Significance of the chaetotaxy in larval identification of *Pyrausta bambucivora* Moore (Lepidoptera: Crambidae: Pyraustinae)

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Abstract

The identification and diagnosis of insect pest can best be strengthened through an examination of the arrangement of various setae and punctures of different body segments. In the current study, the cephalic region and other body segments (thoracic, abdominal) of the last instar caterpillar of *Pyrausta bambucivora* Moore (Crambidae) have been examined thoroughly and contingent the occurrence of 17 tactile setae, 4 proprioceptors and 10 pores on each half of the head.

Keywords: Chaetotaxy, Crambidae, Lepidoptera, Pyraustinae

Introduction

*Pyrausta bambucivora* Moore is commonly known as bamboo leaf roller. Larvae of this species rigorously attack bamboo tree and left it deskeletonized after feeding on them. The identification and control of this pest species is much more important at imago stage than that at adult by studying their biology and chaetotaxy. The purpose to carry out chaetotaxic studies of aforesaid species is to identify the different setae and puncture on the larval head and other body segments by studying their arrangements, distribution pattern and size, which further help to classify the species. Globally, the minority of workers such as Mathur (1954 and 1959), Singh (1956), Mathur and Singh (1963), Azam and Ali (1965), Franzmann and Garrett (1978), Yoshiyasu (1980), Goel and Kumar (1981), Stehr (1987), Lin (1993), Amutha and David (1998), Rose and Singh (2010) and Pinheiro et. al., (2011) have given significant contribution in intensification of the chaetotaxic study. So due to paucity of chaetotaxic information and nomenclature, in the present paper, we endow with detailed descriptions of the chaetotaxic study of *Pyrausta bambucivora* Moore along with diagram's.

Material and Methods

Immature stages of *Pyrausta bambucivora* Moore has been collected from Punjab and reared in the laboratory up to pupal stage on fresh host plant leaves. To study chaetotaxy in legitimate manner, the complete distention of the larval body was done by boiling the mature larvae in the test tube. For proper maceration isolated heads and body were kept in KOH (10%) for 7-9 hrs followed by washing in 1% glacial acetic acid followed by mounting in 70% alcohol and glycerine in 9:1 ratio. For setal study, isolated heads of caterpillar shifted to petridish containing glycerine whereas permanent slides of thorax and abdomen were made by fixing them in DPX on glass slide and then observed under stereoscopic zoom microscope.

Results

Head: Cranium moderately sclerotized, golden brown in colour and somewhat shiny; median epicranial suture less than half the length of adfrontal suture; front clypeus longer than broad; ec dysial line wavy joining in middle to medium epicranial suture; mouth parts strongly

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sclerotized; stemmatal area somewhat differentiated from rest of cranium, having six stemmata, fifth stemmata present near the base of antenna and sixth behind fifth stemmata; stemmata 1, 2 and 6 large and almost equal in size; stemmata 3 present away from stemmata 2; each half of head represents 17 tactile setae, 4 proprioceptors and 10 pores; all setae spine like arise from pinacula on the last larval instar.

Frontal group seta F1 and pore Fa; F1 situated much closer to lateral margin of frons, directly postrad to C2, whereas, pore Fa lies near median longitudinal line; present dorsad to F1. Clypeal group contains setae C1 and C2, the latter present close to epicondyle, C1 slightly shorter than C2 and present towards median longitudinal line. Setae AF1 and AF2 along with pore AFa constitutes adfrontal group; AF2 slightly more than half the length of AF1, situated posterad to point where median epicranial suture joins the lateral adfrontal suture near median epicranial suture, AF1 posteromesad to A1, close to lateral frontal suture; pore AFa lies near the mid line and also anterad to AF2. Setae A1, A2, A3 and pore Aa located on the anterodorsal area, represent anterior group; A1 in level of stemmata 3, lies towards median longitudinal line; A2 present almost in straight line posterior to A1; A3 posterolatrad to A2; A3>A1>A2 lengthwise; pore Aa lies close to A2 than A3 and posteromesad to A2. Setae P1 and P2 along with pore Pb denotes as posteriodorsal group; P1 greatly longer than P2; P2 posterolaterad of P1; pore Pb closer and posteromesad to P1. Setae MG1 and pore MGa constitutes genal group; MG1 present at lower and rear portion of the head; pore MGa lies dorsoanterad to seta MG1. Microdorsal group furnished with setae MD1, MD2, MD3 and pore MDa; MD1 dorsolaterad to P2; MD2 lies in middle of MD1 and MD3 and present posteromesad to MDa; MD3 posterodorsad to MD2; pore MDa lies close and posterior to MD2 (Plate-1, Figure 1 & 2).

