



TAXONOMIC STUDIES ON GRAMINACEOUS STEM BORERS FROM NORTH INDIA

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ABSTRACT

Thirteen species of stem borers attacking graminaceous crops, belonging to five genera viz. *Chilo* Zincken, 1817; *Scirpophaga* Treitschke, 1832; *Bissetia* Kapur, 1950; *Emmalocera* Ragonot, 1888; *Sesamia* (Guenée, 1852) have been redescribed with current valid names, synonyms, authors, distribution, and host plants. The specimens were identified from characters of the genitalia such as shape of the uncus, gnathos, valva, projections of the costa or tegumen, and shape of aedeagus. The genitalia of *Emmalocera aurifusellus* (Walker, 1866) is described here for the first time. Photographic illustrations for each species which includes the male and female habitus, and the genitalia of both sexes and diagnostic keys are provided.

Key words: Lepidoptera, Noctuidae, Crambidae, Pyralidae, *Chilo*, *Scirpophaga*, *Bissetia*

Graminaceous crops are one of the most important sources of food for humans and their livestock. Rice, maize, wheat, sugarcane, pearl millet and sorghum are important graminaceous crops in India. Many biotic factors hinder the productivity of these crops of which 20–40% of crop losses occur across the world due to pests and among them lepidopteran stem borers cause the most significant damage (Vallée et al., 2016). Especially, lepidopteran stem borers belonging to family Crambidae, Pyralidae and Noctuidae are the important economic pests of these graminaceous crops worldwide, reducing crop yields up to 40% (Lee et al., 2019). Among several stem borers, genus *Chilo* Zincken, 1817; *Scirpophaga* Treitschke, 1832 and *Sesamia* (Guenée, 1852) are economically important and taxonomically complex.

In India, many historical accounts have documented lepidopteran insect pests viz., Cotes (1889-1896), Lefroy (1909), Fletcher (1914), Pruthi (1969), Kapur (1950) Kollar (1844-48) and Moore (1865) contributed to stem borer fauna from India. Walker (1863) published a list of specimens in the collection of British Museum (now NHM, London). Moore (1884-87) published the *Lepidoptera of Ceylon*, including pyralid and present crambids fauna. Butler (1879) dealt with the North Eastern fauna and provided illustrations of lepidopteran type specimens present in the British Museum. Ghai et al. (1979) reported lepidopterous pests associated with rice crop in India including several rice stem borers. Arora (2000) studied taxonomy of economically important pyralids and crambids from India and provided keys for identification of economically important species of crambids. However, most of the isolated publications

are on stem borers with special reference to crops i.e., rice, maize, sugarcane and sorghum. Moreover, majority of the publications provide line diagrams which are difficult to be understood by many non-taxonomists. Keeping this in view, in present study we redescribe important stem borer species occur in North India along with current taxonomic status, colour illustrations, Host plants, distribution, remarks and diagnostic keys for their identification.

MATERIALS AND METHODS

The materials used were obtained from different sources. A substantial number of identified specimens were obtained from National Pusa Collection (NPC), Division of Entomology, ICAR-Indian Agricultural Research Institute, New Delhi. Some specimens were also sorted out from the unidentified collections at NPC. The specimens were also collected from different locations viz., New Delhi, Lucknow and Punjab. Characters like length of labial palpi with respect to the diameter of the eye, venation of forewing and hindwing giving emphasis to the origin of the veins, specific colour and markings on wings, characters of male genitalia like the shape of gnathos, uncus, the shape of the valva, presence of costal or subteguminal processes, shape of the aedeagus etc. and characters of the female genitalia like the presence or absence of signum, shape of the bursa copulatrix etc. were used in the present study.

For preparation of genitalia slides, the abdomen of the moths was separated by a small hitch at its base. The separated abdomen was then placed in a

cavity block containing 10% KOH solution and left overnight. The abdomen was then washed in a cavity block with distilled water to remove excess KOH. The abdomen was then placed in another cavity block containing 10% ethanol. Using a pair of fine forceps, the genitalia was then separated gently from the abdomen. The separated genitalia structures were then placed on a clear microscope slide in 98% pure glycerol medium, covered with a cover slip and thereafter photographed and identified. The terminologies of Klots (1965) were adopted to describe the genitalia. After examining the specimen parts, it was transferred to into a micro-vial containing 98% glycerol and pinned below the respective specimen. The adult moths were photographed using a Canon 80D with 110 mm macro lens. The slides of male and female genitalia were photographed with digital camera Leica DFC 425C on a Leica 205FA stereo zoom microscope with auto-montage at the National Pusa Collection (NPC), Division of Entomology, ICAR-IARI, New Delhi. The specimens were identified with the help of genitalia structures using appropriate literature (Kapur, 1950; Bleszynski, 1970; Lewvanich, 1981; Arora, 2000).

RESULTS AND DISCUSSION

The stem borers infesting graminaceous crops are economically important and mostly belong to different families including Crambidae, Pyralidae and Noctuidae. The species can be recognised by the shape of labial palpi, wing venation pattern and genitalia. The species dealt within this paper in the aforementioned families are *Bissetia steniellus* (Hampson, 1899); *Chilo auricilius* Dudgeon, 1905; *Chilo infuscatellus* Snellen, 1890; *Chilo partellus* (Swinhoe, 1885); *Chilo sacchariphagus* Bojer, 1856; *Scirpophaga excerptalis* (Walker, 1863); *Scirpophaga gilviberbis* Zeller, 1863; *Scirpophaga incertulas* (Walker, 1863); *Scirpophaga nivella* (Fabricius, 1794) belonging to Crambidae; *Emmalocera aurifusellus* (Walker, 1866); *Emmalocera depressella* (Swinhoe, 1885) of Pyralidae family; *Sesamia inferens* (Walker, 1856) and *Sesamia uniformis* (Dudgeon, 1905) of Noctuidae.

1. *Bissetia steniellus* (Hampson, 1899) [Figs. 1, 2, 27, 40]

Chilo steniellus Hampson, 1899: 305; *Chilo trypetes* Bisset, 1939: 47, 48; *Chilo griseoradians* de Joannis, 1930: 603

The species was first placed under *Chilo*, due to the characters of the frons and venation of the forewing.

Bisset (1939) described it as *Chilo trypetes*. Kapur (1950) placed it under *Bissetia* owing to the shape of the frons, serration in antennae and characters of genitalia.

Redescription: Pale brownish head. Length of labial palpi more than three times the diameter of the compound eye. Segments of male antenna very broad and widely located and segments of female antenna are at some point flat and serrated. Forewings brownish grey. SC and R₁ cross each other forming a cross, none of these two veins reach the costal margins. R₂ takes its origin from the anterior angle of the cell. R₃ originates from the upper region in the anterior of the cell and then separates into branches R₃ and R₄. R₅ arises from the anterior angle of the cell. M₁ originates from RS after the angle of the cell; M₂ and M₃ arise from lower angle of cell; Cula and Culb arise from before angle of the cell. Hindwing whitish in colour. SC + R₁ and RS diverge out from a common stalk from which M₁ also originates. M₂ and M₃ slightly stalked at origin and diverge after the posterior angle.

Male genitalia with moderately enlarged collar shaped vinculum, curved in middle and bent on both sides. Costa has two broad teeth like projections proximally, serrations on costal arm near the projection, serrations have sparse hairs. Distal region of valval curved, narrow, elongated and covered with long hairs. Tegumen triangular in shape; apex and sides of the tegumen are sclerotised. Uncus and gnathos narrow, pointed at the apex and almost as long as the tegumen. Aedeagus tubular shaped without any cornuti. Female genitalia with ovipositor opening funnel-shaped, and seems like a single elongated plate. Ostium bursae longitudinally oval shaped and sunk in the genital chamber. Ductus bursae sclerotized at its proximal one-third portion. Pear shaped bursa copulatrix, spot like signum present on mid-ventral surface.

Material examined: India: Punjab, 6♂ and 11♀, 2.viii.1997, on sugarcane coll. Z.H. Khan

Distribution: India, Vietnam (Nuss et al., 2003-2020), China (Kapur, 1950)

Host plants: exclusively on Sugarcane (Kapur, 1950)

Remarks: *Bissetia steniellus* was initially described as *Chilo trypetes*, based on the forewing venation and frons characteristics. Apart from the differences in genitalia, Kapur (1950) observed that although quite similar, the frons shape is not identical in *Chilo* and

Bissetia genera. A conspicuous corneous point and lower ridge observed in *Bissetia* but not in *Chilo*. Moreover, *Chilo* has well developed ocelli and the antenna not distinctly serrate; whereas in *Bissetia* there is no ocelli and antennal serrations are comparatively distinct.

2. *Chilo auricilius* Dudgeon, 1905 [Figs. 3, 4, 28, 41]

Chilo auricilia Dudgeon 1905: 405; *Diatraea auricilia* (Dudgeon): Fletcher 1928: 58; Gupta 1940: 799; *Chilotraea auricilia* (Dudgeon): Kapur 1950: 408; *Chilo popescugorji* Bleszynski 1963: 179; *Chilo auricilia* Dudgeon: Bleszynski and Collins 1962: 239; *Chilo auricilius* Dudgeon; Bleszynski 1965: 113; 1969: 16.

