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Faunistic studies on Pyralidae (Lepidoptera: Pyraloidea) associated with horticultural crops from zone-1 and 2 of Karnataka

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Abstract

The investigations on faunistic studies of Pyralidae (Lepidoptera; Pyraloidea) associated with horticulture crops of zone-1 and 2 of Karnataka were carried out during August 2015 to January 2016. During the survey, a total of 4 number species of Pyralidae were documented which were collected and reared on their respective hosts. All the species represented 2 sub-families of Pyralidae viz., Phycitinae and Epipaschiinae. The morphological and genital characters of the all the species documented were studied in detail.

Keywords: Pyralidae, rearing, survey, horticultural crops, zone-1 and 2

Introduction

The diverse climatic condition of India guarantees the successful cultivation of agricultural as well as horticultural crops. India ranks second in fruits and vegetable production next only to China ^[1]. India has produced 86.602 million metric tons of fruits and 169.478 million metric tons of vegetables in 2014-15 ^[2]. Karnataka is divided into 10 agro-climatic zones by considering the rainfall pattern, soil types, topography, major crops grown, etc. The zone-1 (Eastern-transition zone) and zone-2 (North-Eastern dry zone) comprises of 4 districts namely, Bidar, Kalaburagi, Yadagir and Raichur with two districts under each zone, respectively. These zones have diverse soil types, climatic conditions, and good irrigation facilities through irrigation projects like Krishna, Tungabhadra, etc. Hence, these zones are ideal for the growing of agricultural as well as horticultural crops. The major horticultural crops growing in these zones include mango, banana, sapota, brinjal, chilli, onion, cucurbits, ginger, turmeric, etc., with an area of 0.064 Mha which represents 3.36 per cent of the total horticultural area of Karnataka ^[3].

The lower production and productivity in horticultural crops is a result of biotic and abiotic pressure. Among biotic stresses, the damage and yield loss caused by insect pests are main contributory factors. Among insect pests, the superfamily Pyraloidea (Lepidoptera) has great economic importance as many of them cause serious damage either internally as borers, root feeders and seed feeders or externally as leaf rollers or webbers ^[4]. The extent of yield loss due to Pyraloidea ranges from 10 to 100 per cent across the world ^[5].

Pyralidae (Snout moths) is the third largest family of Lepidoptera, with about 16,500 described species across the world. Currently, there are 19 subfamilies in this family, which were divided broadly into two groups viz., group Crambinina (14 subfamilies) and group Pyralinina (5 Subfamilies). There are several numbers of economically important species reported from this family, because their larvae usually cause damage to field and forest trees by acting as leaf rollers, leaf webber, root borers and leaf miners ^[6]. In the zone-1 and 2 of Karnataka, the information pertaining to the fauna of Pyralidae associated with horticultural crops is not available. And also, earlier workers did not make any efforts to associate Pyraloidea species with their host plants. However, Nagaraj (2014) made the first effort to survey and document the Pyraloidea fauna associated with major cereals of Hyderabad-Karnataka (zone-1, zone-2 and zone-3) region for his M. Sc. research work ^[7]. Investigations pertaining to the collection of Pyralidae through survey and authentication of their hosts, taxonomic studies on morphological and genital characters did not carried out so far for Pyralidae associated with horticultural crops in zone-1 and 2 of Karnataka.

In this context, the present investigations have been undertaken to study the morphological and genital characters of poorly known species of Pyralidae.

Materials and Methods

Collection and rearing techniques

Collections were made on Pyralidae associated with horticultural crops by undertaking a survey in different localities of zone-1 (Bidar, Humnabad, Kalaburagi, and Raddewadgi) and zone-2 (Naganoor, Kavadinatti, Raichur and Chandrabanda) of Karnataka, India. The survey was carried out in these locations once in a month from August 2015 to January 2016, and the places visited during the period are shown in Fig. 1. Since the present study was mainly focused on host based taxonomy, the various life stages of Pyralidae like eggs, larvae and pupae wherein external feeders, damaged plant specimens in the case of internal feeders brought to the laboratory. The immature stages collected from the field were reared in the laboratory by adopting the methodology proposed by Nagaraj (2014), Juanz *et al.* (2016) with slight modification wherever required for further rearing to adult stage [7, 8].

Study of morphological and genital characters

The adults were killed immediately after emergence using ethyl acetate and pinned through thorax using stainless anticorrosive insect pins (No.4) imported from Sphinx Company, Zech Republic. The specimens collected were identified to generic and species level based on the keys developed by Hampson in the Moths volumes of the Fauna of India [9] and adjacent countries series and also using recently available literature. The keys have been prepared from referring different sources like other published keys, descriptions, and an examination of specimens of the groups concerned. Some are taken largely from previously published keys based on study of different authors [9-12] like generally with some changes in wording or organization and adding some more morphological and genital characters. Genitalia of adults (male and female) were dissected using the techniques described by Kirti and Gill (2005), and Nagaraj (2014) with little modification wherever required [7, 13]. Later, the genitalia was stained by using standard staining procedure proposed by Lee and Brown (2009) [14]. Further, the stained genitalia was photographed with the help of Leica M205C with auto montage by keeping male genitalia in glycerine, and female genitalia in water.

