales (>3.5mm length) to ensure the emergence of a higher proportion of female parasitoids. These newly emerged female parasitoids should be released in the biocontrol of *S. coffeae* for they have higher egg-laying capacity and longer longevity. The effect of temperature on the parasitoids has its practical application in the temperate countries such as the United Kingdom where there is a great variation in seasonal temperatures. In temperate glasshouses, the winter temperature is so cold that it can reduce the egg-laying capacity of the parasitiods. Therefore the parasitoids should be released in the glasshouse during summer so that they have a greater egg-laying capacity and turn-over during the warm temperature.

ACKNOWLEDGEMENTS

The author is indebted to Dr. M.J.W. Copland of the Department of Biological Sciences, Wye College (University of London) for guidance of the research and Prof. G. Varghese (Dept. Plant Protection, UPM) for his critical comments on the manuscript. My thanks are also due to Dr. Argyrio for parasitoid culture. This work is part of a thesis submitted for a Ph.D degree to the University of London by the author who was in receipt of funding from the Commonwealth Scholarship Commission. The work was carried out under MAFF Licence PHF 64.

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(Received 25 June, 1984)