This species was first described by Dudgeon as *Chilo auricilia*. Hampson (1912) stated that *Chilo auricilia* and *Chilo suppressalis* Walker were synonyms. In 1918, Fletcher considered *auricilia* as a distinct species. But in 1928, he stated that the species he regarded as *C. auricilia* was in fact *Argyria sticticrasis* Hampson, and the species he designated as *Diatraea* sp. was actually *auricilia*. Thereafter, he considered the species in the genus *Diatraea*. But, *Diatraea* Guiling is confined to the New World species, therefore this species cannot be placed under that genus and thus considered under *Chilotraea* Kapur (1950). Bleszynski and Collins (1962) considered the genus *Chilotraea* of Kapur as a synonym of the genus *Chilo*.

Redescription: Head with small and distinct ocellus. Forward produced face with or without small point. Labial palpus length about 3 times (in male) to 4 times (in female) of that of the diameter of the eye. Ground colour of wings yellowish to brownish; variably covered with small spots of brown scales; discal dot observed; subterminal line has a row of metallic scales, present close to termen; median line and subterminal line have same colouration; shiny golden coloured fringe; terminal dots of considerable size. Wing coupling frenate type with a single spine in males and three spines in females. In forewing, Sc and R₁ passes near each other without fusing and proceed as separate veins. R₂ arises from the radial sector before the upper end of the cell. R₃ originates from the upper corner in the anterior of the cell and then separates into R₃ and R₄. R₅ takes its origin from near the anterior angle of the cell. M₁ originates from the RS after the angle of the cell. M₂ and M₃ are separate, both emerge from the common stalk observed at the posterior end of the cell. Hind

wing slightly brownish, veins SC+R₁ and RS originate free to a limited extent, but near to beyond the cell, they anastomose but again diverges to form SC+R₁ and RS. M₁ arises as a free vein, connects to RS by a small branch and again separates as M₁. Both M₂ and M₃ originate from a single short stalk after the cell. A₁, A₂ and A₃ are present.

Male genitalia with large saccus; two arms of juxta-plate with symmetrical ends and does not reach the costal angle of valva near the base; well defined, cone shaped projection on aedeagus near the apex; long ventral arm, notched apex; small bulb like basal projection. Female genitalia having ostial pouch somewhat delineated from ductus bursae, sclerotization is moderate; small sized; signum absent.

Material examined: INDIA: Bihar: Pusa, 2♂ and 8♀, 6.ii.1916, on sugarcane, coll. Haq; INDIA: Hyderabad, 3♂ and 9♀, 10.v.1988 on sugarcane, coll. Hassan.

Distribution: India, Bangladesh, East Malaysia, Hong Kong, Indonesia, Myanmar, Nepal, Papua New Guinea, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam (Bleszynski, 1970; David and Easwaramoorthy, 1990; Harris, 1990).

Host plants: *Oryza sativa*, *Saccharum officinarum*, *Sorgum biolor*, *Zea mays* (Bleszynski, 1970; Huang et al., 1985; Chundurwar, 1989; Harris, 1990).

Remarks: *Chilo auricilius* and *C. polychrysus* are morphologically similar. *C. polychrysus* has a shorter labial palpus (Kalshoven, 1981) compare to *C. auricilius*. Pars basalis notched in *C. polychrysus* but not in *C. auricilius*; in *C. polychrysus* arms of juxta plate are not completely symmetrical, whereas in *C. auricilius* they are symmetrical. In females of *C. polychrysus* a heavily sclerotized region proximal to the ostial pouch is found on the ductus bursae, which is not the case with *C. auricilius*. Similar results were observed by Bleszynski (1970).

3. *Chilo infuscatellus* Snellen, 1890 [Figs. 5, 6, 29, 42]

Chilo infuscatellus Snellen 1890: 94, Shibuya 1928b: 54, Bleszynski, 1962b: 111, 1965: 116, 1969: 15; *Argyria sticticrasis* Hampson 1919: 449, Gupta 1940: 788, Isaac and Rao 1941: 799; Isaac and Venkatraman 1941: 806 [syn. Kapur 1950]; *Argyria coniorata* Hampson 1919: 449 [syn. Fletcher 1928]; *Diatraea calamina* Hampson 1919: 544 [syn. Kapur 1950];

Diatraea auricilia (Dudgeon): Fletcher and Ghosh 1920: 387; *Diatraea shariinensis* Eguchi 1933: 3 [syn. Kapur 1950]; *Chilo tadhikiellus* Gerasimov 1949: 704; *Proceras infuscatellus* (Snellen): Kalshoven 1950: 413; *Chilotraea infuscatellus* (Snellen): Kapur 1950: 404.

Kapur (1950) synonymised *Chilotraea infuscatellus* with *Argyria sticticraspis* Hampson and also with *Diatraea calmina* Hampson. The specimens of *Diatraea shariinensis* Eguchi, as well as the figures given by Eguchi (1933) also agree in structural details with *infuscatellus*; which was also synonymised by Kapur (1950) as *Chilotraea infuscatellus*. Bleszynski and Collins (1962) recently considered the genus *Chilotraea* of Kapur as a synonym of the genus *Chilo*.

Redescription: Ocelli easily noticeable and well developed. Labial palpus length about 3 times (in male) to 3.5 times (in female) of the diameter of the eye. Face rounded; the anterior part of the head protrudes slightly beyond the eye. Fore wing ground-colour is drab, from pale yellowish to light brownish; discal dot reduced; transverse lines are not consistent; terminal dots are observed; absence of metallic scales. Frenate type wing coupling with a single tough frenulum in males and tripartite in females. In forewing, Sc and R₁ passes near each other without fusing and proceed as separate veins. R₂ takes its origin from the anterior angle of the cell. R₃ originates from the upper corner in the anterior of the cell. It then separates into R₃ and R₄. R₅ takes its origin from near the anterior angle of the cell. M₁ originates from the RS after the angle of the cell. M₂ and M₃ are separate and free, both emerge from the common stalk observed at the posterior end of the cell. Hind wing white coloured with a silk like texture in females. The veins SC + R₁ and RS originate free to a limited extent, but near to beyond the cell, they anastomose but again diverges to form SC + R₁ and RS. M₁ arises as a free vein, connects to RS by a small branch and again comes out as M₁. Both, M₂ and M₃ originate from a single short stalk after the cell. A₁, A₂ and A₃ are present.

Male genitalia having slight presence of pars basalis, juxta symmetrical, juxta arms are close to the basal-costal angle of valva; toothed strengthening present on both arms; ventral part of aedeagus with conspicuous swelling; cornuti single, tapering and large. Female genitalia with ostial pouch sclerotized and delineated from ductus bursae; anterior portion presents a deep incision; signum lamellate, median ridge present on signum.

Material examined: India: Orissa: Cuttack, 5♂ and 8♀, 10.viii.1960, at light coll. Misra; INDIA: Uttar Pradesh: Cawnpur, 6♂ and 5♀, 18.viii.1914, on sugarcane coll. E.S.Daniel.

Distribution: India, Bangladesh, China, Afghanistan, Indonesia, Korea, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Tadjikistan, Taiwan, Thailand, Timor, Vietnam (Carl, 1962; Bleszynski, 1970; Chundurwar, 1989; David and Easwaramoorthy, 1990; Harris, 1990; Neupane, 1990).

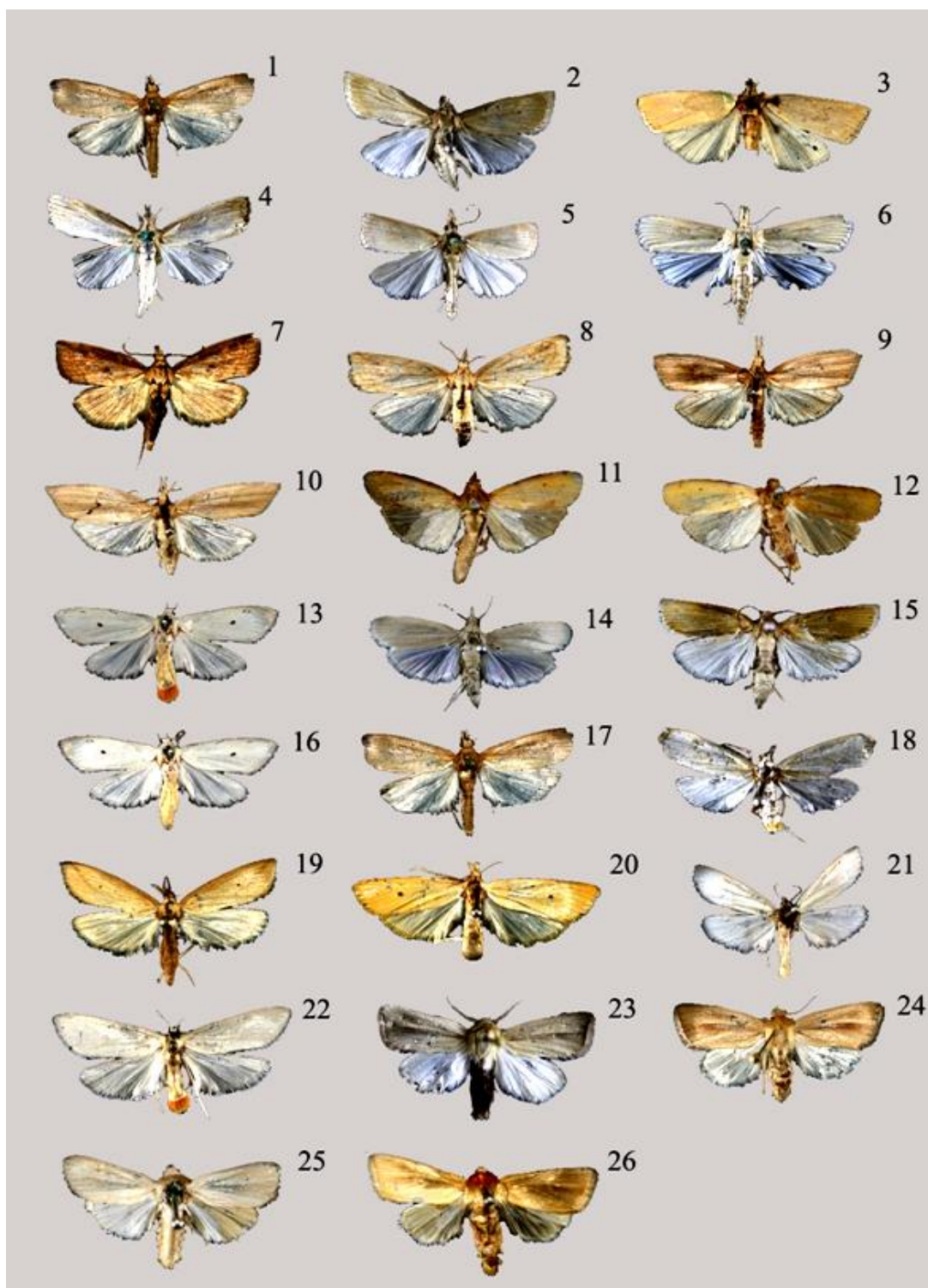
Host plants: *Andropogon sorghum*, *Avena sativa*, *Cynodon dactylon*, *Cyperus rotundus*, *Echinochloa colonum*, *Hordeum vulgare*, *Oryza sativa*, *Panicum* spp., *Rottboellia compressa*, *S. officinarum*, *S. spontaneum*, *Saccharum fuscum*, *Sorghum bicolor*, *Zea mays* (Bleszynski, 1970).