Results and Discussion

During the survey, a total of 4 species of Pyralidae were recorded on their respective hosts (Table 1, Fig. 1; Plates 1-4). All the species represents 2 sub-families, Epipaschiinae and Phycitinae. The subfamily Phycitinae was documented with three genera viz., *Etiella* Zeller, *Euzophera* Zeller and *Nephoterix* Hübner, whereas single genus *Orthaga* Walker was documented from subfamily Epipaschiinae. All the genera documented with single species under each viz., *Etiella zinckenella* Treitschke, *Euzophera perticella* Ragonot, *Nephoterix eugraphella* Ragonot, and *Orthaga exvinacea* Walker. Further, the results on Pyralidae collected and reared on horticultural crops from zone-1 and 2 of Karnataka revealed that morphological and genital characters of the adults found variation with respect to diagnostic morphological characters. Morphological characters like frons, vertex, chaetosemata, labial and maxillary palps, wing colour, wing venation, structure of tympanum and tibia etc.,

Genital characters like uncus, saccus, valvae, juxta, vinculum, gnathos, tegumen and phallus (aedeagus) in male, and in female, the corpus bursae, ductus bursae, ductus seminalis, ostium, anterior apophysis and posterior apophysis and signum *etc.*, were recorded. Similarly, Bhattacharjee (1962) made an extensive surveys on Indian Pyralidae for his *Ph.D.* research work, he collected 35 species belonging to 20 genera [10]. In another study, Rose (1982) collected 93 species of pyralid moths which belonged to 61 genera of sub-family Pyraustinae from North India [11]. Likewise, recently Nagaraj (2014) surveyed for Pyraloidea associated with cereals from Hyderabad-Karnataka region, and he documented 7 identified and 6 unidentified species [7]. Similar results were also reported by various authors like Du (2008) [15], Mey (2008) [16], Qi *et al.* (2011) [17], Sharma (2011) [18], Li (2012) [19], Zhang *et al.* (2014) [20] across the world.

Table 1: Species of Pyralidae collected through survey and reared on horticultural crops from zone-1 and 2 of Karnataka

Crops	Common name	Scientific name	Sub-family	Family
Mango	Leaf Webber	<i>Orthaga exvinacea</i> Walker	Epipaschiinae	Pyralidae
Sapota	Leaf webber/ fruit borer	<i>Nephoterix eugraphella</i> Ragonot	Phycitinae	Pyralidae
Fieldbean	Pod borer	<i>Etiella zinckenella</i> Treitschke	Phycitiinae	Pyralidae
Brinjal	Stem borer	<i>Euzophera perticella</i> Ragonot	Phycitinae	Pyralidae

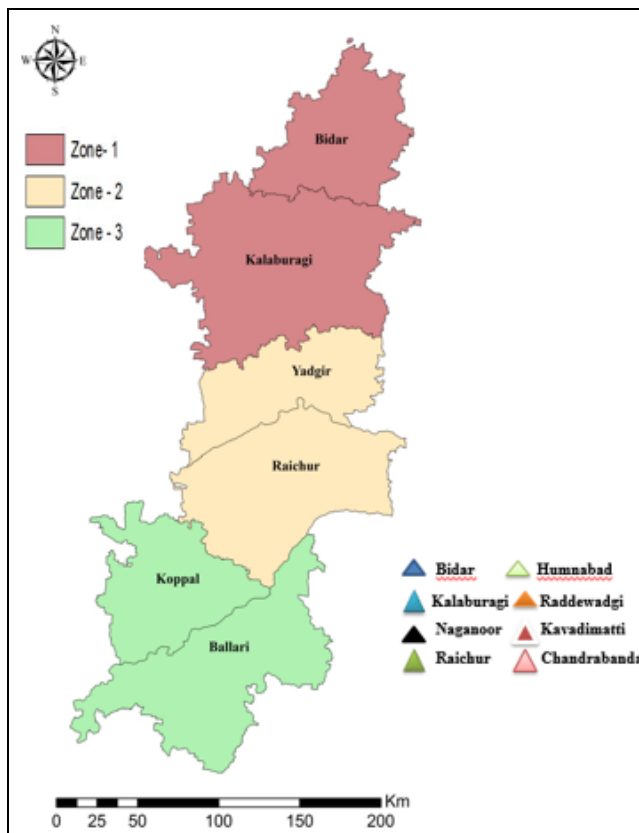


Fig 1: Locations from where Pyralidae were collected for taxonomic studies



Plate 1: Morphological and genital characters of *Etiella zinckenella* Treitschke a) Male; b) Male genitalia; c) Phallus