Thoracic Chaetotaxy: Spine like tactile setae.

T1 (Plate-1, fig.3): Prothoracic shield dark brown strongly sclerotized, elongated and bent inwards; anterior margin straighter and longer, posterior margin short and notched in the middle with edges rounded; each half with six setae and two pores; XD group present near anterior margin of shield; XD1 lies above and anterad to XD2; pore XDa present posterodorsad to XD1; XDb anterodorsad to XD2; XDa and XD1 situated close to each other. Dorsal group present near posterior margin of shield; D1 anterodorsad to D2; D1 close to middorsal line; D2 longer than D1 in length. Subdorsal group situated on posterolateral margin of shield; SD1 longer than SD2; SD1 anterolaterad to SD2. Lateral group bisetose, with setae L1 and L2 sharing same pinaculum; the latter prespiracle in position; L1 longer than L2; L2 directly laterad to SD1; L1 posteroventral to L2. Subventral group lies above leg base, bisetose, beset on common oblong pinaculum; SV2 shorter and anterior to SV1. Ventral group consisted of single tactile seta V1, present below coxa near midventral line. Microscopic setae bear two groups MXD and MV; MXD1 equally distant from D1 and D2 and lies close to posterior margin of thoracic shield; MV group represented by setae MV2 and MV3; MV3 lying precoxal in position; MV2 posterodorsad to MV3.

T2 and T3 (Plate-1, fig. 4): Dorsal group composed of two setae D1 and D2 share same pinaculum; D1 posterodorsad to D2; D2 longer than D1. Subdorsal group comprises setae SD1 and SD2 present on common pinaculum; SD1 anterolaterad to SD2. Lateral group trisetose with setae L1 and L2 present on common pinaculum and L3 on separate irregular pinaculum; L1 anteroventrad to SD1; L2 anteroventrad to L1; L3 posterodorsad to L2. Subventral group unisetose; seta SV1 lying on subtraingular pinaculum, present anteroventrad to L3. Seta V1 situated posteroventral to base of leg close to midventral line. MD1 situated close to the anterior margin of segment and anterolaterad to D2; proprioceptors MSD1 and MSD2 lying anterad to seta SD1; MSD1 posterodorsad to MSD2; microsetae MV1, MV2 and MV3 situated opposite leg; MV3 anteroventrad to MV2 and latter posteroventral to MV1.
Abdominal Chaetotaxy

**A1, A2, A7 and A8 (Plate-1, fig.-5,7):** Setae of dorsal group D1 and D2 present close to middorsal line of segment; in A1 and A7, D1 longer and anterodorsad to D2; but in A2 and A8, D2 somewhat longer than D1. Subdorsal group possesses setae SD1 and SD2; SD1 longer than SD2 and encircled by rounded pinaculum; SD2 microscopic; in all the segments, SD1 dorsad to spiracle; SD2 anterodorsad to spiracle. Lateral group trisetose, represented by setae L1, L2 and L3; L1 and L2 present on common pinaculum; L3 present on a separate irregular pinaculum; L1 posteroventrad to spiracle; L2 anteroventrad to L1; L3 posteroventrad to L1; L3>L2>L1 lengthwise. Subventral group contains setae SV1, SV2 and SV3; in segment A2, subventral group trisetose, beset with setae SV1, SV2 and SV3, share same pinaculum; SV1 ventrad to L3; SV2 anterodorsad to SV1; SV3 anteroventrad to SV1; in segment A1 and A7, subventral group bisetose, beset with seta SV1 and SV2 and share same pinaculum; SV1 longer than SV2; SV1 present below L3; SV2 anterodorsad to SV1; in segment A8, subventral group unisetose with seta SV1 posteroventrad to L3. Ventral seta V1 posteroventrad to SV1 and close to midventral line. Micro setae MD and MV groups present; seta MD1 anterolatrad to D1; MV3 anterodorsad to SV1.