Remarks: *C. infuscatellus* and *C. auricilius* are similar in terms of the frons being smooth, produced forward, and corneous point not observed. But they can be differentiated based on the wing venation, in *C. infuscatellus* R₂ arises from the anterior corner of cell, but in *C. auricilius* R₂ arises from RS before the cell's upper angle (Puri, 1957). Aedeagus has a ventral arm in *C. auricilius* absent in *C. infuscatellus*. In the female genitalia, a lamellate signum present in *C. infuscatellus*, absent in *C. auricilius* (Bleszynski, 1970).

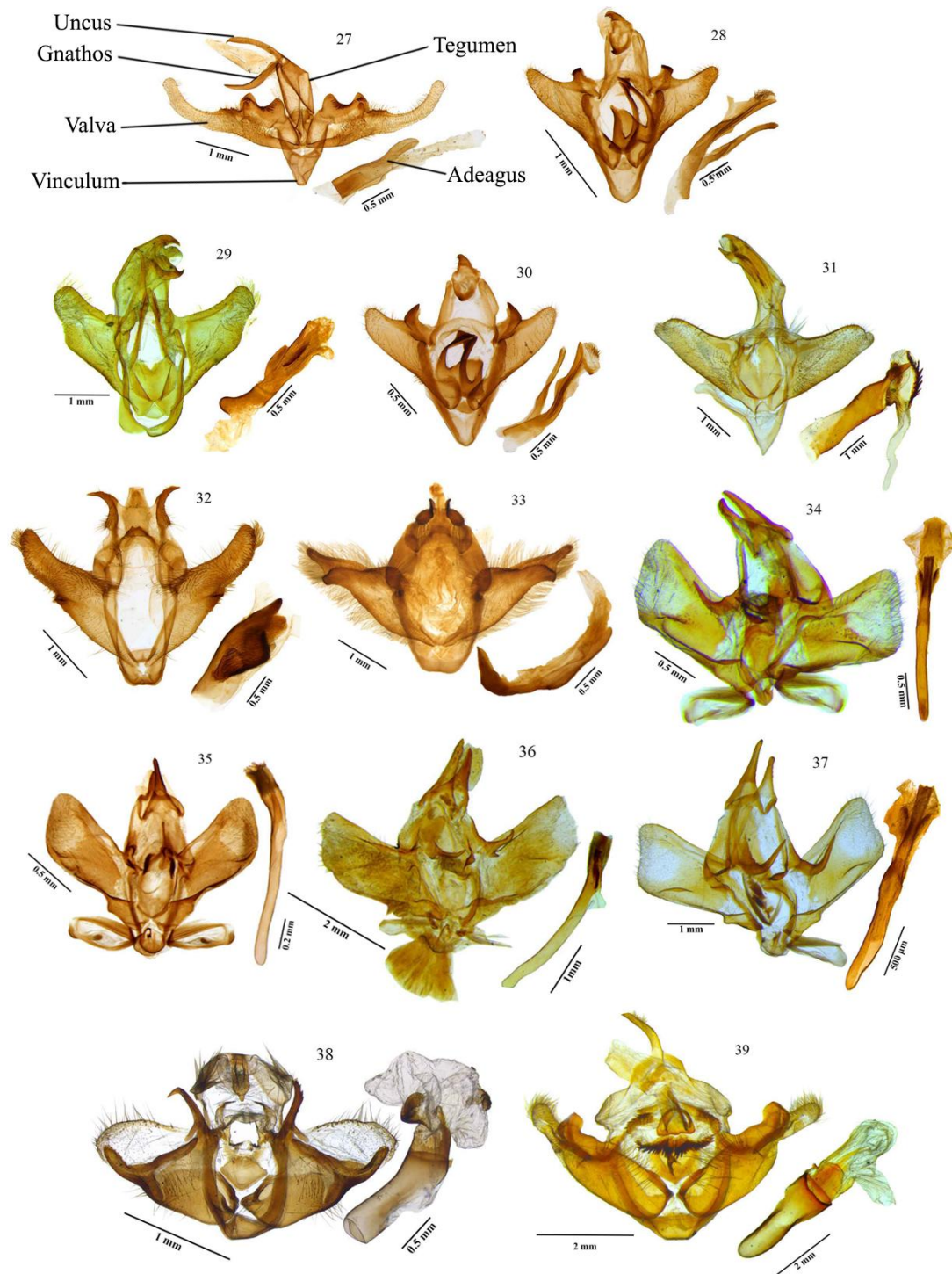
4. *Chilo partellus* (Swinhoe, 1885) [Figs. 7, 8, 30, 43]

Crambus zonellus Swinhoe 1884: 528; *Crambus partellus* Swinhoe 1885: 879; *Chilo simplex* (Butler): Hampson 1896a: 957, Hampson 1896b: 26, Rebel 1901: 259; *Diatraea calamina* Hampson 1919: 544; *Chilo zonellus* (Swinhoe) Fletcher, 1928; *Argyria lutulentalis* Tams 1932: 127; *Chilo zonellus* (Swinhoe): Gupta 1940: 806; Isaac and Venkatraman 1941: 810 [larva, pupa]; Kapur 1950: 399; *Chilo partellus* (Swinhoe): Bleszynski and Collins 1962: 243; Bleszynski 1965: 119; 1970: 126.

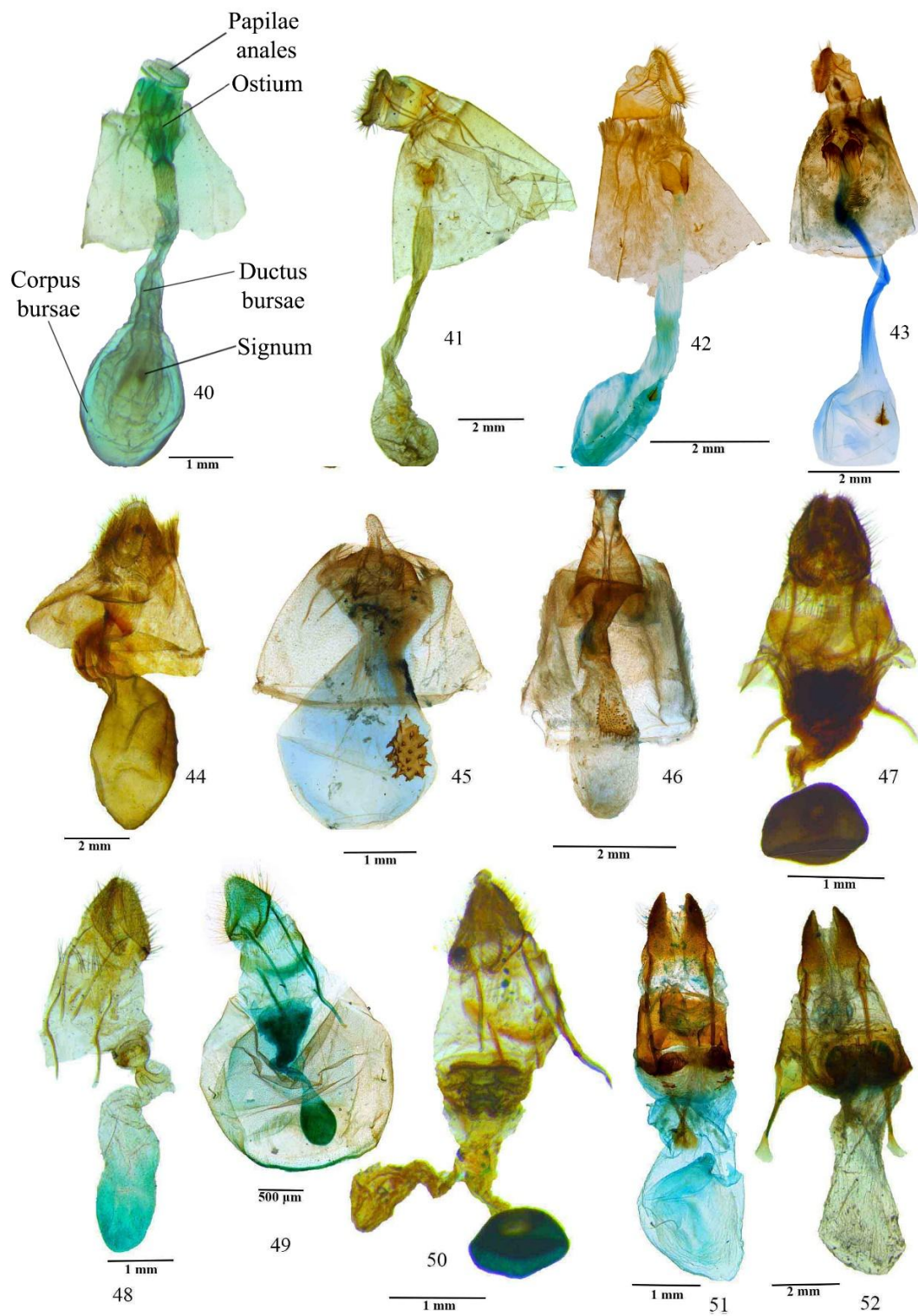
Hampson (1895, 1896) synonymised *Crambus zonellus* and *Crambus partellus* with *Chilo simplex* Butler. Fletcher (1928) considered *C. simplex* and *Chilo zonellus* to be separate species, and regarded *Chilo partellus* as a synonym of *C. zonellus*. Bleszynski (1970) revised all known species of *Chilo*, and in it, *Chilo zonellus* (Swinhoe), was considered a synonym of *C. partellus*. At present, therefore *C. partellus* is the valid name for the spotted stem borer.



