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OBSERVATIONS ON THE LIFE HISTORY AND CHAETOTAXY OF *STREPSICRATES RHOTHIA* (MEYRICK) (MICROLEPIDOPTERA : TORTRICIDAE : EUCOSMINI)

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INTRODUCTION

Strepsicrates rhothia (Meyrick) was formerly placed under the genus *Spilonota* Hubner by Meyrick (1910) and Diakonoff (1950). Later Clark (1958) after examination of the male genitalia suggested a new combination of the species under genus *Strepsicrates* Meyrick. Fletcher (1914) reported *Eugenia jambolana* as its larval food plant from India whereas Clarke (1958) reported *Psidium guava* as its larval food plant from Sri Lanka. During the course of present studies, the larval food plant of *Strepsicrates rhothia* has been recorded as *Woodfordia fruticosa* (Linnaeus) (Lyrthraceae) (Plate -1, Fig. 5) from Sekhupur, Khalian, Sahni, Phagwara (Distt. Kapurthala, Punjab, India). The life history as well as chaetotaxy of the speices under reference has been studied for the first time on *Woodfordia fruticosa.*

Methodology : Survey were conducted in different localities of Punjab from 2001-2004 to collect immature stages of *Strepsicrates rhothia* Meyrick. The eggs and different larval instars brought from field were kept in circular transparent containers, (each measuring 10 cm in diameter and 4.5 cm in depth). Subsequently, the later instars were shifted to relatively larger transparent containers (12 × 7 cm, 15 × 20 cm and 18 × 23 cm) furnished with fresh clippings of the food plants. The mature larvae nearing pupation were then shifted to still bigger rearing containers (18.5 cm in diameter and 12.5 cm depth) for pupation. The freshly emerged adults were transferred to the insect breeding cages of varied sizes. The rearing boxes were carefully examined twice a day in order to make observations on different life history aspects. The rearing boxes were cleaned at regular intervals by removing the faecal matter, dead insect stages and left over food plant clippings etc. for maintaining proper hygienic conditions. The fresh host plant cuttings were provided to the larvae for their proper development and also to minimize the mortality rate due to starvation.

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The gross morphology, colouration and measurements of the eggs, different larval instars and the pupae were recorded with the help of occulometer, taking a mean of 5 specimens of each stage. The newly emerged adults were kept on an artificial diet consisting of 10% sugar solution to record their longevity. For the purpose of examination of chaetotaxy, the last instar larvae were first killed by dipping in boiling hot water before preserving them in nine parts of 75% ethyl alcohol and one part of glycerine (Stehr, 1987). Some of the individuals were also killed in KAAD solution (10 ml kerosene, 90 ml 95% ethyl alcohol, 20 ml glacial acetic acid and 10 ml dioxane) to preserve the original colouration of the larvae, as advocated by Peterson (1948). The larvae were kept in this solution for a few minutes to half an hour depending upon the size of the larva for full distension, before storing the same in 95% ethyl alcohol. After dehydration, the chaetotaxy of the head was examined by placing the same in glycerine in a cavity slide. For skin preparation, the body of each larva was stained in 1% eosin solution, followed by dehydration and clearing in xylene before mounting it permanently on a glass slide in Canada balsam. For naming the setae and pores, the nomenclature proposed by Heinrich (1916), Hinton (1946) and Stehr (1987) has been followed. The terminology for naming the setae of the A_{10} segment has been adopted from Allyson (1976) and Stehr (1987).

OBSERVATIONS

Life History Stages and Developmental time :

Egg (Plate-1, Fig. 2) : Incubation period : 3.75 ± 0.35 days.

Length 0.57 ± 0.03, width 0.48 ± 0.10; scale-like, somewhat oval in shape, chorion rough with minute small reticulations; cream, turns dark orange-red after two days, three black spots appear on egg surface prior to hatching; laid singly or in a batch of 2 to 4 on both lower and upper sides of leaf.