**A9 (Plate-1, fig. 9):** Dorsal group bisetose having setae D1 and D2; D1 seta share same pinaculum with subventral group; D1 anteroventrad to D2; D1 shorter than D2. Subdorsal group unisetose, seta SD1 posteroventrad to D1, SD1 thin and hair-like, much shorter than D1. Lateral group unisetose with seta L1 posteroventrad to SD1. Subventral seta SV1 posteroventrad to L1. Seta V1 posteroventrad to SV1 and lies close to ventral meson. Microsetae MD1 and MV3 lies near anterior margin of segment; MD1 anteroventrad to D2; MV3 anteroventrad to SV1.

**A10(Plate-1, fig.-10):** Anal shield well developed; anterior margin straight; posterior margin more or less rounded; D1 present near anterior margin of shield; D1 longer than D2; D2 lies at distal margin of shield. SD1 anterolateral to D2; SD2 beset near lateral margin of shield, anteroventrad to SD1; SD1 longer than SD2. Lateral group lies at dorsal margin of anal leg with seta L1 on anterior margin of the leg; L2 posteroventrad to L1; L3 dorsocaudad to L2; a pore lies posteroventrad and near to L1. Subventral group contains setae SV1, SV2, SV3 and SV4; SV1 lies dorsad to crochets; SV2 present anteroventrad to L2; SV3 anteroventrad to L1; SV4 anteroventrad to SV2. Ventral seta V1 located near midventral line.

**Discussion**

With look upon at larval head in the order Lepidoptera, a single seta F1 and a pore Fa represents frontal group (Heinrich, 1916). The similar condition found in Crambidae (Solis, *et al.* 2005): Pyralidae (Azam and Ali, 1965; Doerkson and Neunzig, 1975; Yoshiyasu, 1980; Center *et al.*, 1982; Franzmann and Garret, 1978; Yoshiyasu and Ohara, 1982; Rose and Behl, 1985; Passoa and Habeck, 1987) by the respective workers. The present observation conforms to these aforesaid studies in the *Pyrausta bambucivora* Moore. On the otherside, Valley and Wheeler (1976) and Adamski and Brown (1987) have revealed that the species, *Stomopteryx palpilineella* Chambers (Gelechiidae) and *Glyphidocera juniperella* Adamski (Blastobasidae) have two frontal setae i.e., F1 and F2.

The presence of two clypeal setae viz., C1 and C2 has been found to be there in the order Lepidoptera (Heinrich, 1916; Hinton, 1946) confirmed by Mathur, 1954, 1959;
Bhattacharjee and Menon, 1962; Mathur and Singh, 1956; Doerksen and Neunzig, 1975; Yoshiyasu and Ohara, 1982; Rose and Behl, 1985; Passoa and Habeck, 1987; Leonard et al., 1992, Nasu and Komai, 1997; Solis et al., 2005. The similar condition of clypeal group (i.e., C1 and C2) has been seen in species mentioned above. The inverted V shaped adfrontal area contains two setae AF1 and AF2 along with a pore, condition similar to this has been found by Bhattacharjee and Menon (1962); Azam and Ali (1965); Doerksen and Neunzig (1975); Franzmann and Garrett (1978); Center et al. (1982); Rose and Behl (1985); Amutha and David (1998) in Pyralidae; Singh and Goel (1986) in Noctuidae and Solis et al. (2005) in Crambidae. An equilibrium condition has also been noticed in the aforesaid species of superfamly Pyraloidea contains Pyrausta bambucivora Moore. Whereas, the pore AFa has been wanting in two Olethreutinae moth species by Hetz and Werner (1980). The anterior group comprises three setae i.e., A1, A2 and A3 and a pore Aa and the same has earlier been confirmed by Azam and Ali (1965); Rose and Behl (1985) and Amutha and David (1998); Singh and Goel, 1990; Singh, 1991 and Solis et al., 2005 in the families Pyralidae, Geometridae, Lymantridae and Crambidae respectively. The posterior group contains two setae viz., P1, P2 and two pores Pa and Pb on the larval head. But in presently studied species pore Pb is wanting. The arrangement of two setae and one pore has been found by Yoshiyasu (1980).