Figs. 1-26. Adult habitus: 1. *B. steniellus* male, 2. *B. steniellus* female, 3. *C. auricilius* male, 4. *C. auricilius* female, 5. *C. infuscatellus* male, 6. *C. infuscatellus* female, 7. *C. partellus* male, 8. *C. partellus* female, 9. *C. sacchariphagus* male, 10. *C. sacchariphagus* female, 11. *E. aurifusellus* male, 12. *E. aurifusellus* female, 13. *E. depressella* male, 14. *E. depressella* female, 15. *S. excerptalis* male, 16. *S. excerptalis* female, 17. *S. gilviberbis* male, 18. *S. gilviberbis* female, 19. *S. incertulas* male, 20. *S. incertulas* female, 21. *S. nivella* male, 22. *S. nivella* female, 23. *Se. inferens* male, 24. *Se. inferens* female, 25. *Se. uniformis* male, 26. *Se. uniformis* male female.



Figs. 27-39. Male genitalia and aedeagus: 27. *B. steniellus*, 28. *C. auricilius*, 29. *C. infuscatellus*, 30. *C. partellus*, 31. *C. sacchariphagus*, 32. *E. aurifusellus*, 33. *E. depressella*, 34. *S. excerptalis*, 35. *S. gilviberbis*, 36. *S. incertulas*, 37. *S. nivella*, 38. *Se. inferens*, 39. *Se. uniformis*



Figs. 40-52. Female genitalia: 40. *B. steniellus*, 41. *C. auricilius*, 42. *C. infuscatellus*, 43. *C. partellus*, 44. *C. sacchariphagus*, 45. *E. aurifusellus*, 46. *E. depressella*, 47. *S. excerptalis*, 48. *S. gilviberbis*, 49. *S. incertulas*, 50. *S. nivella*, 51. *Se. inferens*, 52. *Se. uniformis*

Redescription: Well-developed ocellus. Face cone shaped anteriorly, having a definite hard point; slight ventral ridge present. Labial palpus about 3 times (in male) to 3.5 times (in female) in length compared to that of the diameter of the eye. Forewing dirty brown to straw brown coloured. Subterminal line brown coloured, thin; median line not distinct; presence of discal dot; no metallic scales on wing. Wing coupling frenate type. Sc and R₁ do not fuse. Vein SC remains free and borders the costal margin. In forewing, Sc and R₁ passes near each other without fusing and proceed as separate veins. R₂ takes its origin from the anterior angle of the cell. R₃ originates from the upper corner in the anterior of the cell. It then separates into R₃ and R₄. R₅ takes its origin from near the anterior angle of the cell. M₁ originates from the RS after the angle of the cell. M₂ and M₃ are separate and free, both emerge from the common stalk observed at the posterior end of the cell. Hind wing greyish in colour. The veins SC + R₁ and RS originate free to a limited extent, but near to beyond the cell, they anastomose but again diverges to form SC + R₁ and RS. M₁ arises as a free vein, connects to RS by a small branch and again comes out as M₁. Part of M₁ that comes out seems disconnected from the main stalk of M₁. Both M₂ and M₃ originate from a single short stalk after the cell. A₁, A₂ and A₃ are present.

Male genitalia with tapering projection present on costa; symmetrical juxta-plate, central part of juxta plate large, arms of juxta stout and does not cross the costa, arms of juxta with sub-apical tooth; aedeagus having ventral arm and basal projection. Female genitalia with heavy sclerotization in ostial pouch; delicately longitudinal wrinkled; well demarcated from ductus bursae; deeply notch present; signum present having lamellar shape with a median ridge.

Material examined: India: New Delhi, 8♂ and 5♀, 10.viii.2019, Mercury vapour lamp, coll. Dey; India: Assam, 11♂ and 7♀, 18.ix.2019, pupa from maize plant, coll. Shashank.

Distribution: Afghanistan, Bangladesh, Botswana, Cambodia, Cameroon, Comoros, Congo, Ethiopia, India, Indonesia, Kenya, Laos, Madagascar, Malawi, Mozambique, Nepal, Pakistan, Rwanda, Somalia, South Africa, Sri Lanka, Sudan, Swaziland, Tanzania, Taiwan, Thailand, Togo, Uganda, Vietnam, Zambia, Zimbabwe (Bleszynski, 1970; Harris, 1989; Maes, 1998; Overholt, 1998).

Host plants: *Eleusine coracana*, *Hyparrhenia rufa*, *Oryza sativa*, *Panicum maximum*, *Pennisetum glaucum*,

P. purpureum, *Rottboelia compressa*, *Saccharum officinarum*, *S. arundinaceum*, *S. halepense*, *S. spontaneum*, *S. sudanense*, *S. verticilliflorum*, *S. vulgare*, *Vossia cuspidate*, Wheat, *Zea mays* (Bleszynski, 1970; Chundurwar, 1989; Maes, 1998).

Remarks: In terms of female genitalia, *C. partellus* and *C. tamsi* are quite similar. The two are differentiated by the ostial pouch, in *C. tamsi* it is elongated and comparatively small, but rounded in *C. partellus*. *C. partellus* is also similar to *C. orichalcociliellus*. But, *C. orichalcociliellus* has a sub-terminal line of shiny, golden yellow specks on the forewing and the hind wing colour is cream-yellow but in *C. partellus* the hindwing dirty white or greyish. In the female genitalia, the signum in *C. orichalcociliellus* is scobinate whereas in *C. partellus* the signum is lamellate and has a median ridge (Bleszynski, 1970).

5. *Chilo sacchariphagus* (Bojer, 1856) [Figs. 9, 10, 31, 44]

Proceras sacchariphagus Bojer 1856: unnumbered, Tams 1942: 67, Kapur 1950: 412, Kalshoven 1950: 411; *Borer saccharellus* Guenée 1862: unnumbered [syn. Tams 1942]; *Chilo mauriciellus* Walker 1863: 141. [syn. Tams 1942]; *Chilo venosatus* Walker 1863: 144 [syn. Bleszynski 1970]; *Diatraea striatalis* Snellen 1890: 98, 1891: 349 [syn. Hampson 1896b]; *Diatraea mauriciella* (Walker): Hampson 1896b: 953; *Diatraea venosata* (Walker): Hampson 1896b: 954; *Diatraea mauriciella* (Walker); Vinson 1941: 39, 1942: 39; *Proceras venosatus* (Walker): Kapur 1950: 413, Bleszynski 1962a: 9; *Chilo sacchariphagus* (Bojer): Bleszynski 1966: 494, 1969: 18, 1970: 182.

Bojer (1856) described the species as *Proceras sacchariphagus*. Hampson (1895) considered a species from Mauritius, under the name *D. mauriciella* separate from *D. striatalis*, and that was considered synonymous to a related species *D. venosatus* Walker occurring in Borneo, Malaya, China, India, etc. Later these three names were regarded as synonymous.

Fletcher (1914) reported *Diatraea venosata* Hampson, from south India. Tams (1942) considered it as a synonym of *Proceras sacchariphagus* Bojer. Kapur (1950), renamed the Indian specimen as "*Proceras indicus*", and considered it different from *Diatraea venosata* Hampson and *Proceras sacchariphagus* Bojer. However, Bleszynski (1970) considered *Proceras indicus* (sensu Kapur, 1950) as a subspecies of *P. sacchariphagus* Bojer as *Chilo sacchariphagus indicus* (Kapur) (Arora, 2000).