Larva : Number of instars : 04.

Larval duration : 17.25 ± 1.75 days.

First instar : Duration : 4.25 ± 0.35 days.

Head : Width 0.15 ± 0.03 mm, black, hypognathus.

Body : Length 1.25 ± 0.20 mm, width 0.18 ± 0.02 mm; pale cream, thoracic shield brownish-black; prolegs and thoracic legs of body colour.

Second instar : Duration : 3.50 ± 0.70 days.

Head : Width 0.30 ± 0.00 mm; light brown.

Body : Length 3.30 ± 0.96 mm, width 0.38 ± 0.10 mm; pale-brown; thoracic shield shinning pale-brown; segmentation clear, intersegmental region white, intestine green, visible through transparent skin.

Third instar : Duration : 3.25 ± 0.35 days.

Head : Width 0.63 ± 0.10 mm; same as above.

Body : Length 6.00 ± 1.00 mm, width 0.59 ± 0.19 mm; pale cream; otherwise same as in second instar.

Fourth instar (Plate-1, Fig. 3) : Duration : 6.25 ± 0.35 days.

Head : Width 1.00 ± 0.00 mm; light brown.

Body : Length 12.30 ± 2.58 mm, width 1.28 ± 0.03 mm; colour of larva light brownish-green, middorsal and subdorsal blackish-brown stripes appear; anal shield broadly black at posterior and lateral margins, otherwise shiny watery-white.

Pupa (Plate-1, Fig. 4) : Duration : 7.00 ± 1.00 days.

Length 8.50 ± 0.50 mm; width 2.75 ± 0.50; newly formed pupa cream, after 4 to 5 hours turns brown, approaching eclosion it becomes black; mesothorax with median carinate ridge usually extending along the cephalic half, indistinct on metathorax; second abdominal segment with two rows of spines distinct.

Adult longevity : 7.00 ± 1.00 days.

Adult (Plate-1, fig. 1) : Alar expanse : 12-14 mm.

Vertex and frons decorated with long, dark, fuscous scales; labial palpi fuscous with some ochreous scales, porrect, second segment long, slender, third segment minute, drooping; antennae filiform, dark fuscous in colour, about 3/4th length of forewing; forewing with costa arched, apex rounded, termen oblique, tornus obtuse, anal margin straight, greyish fuscous in colour, with light greyish-brown and creamy suffusion, dark oblique area from apex towards anal margin, costa with fine costal strigulae, anal and termen margin with cilia greyish-fuscous in colour; hindwing quadrate, grey scale, fringes grey with dark sub-dorsal shade; legs whitish-ochreous in colour, tarsal segment with yellow and fuscous band.

OBSERVATIONS ON BEHAVIOUR

Larval behaviour : The entire egg-shell is almost consumed by the first instar, leaving behind only a minute scar-like portion. The first instar larva folds the margins of the tender leaf with the help of silken threads to make a concealment, which is formed by joining 3-5 leaves together in the later instars. The first instar larva feeds on the upper epidermis and chlorophyll of the leaf, leaving behind the vein network and lower epidermis. The succeeding two instars follow the same pattern and mode of feeding except that they do so on rather older leaves. The last instar consumes all layers and vein network of the leaf leaving behind the midrib alone. The faecal matter is always thrown out of the concealment in older instars. All instars, when disturbed, show drop off behaviour

by silken threads or express splashing movements. The last instar when pinched with forceps exhibits spasmodic quick movements.

Moulting behaviour : It takes about 10-11 hours by the larva to shed off its skin.

Pupation : While attaining maturity, the larva stops feeding and remains in concealment. The colour of larva changes to orangish-brown, which turns maroonish-pink after 4-5 hours. The prepupa is brownish-green and this stage lasts for two days. The pupa is formed inside the leaf fold. The body moult remians at the pointed anal end of the pupa.