As far as, the seta L1 of the lateral group is concerned it has been noticed in almost all the species of different Lepidopteran families where as, the incidence of the pore La has been recorded as variable. On the other hand, this pore has been noted to be wanting in Crambid species Pyrausta bambucivora Moore. Similarly, this pore has been shown to be absent in Sceiidodes laialis Walker and genus Austromosotima Yen and Solis of the families Pyralidae and Crambidae by Ogunwolu (1978) and Yen et al. (2004) respectively. The dorsal group on the caterpillar head contains three microsetae i.e., MD1, MD2 and MD3 and a pore MDa (Hinton, 1946), which are duly present in the species Pyrausta bambucivora Moore.

The stemmatal group consists of three setae viz., S1, S2 and S3 besides two pores Ss and Sb as has been observed in Pyrausta bambucivora Moore. However, workers such as Mathur (1954), Sohi and Mavi (1969), Rishi (1971), Singh and Goel (1986) and Singh and Goel (1990) have reported an absence of the pore Sb in the families Pyralidae and Noctuidae.

Setae D1 and D2 are duly recorded in the above mentioned species (Hinton, 1946; Carter, 1984; Stehr, 1987). The position of setae in species such as Agrotis ypsilon Rottemberg (Rishi, 1971), Chalciope hyppasis (Cramer) (Singh and Goel, 1986) and Noctua pronuba (Linnaeus) (Neil and Specht, 1987) (Noctuidae) has been noticed by the respective workers.

It has been investigated that the subdorsal group is bisetose and represented by two setae i.e., SD1 and SD2 which found to be present in the species Pyrausta bambucivora Moore, Workers such as Sohi and Mavi (1969), Rishi (1971), Singh and Goel (1986) and Neil and Specht (1987) have reported similar setal arrangement in the species viz., Agrotis flammataria Schiffermullar, Agrotis ypsilon Rottemberg, Chalciope hyppasis (Cramer) and Noctua pronuba (Linnaeus) of family Noctuidae.

T1 contains bisetose lateral group which is anterior to spiracle and both the setae i.e., L1 and L2 being present on a single pinaculum has been noticed in the Pyrausta bambucivora Moore. Presence of two setae in the species of genus Plusia Felder, in species Hybalaea puera Cramer, Melanolophia imitata (Walker), Dichocrocis punctiferalis Guénée, Agrotis flammataria Schiffermullar, have also been recorded by workers such as Mukherji and Singh (1951); Singh (1955), Evans (1962), Azam and Ali (1965), Sohi and Mavi (1969), Rishi (1971), Mackay (1972), Wong and Melvin (1976) and Allyson (1980, 1981). Whereas, workers like Rishi (1971), Godfrey (1973), Kumar and Goel (1987), Singh and Goel (1990) and Singh et al. (1995a) have observed only L2 seta of the lateral group in the Noctuid species i.e., Agrotis ypsilon Rottemberg, Platysera albalabes (Grote), Plusia orichalcea Fabricius, Amyna leucostriga Hampson and Earias insulana (Boisdalva), E. vitella (Stoll) respectively. The subventral group furnished with two setae i.e., SV1 and SV2 are always arranged on a common pinaculum in all the species of superfamly Pyraloidea. Presence of two subventral setae in the species Hybalaea puera Cramer of family Hyblaeidae; in Melanolophia imitata (Walker) of family Geometridae; in species Agrotis flammataria Schiffermullar, Agrotis ypsilon Rottemberg, Enargia decolor (Walker), Chalciope hyppasis Cramer, Noctua pronuba (Linnaeus), Amyna leucostriga Hampson of family Noctuidae, in species Cochylis arthuri Dang of Cochylidae has been reported by Singh (1955), Evans (1962), Sohi and Mavi (1969), Rishi (1971), Wong and Melvin (1976), Singh and Goel (1986), Neil and Specht (1987), Singh and Goel (1990) and Arthur.
and Powell (1990). Besides the presence of seta V1 in the presently studied species, the proprioceptors i.e., MXD1, MV2 and MV3 are always present.