Redescription: Frons almost flat or subrounded, face do not protrude beyond compound eyes. Ventral ridge not observed. Ocellus reduced. Labial palpus three (in males) to about four (in females) times in length as compared to the diameter of compound eye. Fore wing light brownish coloured. Streaks present between and on the veins and dark spots present on termen. R_1 anastomosed with Sc. Sc meets the costal margin at a distance greater than two-thirds of the wing length. R_2 arise from beyond the upper angle of cell. R_3 and R_4 are stalked. R_5 and M_1 diverge distally from upper angle of cell; M_2 and M_3 diverge distally from lower angle of cell; Cu_1 not close to M_3 . Hind wing whitish in colour. Hindwing, $Sc+R_1$ meets the costal margin near the wing apex. RS originates close to the upper angle of the cell and anastomose with $Sc+R_1$ at $2/3^{rd}$ of the wing length and diverges to reach the wing margin. M_1 diverge distally from upper angle of cell; M_2 and M_3 diverge distally from lower angle of cell. M_2 and M_3 diverge distally from lower angle of cell; Cu_1 not close to M_3 . A_1 , A_2 and A_3 complete.

Male genitalia having uncus shaped like beak, gnathos sclerotised and almost equal in length as the uncus. Pars basalis is not present. Valva tapers slightly towards the apex into a blunt margin; juxta-plate short, broad, deeply notched, juxta arms are tapering and lack teeth. V-shaped saccus present. Ventral arm and basal process absent in aedeagus; vesica has row of strong cornuti. Female genitalia with papillae anales shaped like funnel. Ostial pouch quite delineated from ductus bursae, longitudinal ribs having heavy sclerotization; corpus bursae oblong shaped and longer compared to ductus bursae. Signum absent.

Material examined: India: Bihar: Pusa, 4♂ and 3♀, 28.ix.1917, sorghum stem; INDIA: Bihar: Pusa, 7♂ and 4♀, 27.viii.1917 on sugarcane, coll. R.S.

Distribution: India, Bangladesh, Comoros, China, Indonesia, Japan, Madagascar, Malaysia, Mauritius, Mozambique, Philippines, Singapore, Sri Lanka, Taiwan, Thailand (Bleszynski, 1970; Williams, 1983; Facknath, 1989; David and Easwaramoorthy, 1990; Leslie, 1994; Suasa-ard, 2000).

Host plants: *Saccharum officinarum*, wild *Saccharum* spp., rarely on maize and sorghum (Betbeder-Matibet and Malinge, 1968; Williams, 1983).

Remarks: This species has three different subspecies viz. *C. sacchariphagus sacchariphagus* (Bojer), *C. sacchariphagus indicus* (Kapur) and *C. sacchariphagus*

stramineellus (Caradja, 1932). The male genitalia of *C. s. stramineellus* has a broader aedeagus compared to *C. s. sacchariphagus*, and the apical part has scobinations which are not seen in *C. s. sacchariphagus*. In the female genitalia of *C. s. stramineellus*, ductus bursae twisted and having a distinct elongated sclerite which is not found in *C. s. sacchariphagus*. Aedeagus of *C. s. indicus* is also broader compared to *C. s. sacchariphagus*. However, the female genitalia of *C. s. indicus* is similar to that of *C. s. sacchariphagus* (Bleszynski, 1970).

6. *Emmalocera aurifusellus* (Walker, 1866) [Figs. 11, 12, 32, 45]

Crambus aurifusellus Walker 1866: 35

The species was first described as *Crambus aurifusellus* by Francis Walker in 1866. It was transferred to *Emmalocera* by Hampson (1918).

Redescription: Head with orange tinge. Frons having a tuft of scales. Labial palpi porrect. Second joint of labial palpi hollowed out to receive the brush like maxillary palpi. Middle and hind tibia are fringed with hairs on the outer side. Forewings with the apex rounded. Ground colour golden yellow. The base has a reddish-orange spot. The costal fascia extending before base to the apex. R_2 arise from before the cell. R_3 and R_4 stalked. $Cu1A$ and $Cu1B$ arise from a common stalk. Hindwing whitish with a yellowish tinge. Vein R_2 emerge from the angle of the cell. M_2 , M_3 , $Cu1A$ and $Cu1B$ arise from a common stalk from which $Cu1A$ and $Cu1B$ diverge out before the posterior angle of the cell.

Male genitalia with uncus lobes long, curved and pointed apically. Uncus lobes with hair-like setae. Gnathos arms stout with the middle part broad, distal process narrow, elongated, pointed. Tegumen sclerotized, hexagonal in shape. Valva narrowed to half of its length, then both the margins run parallel to a rounded apex; Costal region of valva covered with long setae. Juxta small, plate-shaped, subovate. Saccus rounded rectangular. Aedeagus short and stout. Female genitalia with ductus bursae short. Corpus bursae globose shaped. Corpus bursae increases in diameter cross section up to two-third of it from the ductus bursae, remaining portion hemispherical shaped. The signum present, signum almost circular shaped sclerotised plate covered with spines.

Material examined: India: Bihar: Pusa, 1♂ and 1♀, 11.ix.1929, wild sugarcane, coll. Menon.

Distribution: India (Mathew, 2006)

Host plant: *Saccharum spontaneum* (from label data)

Remarks: In the genus *Emmalocera*, there are 67 species worldwide. It can be distinguished from other species of *Emmalocera* by its male genitalia where the uncus lobes are long, curved and pointed apically and having hair-like setae. Gnathos arms are stout with the middle part broad. Valva narrowed to half of its length, then both the margins run parallel to a rounded apex and aedeagus short and stout. In *E. depressella* the uncus lobes are short and apically pointed and valva narrowed towards apex. In *E. aurifusellus* females, the corpus bursae globose shaped with an almost circular plate like signum covered with spines. In *E. depressella* the shape of the signum is ovate. The detailed species list is provided by Nuss et al. (2003-2020).

7. *Emmalocera depressella* (Swinhoe, 1885) [Figs. 13, 14, 33, 46]

Melissoblaptus depressellus Swinhoe 1885: 876; *Polyocha depressella* Hampson 1896: 63; *Papua sacharella* Dudgeon 1977.

The species was first described as *Melissoblaptus depressella* by Swinhoe in 1885. Hampson (1896) transferred it under *Polyocha depressella*. In 1977, *Polyocha depressella* was transferred to *Papua* and later on to *Emmalocera* (Hampson, 1918).

Redescription: Frons slightly protruded and rounded in shape. Well-developed ocelli. Antennae serrated. Porrect labial palpi, labial palpi has hollowed out region for receiving maxillary palpi. Outer side of middle and hind tibia are fringed with scales. Wing coupling frenate, frenulum spine single in both sexes. In forewing, SC and R_1 remain wide apart and do not fuse. R_2 arises from the before the upper end of the cell. R_2 arises much before the upper angle of the cell. R_3 originates from the upper corner in the anterior of the cell. It then separates into R_3 and R_4 . M_1 originates from the RS after the angle of the cell. M_2 and M_3 are separate and free, both emerge from the common stalk observed at the posterior end of the cell. Hindwing whitish in colour. SC + R_1 and RS diverge out from a common stalk. From this common stalk, M_1 also originates. M_2 , M_3 , Cu1A and Cu1B arise from a common stalk from which Cu1A and Cu1B diverge out before the posterior angle of the cell.

Male genitalia with uncus lobes short, pointed apically. Gnathos arms slender, distal process narrow,

elongated, pointed. Tegumen weakly sclerotized. Valva basally broad and conspicuously narrowed towards apex; valva densely covered with long hairs. Juxta plate-shaped, broader than long, subovate. Saccus moderate sized with the distal region flat. Aedeagus longer than the valva, curved on one side. Female genitalia with ovipositor has an anterior notch. Genital chamber present laterally. Formed as an infolded pocket, the opening of which forms the ostium bursae. Corpus bursae bag like in shape. Signum present and elliptical sclerotised plate with prickled body.

Material examined: India: Delhi, 3♂ and 8♀, 16.vii.1938, on sugarcane, coll. H. L. Bhatia; India: Delhi, 9♂ and 5♀, 31.viii.1940 on sugarcane, coll. R Saran.

Distribution: India, Afghanistan, Bangladesh, Bhutan, China, Hong Kong, Indonesia, Japan, Kampuchea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Sulawesi, Taiwan, Thailand, Vietnam (Srikanth, 2014).

Host plants: *Andropogon sorghum*, *Erianthus munja*, *Erianthus sara*, *Peinsetum purpureum*, *Saccharum officinarum*, *S. ravennae*, *S. spontaneum*, *Sclerostachya fusca*, *Sorghum halepense*, *S. vulgare* (Srikanth, 2014).

Remarks: Compared to moth borers of genera *Scirpophaga*, *Chilo*, *Bissetia* dealt in the present study, the wings of *E. depressella* are narrower. It can be differentiated from species of *Chilo* and *Bissetia* from the SC and R_1 being free and spaced wide apart. The vein R_2 also arises long before the upper corner of the cell and vein R_3 is not present (Puri, 1957). In male genitalia, the aedeagus is distinctly curved. In female genitalia, the signum is an ovate shaped patch with spines.

8. *Scirpophaga excerptalis* (Walker, 1863) [Figs. 15, 16, 34, 47]

Chilo excerptalis Walker, 1863: 142; *Scirpophaga monostigma* Zeller, 1863: 3, Hampson, 1895: 913, 1896: 46 [partim]; de Joannis, 1929: 608; *Scirpophaga butyrota* Meyrick, 1889: 520; *Scirpophaga intacta* Snellen, 1890: 94, Hampson, 1895: 913, 1896: 46; *Scirpophaga excerptalis* (Walker) Hampson, 1895: 913, Leech, 1901: 402 [partim], Butani, 1970: 169; *Topeutis* [sic] *rhodoproctalis* Hampson, 1919: 319; *Tryporyza butyrota* (Meyrick) Common, 1960: 340.