Pupal parasitoid : The different larval instars brought from field for further rearing in the laboratory undergo normal process of pupation. In many cases adult Hymenopteran parasitoids emerged after 4-5 days of the pupation instead of adult moth.

Eclosion : It is observed that eclosion takes place in the morning hours between 6.00 a.m. to 9.00 a.m.

Adult behaviour : The adult moths were seen emerging from the pupae in captivity and they mated on second day of emergence in the morning hours. The end to end mating lasts about 45 minutes to 1 hour. After twenty-four hours of mating, it was observed that the female laid single eggs on either surface of the leaf. A few eggs were also noticed on the bottom and walls of the glass jar.

Chaetotaxy of Last Instar :

Cephalic chaetotaxy (Plate-2, Figs. 1, 2) : Cranium moderately sclerotized, golden brown; median epicranial suture much shorter in length than lateral adfrontal suture; frontoclypeus longer than broad; ecdysial line close to lateral adfrontal suture at base, otherwise well apart; stemmatal area not well differentiated from rest of cranium, beset with six stemmata, 1-6 stemmata arranged in a semicircle; in all 17 tactile setae, 4 proprioceptors and 8 pores present on each half of head capsule; all setae spine-like, arise from pinacula.

Frons comprised seta F_1 and pore Fa; F_1 closer to lateral margin of frons, directly posterad to C_2; puncture Fa beset near median longitudinal line of head capsule, present anterodorsad to F_1. Clypeal group comprises setae C_1 and C_2; C_1 close to epicondyle, shorter than C_2; C_2 shifted towards median longitudinal line. Afrontal group bears two setae AF_1, AF_2 and one pore AFa; AF_2 longer than AF_1, situated in level to point where lateral adfrontals join median epicranial suture, AF_1 anterad and mesad to AF_2; pore AFa close to AF_1 than AF_2. Anterodorsal area present inbetween stemmata and adfrontal area, bears setae A_1, A_2, A_3 and pore Aa; A_1 in level of stemmata 3, lies towards median longitudinal line; A_2 posterolaterad to A_1, but slightly anterad to A_3; A_3 situated above the stemmata 2 and posterolaterad to A_2; $A_3 > A_1 > A_2$ lengthwise; pore Aa lies close and posteromesad to A_2. Posteriodorsal group compires setae P_1 and P_2 along with pores Pa and Pb; P_1 longer than P_2 and anterolaterad to AF_2; P_2 posterolaterad to P_1; pore Pa nearly equidistant from P_1

and P_2 and lies anterolaterad to P_1; pore Pb situated near P_1, but lies in level of P_2. Seta L_1 represents lateral group; L_1 anterolaterad to P_2. Stemmatal area decorated with setae S_1, S_2 and S_3; S_1 situated inside the stemmatal semicircle, close but dorsocaudad to stemmata 3; S_2 dorsolaterad to stemmata 1; S_3 anterocaudad to S_2; $S_3 > S_2 > S_1$ lengthwise. Substemmatal area studded with setae SS_1, SS_2 and SS_3 with pore SSa; SS_1 ventrad to stemma 6; SS_2 caudad to stemma 6; SS_3 posterad to SS_2; $SS_3 > SS_2 > SS_1$ lengthwise; pore SSa close and anterodorsad to SS_3. Genal group represented by seta MG_1 and pore MGa; MG_1 lies at lower and rear portion of head; pore MGa lies anteroventrad to MG_1. Dorsal epicranial area graced with proprioceptor setae MD_1, MD_2, MD_3 and pore MDa; MD_1 dorsad to P_2; MD_2 lies in middle of MD_1 and MD_3; MD_3 posterodorsad to MD_2; pore MDa lie posterodorsad to MD_2.

Thoracic chaetotaxy (Plate-2, Fig. 5) : XD, dorsal, subdorsal, subventral, ventral groups and proprioceptors mounted on pinacula.