Both T2 and T3 bearing dorsal (D1, D2) and Subdorsal (SD1, SD2) groups have bisetose setae present on the same pinaculum in the species Pyrausta bambucivora Moore. The two setae in dorsal group i.e., D1 and D2 and two into subdorsal group have also been noticed in certain moth species by the following workers (Singh, 1955; Mackay, 1959; Bhattacharjee and Menon, 1962; Azam and Ali, 1965; Evans, 1962; Sohi and Mavi, 1969; Rishi, 1971; Mackay, 1972; Common, 1973; Valley and Wheeler, 1976; Adamski and Brown, 1987; Leonard et al., 1992; Grehan et al., 1994; Amutha and David, 1998; Davis, 2000; Yen et al., 2004 and Solis et al., 2005).

The setae of the lateral group have much variability in their number and arrangement in order Lepidoptera (Stehr, 1987), furnished by one seta i.e., L1 (Aenetus virescens Doubleday, Grehan, 1981), (Korscheltellus gracilis (Grote) and Sthenopis auratus (Grote), Leonard et al., 1992) or two setae viz., L1 and L2 (in genus Glyphidocera Walsingham, Adamski and Brown, 1987) or three setae viz., L1, L2 and L3 (Tracholina homopolia (Turner), Common, 1973), (Heleanna melanomocla (Meyrick), (Nomophila noctuella (Denis & Schiffermüller), Mackay, 1972), (Zophodia convolutella Hübner and Hellula rogalatis (Hulst), Allyson, 1980, 1981), (Melanolophia imitata (Walker), Evans, 1962). In the present observation, the lateral group contains three setae i.e., L1, L2 and L3 in all the species of superfamily Pyraloidea.

The subventral group may be represented by a single seta i.e., SV1, as in the species Pyrausta bambucivora Moore. Workers like Mackay (1972), Ogunwolu (1978), Rose and Behl (1988), Anioke and Boakye (1992) and Amutha and David (1998) in the family Pyralidae; Sohi and Mavi (1969), Rishi (1971) and Singh and Goel (1990) in Noctuidae; Horak (1991), Nasu and Komai (1997) and Komai (1999) in Tortricidae; Brown and Nishida (2003) in Tortricidae have already investigated the presence of single seta SV1 in the respective families. Whereas, Stehr (1987), Joshi et al. (1989) and Darling (2003) have observed that there are two setae SV1 and SV2 in the families Notodontidae, Sphingidae, Epiplemidae and Thyrididae respectively. According to Fracker (1915) and Hinton (1946) the dorsal group comprises two setae i.e., D1 and D2 which are present on A1-A8 in the order Lepidoptera. Likewise, the present species have also the same arrangement as has been reported by Singh (1955) in the species Hyblaea puera Cramer of family Hyblaeidae.