The species was initially described as a species in

Chilo. Shibuya (1928) studied the Schoenobiinae of Taiwan and listed four species in *Scirpophaga*: *praelata*, *nivella*, *excerptalis* and *brunnescens*, and also provided a key to separate these species by using the colour of the forewing and of the anal tuft. In the revision of the Old-World species of *Scirpophaga* complex Lewvanich (1981) describes the name as *Scirpophaga excerptalis*.

Redescription: Spherical frons. Close to the ocellus, on each side a cheatosema. Filiform type antenna having fine serrations. Dorsal region of antenna has smooth scales, ventral region with delicate hairs. Proboscis reduced. Labial and maxillary palpi are porrect. Maxillary palpi extends no more than half of the labial palpi. Wings white coloured. Both cubital and subcostal retinaculum in male and only cubital retinaculum in female. In forewing, Vein R_1 anastomoses with Sc. Vein R_2 free, originates near upper angle of the cell. Veins R_3 and R_4 are stalked. From the upper angle of the cell originates vein R_5 , it diverges terminally from R_4 . M_1 basally approximated to R_5 . M_2 almost parallel to M_1 and arise from above the lower angle of the cell. M_3 arises from the lower angle of the cell. Cu1A originates before the lower angle of the cell. Short CuP vein observed at the wing margin. Complete 1A present. On the hindwing, Sc + R_1 ends near the apex of the wing on the costa, veins Rs and M_1 arise simultaneously from the upper angle of the cell. Veins M_2 and M_3 originate close to each other from above the lower angle of the cell. CuA1 originates in advance to the lower angle of the cell and CuA2 almost from the middle of the cell. 1A+2A and 3A are complete, 3A short.

Abdomen with tuft of scales on 7th abdominal sternite. Females have orange coloured anal tuft on the 7th abdominal segment. Male genitalia with uncus of moderate length, gnathos slightly curved at tip. The subteguminal process like a long spine, tegumen with X-shaped thickening, distal end of the valva expanded. Aedeagus slender, vesica has coarse spines. Juxta in the shape a sclerotised plate. Female genitalia with ostium bursae is broad, strongly sclerotized, and wrinkled in texture and appears as a compact mass. The ductus bursae membranous and corpus bursae have dense spines. Ductus seminalis originates from ductus bursae and is comparatively nearer to ostium bursae than that of corpus bursae.

Material examined: India: Bihar, 2♂ and 9♀, 14.iii.1926, on sugarcane, coll. Misra; India: Dwarka, 5♂ and 11♀, 10.v.1927 on sugarcane, coll. Ayyar; India: Dwarka, 4♂ and 4♀, 10.v.1933 on sugarcane, coll. Prasad.

Distribution: India, Australia, Bangladesh, Bhutan, Britain, China, Indonesia, Ireland, Japan, Java, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Taiwan, Thailand, Vietnam, West Malaysia (Arora, 2000; Chen and Wu, 2014).

Host plants: *Chloris barbata*, *Echinochloa colona*, *Erianthus arundinaceum*, *Naranga prophyrocoma*, *Panicum* sp., *Pennisetum purpureum*, *Saccharum officinarum*, *S. spontaneum*, *S. munja*, *S. ravennae*, *Sclerostachya fusca*, *Sorghum bicolor*, *S. halepense* (Arora, 2000).

Remarks: *S. excerptalis* and *S. nivella* have similar external appearance. However, the difference lies in the labial palpi which is 1.5-2 times in length compared to the diameter of the compound eye in *S. excerptalis* whereas in *S. nivella* it is much shorter (1.3 times that of the diameter of compound eye). The vein R_1 in forewing is anastomosed with SC in *S. excerptalis* but in *S. nivella* it is free. *S. excerptalis* has a single spine in frenulum as opposed to *S. nivella* having two bristles. Furthermore, the anal tuft is ocherous in *S. nivella* while in *S. excerptalis* it is ocherous (Lewvanich, 1981).

9. *Scirpophaga gilviberbis* Zeller, 1863 [Figs. 17, 18, 35, 48]

Scirpophaga gilviberbis Zeller, 1863:2 Walker, 1864:968; Moore, 1867: 666; Hampson, 1895:913; 1896:46 (partim); de Joannis, 1929: 607; *Niphadoses gilviberbis* (Zeller) Common, 1960: 327; Kapur, 1967: 6, 22.

Zeller (1863) redescribed the genus *Scirpophaga* in which he included the species *S. gilviberbis*. Lewvanich (1981) recognised *S. gilviberbis* as a valid name. Common (1960) placed *S. gilviberbis* in the genus *Niphadoses*. Lewvanich (1981) also has shown that *S. gilviberbis* does not belong in *Niphadoses* based on the forewing venation, difference of the scales on the labial palpus and the genitalia.

Redescription: Spherically shaped frons. Presence of cheatosema near ocellus. Filiform antenna with fine serrations. Dorsal region of antenna has smooth scales, ventral region with fine hairs. Proboscis reduced. Both labial and maxillary palpi porrect. Maxillary palpi shorter than half of labial palpi. Frenate type wing coupling, both cubital and subcostal retinaculum observed in male. Subcostal retinaculum absent in females and frenulum single bristled. Forewings are

ocherous in males and white in females. In forewing, vein R_1 not anastomosing with Sc, vein R_2 free, originates near upper angle of the cell. R_3 and R_4 are stalked. Vein R_5 diverges terminally from R_4 and originates from the upper angle of the cell. M_1 basally approximated to R_5 . M_2 almost parallel to M_1 and arise from above the lower angle of the cell. M_3 emanates from the lower angle of the cell. Cu1A takes its origin in advance to the lower angle of the cell. Short CuP vein developed at the wing margin, 1A complete. Hindwings white coloured in both sexes. On the hindwing, Sc + R_1 terminates near the apex of the wing on the costa, veins Rs and M_1 arise simultaneously from the upper angle of the cell. Veins M_2 and M_3 originate close to each other from above the lower angle of the cell. CuA1 originates in advance to the lower angle of the cell and CuA2 almost from the middle of the cell. 1A+2A and 3A are complete, 3A short.

Abdomen like a thin cylinder in males and a tuft of scales observed on the on the 7th abdominal sternite. Females have greyish white anal tuft on the 7th abdominal segment. Male genitalia with long and slender uncus and gnathos, the arms of gnathos converge gradually from the middle to a pointed apex; flattened subteguminal process having smooth and rounded margin. The costal and ventral margins of valva almost straight and parallel to each other, outer margin rounded; aedeagus slender. Female genitalia having broad ostium bursae. Ductus bursae membranous, antrum absent. Portion between ductus seminalis and ostium bursae have sclerotized plates. Cross section of the plates shows a U shape. Small spines present in corpus bursae, spines densely present in basal two-thirds.

Material examined: India: Bihar: Pusa, 1♂ and 3♀, 14.iii.1926, on sugarcane, coll. Pillai; India: Dwarka, 7♂ and 4♀, 10.v.1927 on sugarcane, coll. Prasad.

Distribution: India, Java; Myanmar; Singapore; Sri Lanka; Sulawesi; Thailand; and Vietnam (Arora, 2000).

Host plants: *Oryza sativa*, *Saccharum officinarum* (Arora, 2000)

Remarks: The male individuals resemble that of *S. nivella* and *S. incertulas* as all the three species have similar markings on forewings. However, the genitalia of both sexes in *S. gilviberbis* are quite distinct from the other two species. The females have frenulum with a single bristle, and have no antrum in ductus bursae. In males, the sclerotised thickening in the tegumen roughly triangular shaped (Lewvanich, 1981).

10. *Scirpophaga incertulas* (Walker, 1863) [Figs. 19, 20, 36, 49]

Chilo incertulas Walker, 1863: 143; *Catagela ladmotella* Walker, 1863: 192; *Schoenobius punctellus* Zeller, 1863: 4; *Schoenobius minutellus* Zeller, 1863: 5; *Tipanaea bipunctifera* Walker, 1863: 523; *Chilo gratiosellus* Walker, 1864: 967; *Apurima gratiosella* (Walker) Butler, 1880: 690; *Schoenobius bipunctifera* (Walker) Moore, 1886: 385, Leech, 1901: 403; *Catagela admotella* Walker; Moore, 1886: 386; *Schoenobius bipunctiferus* (Walker); Hampson, 1895: 915; *Schoenobius incertulas* (Walker) Hampson, 1895: 916, 1896: 48, Jepson, 1954: 9, Martin, 1958: 187; *Schoenobius bipunctifer* (Walker); Hampson, 1896a: 48, Strand, 1918: 262; *Schoenobius incertellus* (Walker); Shiraki, 1917: 1-256, Fletcher, 1932: 276, Shibuya, 1928: 63, deJoannis, 1929: 609, Marumo, 1934: 18; *Schoenobius bipunctifer* ab. *quadripunctellifera* Strand, 1918: 263; *Tryporyza incertulas* (Walker) Common, 1960: 341; Kapur, 1967: 6, 23.

Initially the species was placed in the genus *Chilo*. Walker (1863) considered the male as *Catagela admotella* and the female as *Tipanaea bipunctifera*. Zeller (1863) described the male of *Scirpophaga incertulas* as *minutellus* and the female as *punctellus*. *Catagela admotella* and *minutellus* were synonymised with *incertulas* by Hampson (1895). The species *punctellus* and *bipunctifera* were synonymised by Shiraki (1917) with *incertulas*. Lewvanich (1981) describes the name as *Scirpophaga exceptalis*.