T_1 (Plate-2, Fig. 3) : Prothoracic shield brown, well sclerotized, elongated, roughly trough shaped, anterior margin straight, posterior margin with edges rounded; each half comprises six setae and two pores; XD group lie near anterior margin of shield; XD_1 anterodorsad to XD_2; XDa present posterodorsad to XD_1; pore XDb dorsad to XD_2; XDa and XD_1 situated close to each other. Dorsal group present near posterior margin of shield; D_1 posterodorsad to XD_1 and close to middorsal line; D_2 anterolaterad to D_1; D_1 and D_2 closer than XD_1 and XD_2; D_2 longer than D_1. Setae SD_1 and SD_2 of subdorsal group lying near lateral margin of shield; SD_1 anterolaterad to and longer than SD_2; latter anterolaterad to D_2. Lateral group trisetose, composed of setae L_1, L_2 and L_3 raised on common long pinaculum, present anterior to spiracle; L_1 and L_2 lie close to each other than L_3; L_1 ventrad to SD_2; L_2 anterad to L_1; L_3 posteroventrad to L_1; $L_1 > L_3 > L_2$ lengthwise. Subventral group located above leg base, bisetose, beset on common pinaculum; SV_2 shorter and anterad to SV_1. Ventral seta V_1, present below coxa near midventral line. Microscopic setae comprises two groups MXD and MV; MXD_1 close to D_1 and D_2 and lie close to anterior margin of thoracic shield; MV_3 posteroventrad to MV_2.

T_2 and T_3 (Plate-2, Fig. 4) : Dorsal group represented by two setae D_1 and D_2 raised on common rounded pinaculum; D_1 anterodorsad to and smaller than D_2. Subdorsal group bisetose with setae SD_1 and SD_2; SD_1 and SD_2 beset on common oblong pinaculum, present anterolaterad to dorsal pinaculum; SD_1 posterolaterad to SD_2; SD_1 much longer than SD_2. Lateral group composed of setae L_1, L_2 and L_3; L_1 and L_2 lie on common pinaculum and close to each other; L_1 anteroventrad to SD_1; L_2 anteroventrad to L_1; L_3 posterodorsad to L_2; $L_1 > L_2 = L_3$ lengthwise. Subventral group comprises only single seta SV_1, posteroventrad to L_3. Seta V_1 situated ventrad to base of leg near midventral line. Microscopic seta MD_1 situated close to anterior margin of segment and anterolaterad to D_2; proprioceptors MSD_1 and MSD_2 lie anterad to subdorsal pinaculum; MSD_1 anterodorsad to MSD_2; microsetae MV_1, MV_2 and MV_3 lie opposite leg; MV_3 posteroventrad to MV_1 and latter anteroventrad to MV_2.

Abdominal Chaetotaxy :

A_1, A_2, A_7, A_8 (Plate-2, Figs. 8, 10, 11) : Setae of dorsal group D_1 and D_2 lie near middorsal line of segment; D_1 lies near middorsal line of segment and anterodorsad to D_2; latter longer and posteroventrad to D_1; in segment A_8, D_2 almost posterad to D_1. Subdorsal group represented by setae SD_1 and SD_2; SD_1 longer than SD_2; SD_2 microscopic in segments A_1 and A_2; SD_1 posterodorsad to spiracle; SD_2 anterodorsad to spiracle; in segment A_7, SD_1 lies directly above spiracle; SD_2 anterodorsad to spiracle; in segment A_8, SD_1 anterodorsad to spiracle; SD_2 anteroventrad to SD_1; latter and SD_2 lie on common oval pinaculum. Lateral group trisetose, represented by setae L_1, L_2 and L_3; L_1 and L_2 lie on common pinaculum and lie all apart from L_1; $L_3 > L_1 > L_2$ lengthwise; L_1 anteroventrad to spiracle; L_2 anterodorsad to L_1; L_3 posteroventrad to L_1. Setae SV_1, SV_2 and SV_3 subventral group; in segments A_1 and A_2 subventral group trisetose, anteroventrad to L_3; SV_2 anteroventrad to SV_1; SV_3 anterodorsad to SV_1; $SV_1 > SV_3 > SV_2$ lengthwise; in segments A_7 and A_8, subventral group bisetose with setae SV_1 and SV_2; SV_1 anteroventrad to L_3; SV_2 smaller and anteroventrad to SV_1. Ventral seta V_1 present near midventral line. Proprioceptors MD and MV present; MD_1 lie close to anterior margin of segment and anterolaterad to D_1; in segment A_7 and A_8, MV_3 lies anteroventrad to SV_2.