The subdorsal group having two setae i.e., SD1 and SD2 on A1-A8 has also been observed in the presently studied species, which was also confirmed in species such as Stomopteryx palpilineella (Chambers) (Valley and Wheeler, 1976); Coryphista meadi atlantica Murnoe (Mackay, 1972); Zophodia convolutella (Hübner) and Hellula rogalatis (Hulst) (Allyson, 1980, 1981) of the families viz., Gelechiidae and Noctuidae have been recorded by the respective workers. Trisetose lateral group contains three setae i.e., L1, L2 and L3 on the abdominal segments in the aforesaid fifteen species studied during course of present studies. The presence of all the three setae has also been observed in certain species by workers such as Valley and Wheeler (1976), Nasu et al. (1993), Nasu (1995) in their publications.

During present investigation, it has been noticed that on A1, this group possesses two setae (SV1, SV2) in the species Pyrausta bambucivora Moore. Similar condition of setal arrangement on A1 has confirmed by Valley and Wheeler (1976) and Sohi and Mavi (1969), Rishi (1971) and Kumar and Goel (1987) (Noctuidae) in the species Stomopteryx palpilineella (Chambers), Agrotis flammaatra Schiffermüller, Plusia orichalcea Fabricius respectively.

In the presently studied species Pyrausta bambucivora Moore, the subventral group is bisetose (i.e., SV1 and SV2) on A7. Similar bisetose arrangement on A7 has been found in species in Nomophila noctuella Denis and Schiffermüller (Pyralidae) (Mackay, 1972).

A single seta (SV1) of the subventral group on segment A8, is duly present in the species Pyrausta bambucivora Moore, investigated presently. The earlier observations in the species Tracholina homopolia (Turner) (Common, 1973), Neobarbara olivacea Liu and Nasu (Liu and Nasu, 1993), Epinotia tianshanensis Liu and Nasu and Zieiraphera gansuensis Liu and Nasu (Liu and Nasu, 1993), Statherotis discana (Fielder and Rogenhofer) (Nasu et al., 1993), Heleanna melanomocha (Meyrick) (Nasu, 1995) have conformed the aforesaid condition.

The presence of single seta V1 of the ventral group on A1-A8 in all the species goes in accordance to the earlier works by Singh (1955), Evans (1962), Sohi and Mavi (1969), Rishi (1971), Mackay (1972), Common (1973),

According to Stehr (1987), the number of various setae pertaining to various groups on A9 are relatively reduced to D1 and D2, SD1, L1 (sometimes L2 and L3), SV1 (sometimes SV2) and V1 have been observed by workers such as Mackay (1972), Valley and Wheeler (1976), Ogunwolue (1978), Arita and Diakonoff (1979), Center et al. (1982), Arita, (1989), Liu and Nasu (1993) and Nasu et al. (1993) in the species viz., Nomophila noctuella Denis and Schiffermüller (Pyralidae), Stomopteryx palpilineella (Chambers) (Gelechiidae), Sceliodes laisalis Walker (Pyralidae). Allyson (1981) has noticed that the seta SD1 is quite finer than the other setae in a Pyralid, Hellula rogatalis (Hulst). A similar condition has been found in Pyrausta bambucivora Moore.

After scrutiny of the relevant literature, it has been inferred that the chaetotaxy of A10 has been attempted by workers such as Singh (1953), Hasenfuss (1969) and Stehr (1987). Further, workers like Allyson (1980), Yoshiyasu (1980), Yoshiyasu and Ohara (1982), Hashimoto (1982), Wong et al. (1983), Singh and Goel (1986, 1987), Beck et al. (1993) and Singh et al. (1995). But they have just mentioned the names of the setae present on the anal shield. However, in the species studied presently, an attempt has been made to fill the gap regarding the chaetotaxy of A10. In the presently studied species, both the setae of the dorsal (D1, D2) and subdorsal groups (SD1 and SD2) are well represented on the anal shield and the lateral group represented by three setae i.e., L1, L2 and L3. The subventral group contains four setae viz., SV1, SV2, SV3 and SV4 in Pyrausta bambucivora Moore.

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References


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PLATE 1

Head: Frontal View

Head: Lateral view

T1

T2T3

A1A7

A2

A8

A3-6

A9

A10