Redescription: Spherical frons. Ocellus presents beside compound eyes. Close to the ocellus, on each side a cheatosema. Filiform type antenna having fine serrations. Dorsal region of antenna has smooth scales, ventral region with delicate hairs. Proboscis reduced. Labial and maxillary palpi are porrect. Maxillary palpi extends no more than half of the labial palpi. Labial palpi about 3 times in length compared to the diameter of compound eye. Frenulum double-bristled in females. Both cubital and subcostal retinaculum in male and only cubital retinaculum in female. Forewing ochreous, have one dark fuscous spot on the lower angle of the cell. In forewing with vein R_1 curving towards Sc. Vein R_2 free, originates near upper angle of the cell. R_3 and R_4 are stalked. From the upper angle of the cell originates R_5 , it diverges terminally from R_4 . M_1 basally approximated to R_5 . M_2 almost parallel to M_1 and arise from above the lower angle of the cell. M_3 emanates from the lower angle of the cell. Cu1A originates before the lower

angle of the cell. Short CuP vein developed at the wing margin; 1A complete. Hindwing white coloured. On the hindwing, Sc + R₁ terminates near the apex of the wing on the costa, veins Rs and M₁ arise simultaneously from the upper angle of the cell. Veins M2 and M3 originate close to each other from above the lower angle of the cell. CuA1 originates in advance to the lower angle of the cell and CuA2 almost from the middle of the cell. 1A+2A and 3A are complete, 3A short and straight. Males have slender abdomen and females have pale yellow coloured anal tuft. Male genitalia with uncus and gnathos long, slender; tegumen somewhat triangular and sclerotised; subteguminal process spine like and bifid; aedeagus slender, two curved spined cornuti are present. Female genitalia having ostium bursae is broad and membranous, strongly wrinkled. Basal three-fourth of corpus bursae is lined with spines.

Material examined: India: Bihar: Chandradharpur, 8♀, 17. x.1928, Rice stubbles coll. Bose; India: New Delhi, 1♂, 15.xiii.1991 Mercury vapour lamp coll. R.S.; India: Bihar: Pusa, 7♀ 26.ix.1998, Mercury vapour lamp coll. Z.H. Khan.

Distribution: India, Afghanistan, Bangladesh, Borneo, China, Japan, Java, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Sulawesi, Sumatra, Thailand, Vietnam, West Malaysia (Chen and Wu, 2014).

Host plants: *Oryza sativa* (Fletcher and Ghosh, 1920)

Remarks: *S. incertulas* resembles *S. innotata*, however, *S. innotata* has white wings without any spots while in *S. incertulas*, the wings are ochreous to pale yellow and having a dark fuscous spot. Additionally, in male genitalia of *S. innotata*, the subteguminal process single spine whereas in *S. incertulas* it is double spine (Lewvanich, 1981).

11. *Scirpophaga nivella* (Fabricius, 1794) [Figs. 21, 22, 37, 50]

Tinea nivella Fabricius, 1794: 296, Zimsen, 1964: 577; *Crambus niveus* (Fabricius) Fabricius, 1798: 472, Zimsen, 1964: 577; *Scirpophaga chrysorrhoea* Zeller, 1863: 1; Hampson, 1895: 913, 1896: 46 (Partim), Leech, 1901: 401 (Partim), Martin, 1958: 189; Common, 1960: 314; *Scirpophaga auriflua* Zeller, 1863: 2, Moore, 1867: 666; 1886: 387; Hampson, 1895: 913; 1896: 46 (Partim); *Scirpophaga brunnescens* Moore, 1888: 225; *Schoenobius celidias* Meyrick, 1894: 475; Hampson, 1895: 916 (as a synonym of *Schoenobius adjurellus*

Walker); *Schoenobius brunnescens* (Moore) Hampson, 1895: 916, 1896: 48, Caradja, 1925: 45, de Joannis, 1929: 609; *Crambus nivella* (Fabricius) Aurivillius, 1898: 169, *Apurima nivella* (Fabricius) Aurivillius, 1898: 173; *Scirpophaga euclastalis* Strand, 1918: 262; *Scirpophaga nivella* (Fabricius) Shibuya, 1928: 61, pi. 4, Fig. 27 (Partim), de Joannis, 1929: 607.

It was initially described as *Tinea nivella* by Fabricius. Shibuya (1928) provided a key for separating *praelata*, *nivella*, *excerptalis* and *brunnescens*. According to Lewvanich (1981), *S. nivella* and *S. chrysorrhoea* synonymous.

Redescription: Spherical frons. Ocellus present beside compound eyes. Cheateosema present. Filiform type antenna having fine serrations. Dorsal region of antenna has smooth scales, ventral region with delicate hairs. Proboscis reduced. Labial and maxillary palpi correct. Maxillary palpi extends no more than half of the labial palpi. Labial palpi about 1.3 times in length compared to the diameter of compound eye. Frenulum double-bristled in females. Both cubital and subcostal retinaculum in male and only cubital retinaculum in female. Forewing ochreous. In forewing, vein R₁ does not anastomose with Sc. Vein R₂ free, originates near upper angle of the cell. R₃ and R₄ are stalked. From the upper angle of the cell originates R₅, it diverges terminally from R₄. M₁ basally approximated to R₅. M₂ almost parallel to M₁ and arise from above the lower angle of the cell. M₃ emanates from the lower angle of the cell. Cu1A originates before the lower angle of the cell. Short CuP vein developed at the wing margin; 1A complete. Hindwing white coloured. On the hindwing, Sc + R₁ terminates near the apex of the wing on the costa, veins Rs and M₁ arise simultaneously from the upper angle of the cell. Veins M2 and M3 originate close to each other from above the lower angle of the cell. CuA1 originates in advance to the lower angle of the cell and CuA2 almost from the middle of the cell. 1A+2A and 3A are complete, 3A short and straight.

Males have slender abdomen. Females have ochreous yellow coloured anal tuft. Male genitalia with uncus tapering, socii longer than uncus and tapering. Gnathos arms converging abruptly. Large, flattened subteguminal process having sinuous margin; elongated valva., aedeagus simple; cornuti present one fourth from the apex. Female genitalia having broad and membranous and wrinkled ostium bursae. Antrum present in ductus bursae. The portion from corpus bursae to ductus seminalis usually annulated laterally.

Material examined: India: Bihar: Darbhanga, 1♂, 26.ii.1972, On paddy, coll. D.P.Singh; India: Bihar: Pusa, 3♂ and 1♀, 5.xi.1983, Mercury vapour lamp coll. Hassan; India: New Delhi, 1♂ and 2♀, 18.ix.1991, Mercury vapour lamp, coll. Menon.

Distribution: India, Aru Island, Australia, Bangladesh, China, Fiji, Java, Borneo, Myanmar, Nepal, New Caledonia, New Guinea, Philippines, Singapore, Sri Lanka, Sumatra, Thailand, Timor, Vietnam, West Malaysia (Chen and Wu, 2014)

Host plants: *Imperata cylindrica*, *Ischaemum rugosum*, *Miscanthus sinensis*, *Oryza sativa*, *Phragmites longivalvis*, *Typha capensis* (Moritsugu, 1931)

Remarks: The males of *S. nivella* and *S. incertulas* have similar markings on wings, but in *S. nivella*, the labial and maxillary palpi are shorter. The forewing colour somewhat shiny in *S. nivella* as opposed to dull colour in *S. incertulas*. The adults of *S. nivella* are also similar to *S. excerptalis*, but in the later the forewing R1 anastomosed with Sc while in the former it is free. The number of bristles in the wing in *S. nivella* is two whereas in *S. excerptalis* it a single bristle only (Lewvanich, 1981)

12. *Sesamia inferens* (Dudgeon, 1905) [Figs. 23, 24, 38, 51]

Leucania inferens Walker, 1856, List Specimens lepid. Insects Colln Br. Mus., 9:105; *Leucania proscripta* Walker, 1856, Ibid., 9:106; *Sesamia tranquillaris* Butler, 1880: 674; *Nonagria gracilis* Butler, 1880: 675; *Sesamia albiciliata* Snellen, 1880, Tijdschr. Ent., 23: 44; *Nonagria innocens* Butler, 1881: 173.

Sesamia inferens was first described as *Leucania inferens* in 1856 by Walker. Walker also described *Leucania proscripta* from East Indies. Both the species were synonymised as *Sesamia inferens* by Hampson (1910).

Redescription: Brownish yellow coloured antenna, about 8 mm long. The antenna exhibits sexual dimorphism. Flagellum in male antenna has cylindrical segments from the bases of which emerge lateral outgrowths. Flagellum looks vertebra shape from a dorsoventral view. In females, the segments at the base of the flagellum are rounded and flat and remaining segments are square shaped and flattened. Length of labial palpi is almost twice the length of its distal segment. Entire tibiae are scattered irregularly with short and stout setae. Buff yellow coloured forewing.

The costal and anal margins are almost equal in length and apical margin rounded. Wing coupling frenate type with males having one spine in frenulum and females having three. SC and R₁ remain wide apart and do not fuse. R₂ arises from the before the upper end of the cell. R₃, R₄ and R₅ arises from a common stalk which joins with an extension of R₂ and forms a cell over the main cell. R₅ fuses with the extension of R₂ and closes the cell. M₁ arise from the lateral side of the main cell. Hindwing is whitish in colour. SC + R₁ and RS diverge out from a common stalk. M₁ arises from RS at the angle of the cell. M₃ and M₄ arise from a common stalk beyond the cell. A₁, A₂ and A₃ are present.