A_3, A_4, A_5 and A_6 (Plate-2, Figs. 7, 9) : Prolegs present on these segments. Setae D_1 and D_2 comprise dorsal group; D_2 posteroventrad and longer than D_1. Setae SD_1 and SD_2 make up subdorsal group; SD_1 situated above spiracle and anteroventrad to D_2; seta SD_2 very minute and anteroventrad to SD_1. Lateral group comprises three setae L_1, L_2 and L_3; L_1 and L_2 lie on common pinaculum and close to each other; L_2 anterolaterad to spiracle; L_1 posteroventrad to L_2; L_3 wide apart and posteroventrad to L_1; $L_3 > L_1 > L_2$ lengthwise. Subventral group trisetose with setae SV_1, SV_2 and SV_3 situated on dorsal area of proleg; SV_1 anteroventrad to L_3; SV_2 lies inbetween SV_1 and SV_3 and anteroventrad to SV_1; SV_3 anteroventrad to SV_2; $SV_1 > SV_2 > SV_3$ lengthwise. Towards ventral meson, lies seta V_1 of ventral group. Proprioceptor MD_1 present anterolaterad to D_1; microscopic seta MV_3 present infront of coxa. Crochets biordinal and arranged in circle.

A_9 (Plate-2, Fig. 12) : Dorsal group representated by setae D_1 and D_2; latter lies near middorsal line of segment and longer and posterodorsad to D_1; D_2 setae of both sides share common oval pinaculum. Subdorsal group unisetose with seta SD_1 lying on oblong pinaculum with seta D_1; SD_1 posterolaterad to D_1. Lateral group trisetose with setae L_1, L_2 and L_3 lying on oblong common pinaculum; L_2 posteroventrad to SD_1; L_1 posteroventrad to L_2; L_3 posteroventrad to L_1; $L_1 > L_2 > L_3$ lengthwise. Subventral group bisetose; SV_1 posterodorsad to SV_2. Seta V_1 lies near midventral line. Microscopic setae MD and MV present; MD_1 anterolaterad to D_2; MV_3 anteroventrad to SV_2.

A_{10} (Plate-2, Figs. 6, 13) : Anal shield well developed; oblong; anal fork present; D_1 present near anterior margin of shield; D_1 longer than D_2 in length; D_2 lies at distal margin of shield. SD_1

anteroventrad to D_2; SD_2 beset near lateral margin of shield, anteroventrad to SD_1; SD_2 longer than SD_1. Lateral group lies at dorsal margin of anal leg with seta L_1 being anteriormost; L_2 posteroventrad to L_1; L_3 closer and dorsad to L_2; a pore present anterad to L_3. Subventral group comprised of setae SV_1, SV_2, SV_3 and SV_4; SV_1 lies posteroventrad to L_3; SV_2 ventrad to SV_1; SV_3 anteroventrad to L_2; SV_4 posteroventrad to SV_3. Ventral seta V_1 lies near midventral line.

Remarks : The species *Strepsicrates rhothia* (Meyrick) is available during the months of October and November in Kapurthala district of Punjab. The damage done by the species to its food plant is moderate. The species is previously reported from India (Bengal), Sri Lanka and Mauritius (Clarke, 1958). The present record from Kapurthala district of Punjab forms the second report of the species from India.

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