Male genitalia have relatively large uncus. Tegumen broad with prominent peniculi. Apex of the valva rounded and having an acute costal process. Strong harpe with a projection at base of costa. Female genitalia with papillae anales highly sclerotised, they are anteriorly fused and posteriorly separated. A mid-ventral pocket represents the genital chamber. Ductus bursae broad and corpus bursae sac like subrounded structure having a conical point. Signum present and spine like.

Material examined: India: New Delhi, 1♂ and 7♀, 18.ix.2019 Mercury vapour lamp, coll. Dey; India: New Delhi, 8♂ and 12♀, 3.xi.2019, Mercury vapour lamp, coll. Dey; India: Assam, 3♂ and 9♀, 26.ii.2020, Mercury vapour lamp coll. Dey

Distribution: India, Bangladesh, Cambodia, China, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam (Rao and Nagaraja, 1969; Kalshoven, 1981; Cheng, 1994; Kuniata, 1994; Morris and Waterhouse, 2001).

Host plants: *Andropogon nardus*, *A. schaenathus*, *Avena sativa*, *Beckmannia syzigachne*, *Calamagrostis epigejos*, *Coelorachis glandulosa*, *Cyperus japonicus*, *C. rotundus*, *Echinochloa crus-galli*, *E. frumentacea*, *E. stagnina*, *E. villosa*, *Elaeis guineensis*, *Eleusine coracana*, *Eragrostis major*, *Erianthus arundinaceus*, *Eriochloa annulata*, *E. villosa*, *Hordeum vulgare*, *Hymenache sp.*, *Ischaemum rugosum*, *Miscanthus sacchariflorus*, *M. sinensis*, *Oryza latifolia*, *O. sativa*, *Panicum maximum*, *Paspalum scrobiculatum*, *P. thunbergii*, *Phragmites communis*, *P. karka*, *Rottboellia compressa*, *Rumex crispus*, *Saccharum spontaneum*, *Scirpus affinis*, *S. grossus*, *Setaria italica*, *Setaria rubiginosa*, *Sorghum halpense*, *S. sudanensis*, *Teosinte sp.*, *Triticum aestivum* L. *Zea mays* (Azuma and Oshiro, 1969; Rao and Nagaraja, 1969; Kalshoven, 1981; Hasan

and Cervancia, 1986; Shah and Garg, 1986; Garg, 1988; Jacob, 1995; Li, 1993).

Remarks: From analyzing the male genitalia of *Se. inferens* it becomes clear that it does not share a close relationship with the African complex of *Sesamia*. The costal process in African complex is apically bifid, unlike in *Se. inferens*. *S. grisescens* Warren (New Guinea, Seram) and *S. arfaki* Bethune-Baker (New Guinea) have male genitalia similar to that of *Se. inferens* (Wu, 1981).

13. *Sesamia uniformis* (Dudgeon 1905) [Figs. 25, 26, 39, 52]

Nonagria uniformis Dudgeon 1905

The species was first described as *Nonagria uniformis* by Dudgeon in 1905. It was reamed as *Sesamia uniformis* by Hampson (1910).

Redescription: Males have antenna with short fasciculate cilia, females have simple antenna. Thorax having a buff suffusion and is buff coloured. Entire tibiae scattered irregularly with short and stout setae. Inner side of foretibia in males is dark brown but not in females. Forewing uniform ochreous having few fuscous cells mostly on the cell and its inner and outer margins. These include a sub-basal patch present below the cell; a small spot present antemedially; a fuscous fascia longitudinally, occurring partly within the cell along its lower margin and extending beyond the cell to termen; a conspicuous fuscous spot present on the lower angle of the cell, and another small spot above it present in the middle of discocellulars; Hindwing white coloured.

Male genitalia with uncus simple and curved. Costal margin of valva broadly sclerotised having a broad costal spine with a triangular apex. Aedeagus short and slender; cornuti absent. Juxta having a rounded medial projection, having spines. The lower margin of the ventral expansion of the vinculum straight. Female genitalia having bursa copulatrix broad with a somewhat pointed apex, short ductus bursae. Moderately large anteostial pad. Ostium sclerotised. Posterior to the ostium a moderately sclerotised band on the ostial segment.

Material examined: India: Lyallpur, 8♂ and 5♀, 31.viii.1934 on wild sugarcane, coll. R Saran

Distribution: India, Pakistan, Philippines (Rao and Nagaraja, 1969)

Host plants: *Erianthus arundinaceus*, *Oryza sativa*, *Saccharum spontaneum*, *Sorghum bicolor*, *Triticum aestivum*, *Zea mays* (Rao and Nagaraja, 1969).

Remarks: *Se. uniformis* can be differentiated from *Se. inferens* by means of the relatively darker colour in forewings. In the male genitalia of *Se. uniformis* a broad costal spine is present as opposed to a with darker forewings and a costal flange rather than an acute costal process as in *Se. inferens*. The lower margin of the ventral expansion in *Se. uniformis* is flat as opposed to *Se. inferens* which is rounded. Our study reveals the morphological differences in genitalia in details. Earlier worker has only produced adult images and discussed the characters of adults.

Keys for species

A stemborer having the tympanum on metathorax belongs to the Superfamily Noctuoidea, but if the tympanum is on the first abdominal sternite the stemborer is a member of the Superfamily Pyraloidea. *Sesamia* is the only genus which is a member of the superfamily Noctuoidea which is dealt in this paper. The genus *Sesamia* is characterised by a minute, aborted proboscis, upturned palpi with 2nd segment reaching about the middle of frons, thorax and base of the abdomen clothed with dense hairs, tibia fringed with long hairs. In the Superfamily Pyraloidea, the tympanum is present in the first sternite of abdomen. Four genera are dealt with in this study: *Bissetia*, *Chilo*, *Emmalocera* and *Scirpophaga*. The keys to separate the four genera based on morphology is provided:

1. Praecinctorium present..... 2
 - Praecinctorium absent*Emmalocera*
2. Ocelli present 3
 - Ocelli absent*Bissetia*
3. Presence of Coremata in males and lobe-like strongly setose papillae anales*Scirpophaga*
 - No Coremata in males and no lobe-like strongly setose papillae anales *Chilo*

I. Key to the species of *Chilo*

a. Based on male genitalia:

1. Aedeagus with long conspicuous ventral arm 2
 - Aedeagus without long conspicuous ventral arm 3

2. Arms of juxta sollowen near apices.....*C. auricilius*
.....*C. partellus*
 - Arms of juxta short and tapering with a distinct notch
.....*C. partellus*
 3. Vesica with a row of strong cornuti.....*C. sacchariphagus*
.....*C. infuscatellus*
 - Cornuti single, tapering and large*C. infuscatellus*
- b. Based on female genitalia:
1. Signum absent.....2
- Signum present3
 2. Ostial pouch somewhat delineated from ductus
bursae, sclerotization is moderate*C. auricilius*
.....*C. sacchariphagus*
 - Ostial pouch quite delineated from ductus bursae,
longitudinal ribs having heavy sclerotization.....*C. sacchariphagus*
 3. Anterior portion of ostial pouch presents a deep
incision *C. infuscatellus*
- Ostial pouch delicately longitudinal wrinkled and
anterior portion of is notched*C. partellus*

II. Key to the species of *Scirpophaga*

- a. Based on male genitalia:
1. Tegumen with dorsal sclerotized thickening
rectangular; subteguminal process flattened, plate-like.
..... 2
- Tegumen with dorsal sclerotized thickening triangular
or more or less X-shaped; subteguminal process lobed
or spine like..... 3
 2. Gnathos arms converging gradually, subteguminal
process rounded..... *S. gilviberbis*
- Gnathos arms converging abruptly, subteguminal process
with strong sinuous margin*S. nivella*
 3. Tegumen with dorsal sclerotized thickening triangular
..... *S. incertulas*
- Tegumen with dorsal sclerotized thickening X-shaped
..... *S. excerptalis*
- b. Based on female genitalia:
1. Antrum present and strongly sclerotized.....*S. nivella*
.....*S. nivella*
 - Antrum absent 2

2. Corpus bursae completely lined with dense spines
..... *S. excerptalis*
- Corpus bursae partly lined with dense spines3
3. Corpus bursae usually lined with dense spines in the
basal 2/3..... *S. gilviberbis*
-Corpus bursae usually lined with dense spines in the
basal 3/4..... *S. incertulas*

III. Key to the species of *Emmalocera*

- a. Based on male genitalia:
1. Uncus lobes long, pointed apically with stout
gnathos.....*E. aurifusellus*
 - Uncus lobes short, pointed apically with slender
gnathos *E. depressella*
- b. Based on female genitalia:
1. Signum elliptical sclerotised plate with prickled
body.....*E. depressella*
 - Signum almost circular shaped sclerotised plate with
spiny body *E. aurifusellus*

III. Key to the species of *Sesamia*

- a. Based on male genitalia:
1. Juxta having a rounded medial projection, having
spines *Se. uniformis*
 - Juxta not as above..... *Se. inferens*
- b. Based on female genitalia:
1. Ductus bursae broad and corpus bursae sac
like subrounded structure having a conical point
..... *Se. inferens*
 - Ductus bursae not as broad and corpus bursae with a
somewhat pointed apex*Se. uniformis*

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