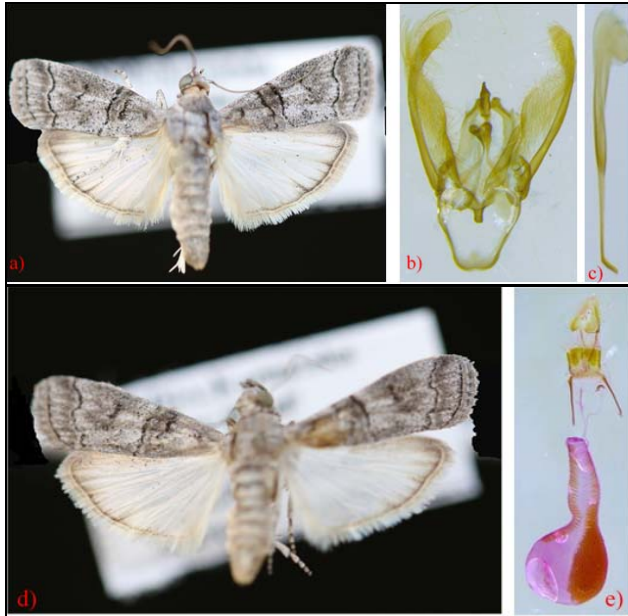


Plate 2: Morphological and genital characters of *Nephopterix eugraphella* Ragonot a) Male; b) Male genitalia; c) Phallus; d) Female; e) Female genitalia

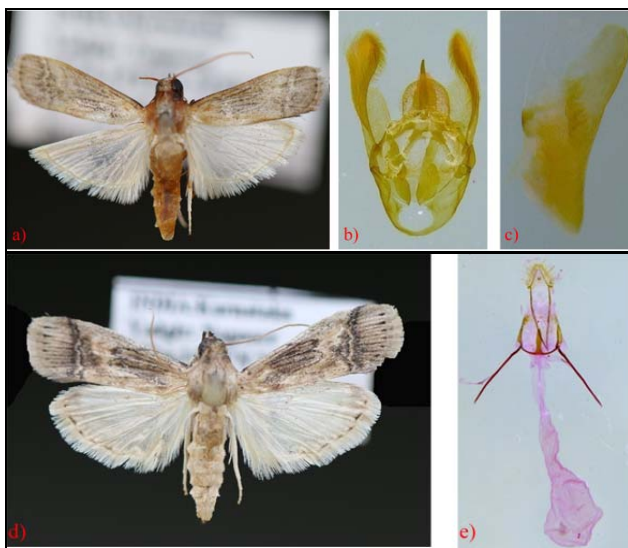


Plate 3: Morphological and genital characters of *Euzophera perticella* Ragonot a) Male; b) Male genitalia; c) Phallus; e) Female genitalia

Subfamily Phycitinae

Diagnosis

Phycitinae have well developed proboscis, and have elongated and straight labial palpi; forewings of some are quite

prominently patterned and lack one or more veins, usually the seventh one; female frenulum composed of multiple acanthae into one bristle as in males; in female genitalia, the ductus seminalis originates in the corpus bursae.

Etiella zinckenella Treitschke, 1832 (Plate 1)

Description

Frontal tufts prominent and conical; labial palpi very long, about three and half times the diameter of eye, the 2nd joint hollowed out to receive the brush-like maxillary palpi; antennae with moderate sinus containing a tuft of scales at base in male, simple in female, about three-fourths the length of fore wing costa; fore wing long and narrow, over three times as long as wide, cell extending to about two-thirds the length of wing; hind wing with the inner margin enlarged, thus very wide at middle, the cell about one-third the length of wing; outer tibial spurs are about half the length of inner spurs.

Male genitalia

Uncus broad and lingulate; lateral arms of gnathos united in the middle in to the pointed structure and oval in outline; vinculum circular in outline and very much expanded dorsally; two blade-shaped structures appearing as juxta, present at the caudal end of vinculum; valvae composed of two parts, a curved slender outer lobe pointed at the tip and inner lobe having flattened base, and the apical region finger-shaped and fringed with hairs; phallus short and stout; cornuti composed of a long piece and short stout piece with an apical pointed lobe and proximal smaller lobes.

Female genitalia: not examined.

Materials examined

INDIA: Karnataka: Yadgir, Bheemaranagudi, 2♂, 22.ix.2015, reared on field bean, Basavaraj.

Nephopterix eugraphella Ragonot 1888 (Plate 2)

Description

Head with the frons smoothly curved, covered with rough scales, labial palpi upturned, closely appressed to head, the 2nd joint normal and not hollowed; maxillary palpi filiform; antennae thickened in male, simple in female, more than two-thirds the length of fore wing costa. Fore wings slightly suffused with brown and irrorated with black; some raised black scales at base in the cell; an ante-median band present, edged by black lines; the inner of which with a ridge of raised scales, the band transversed by a fuscous line. Hind wings are whitish, semi-hyaline; the apical area, a marginal line and a line through the cilia fuscous.

Male genitalia

Uncus small, arch like; valvae long and broad towards the basal 2/3, and narrow apically; dense hairs at costal margin; less hairs towards inner margin; vinculum broadly 'U' shaped, lateral arms slender and short; gnathos produced into median process; phallus narrowed towards apex, swollen towards base.

Female genitalia

Anterior apophysis strongly developed than posterior apophysis; apophyses equal in size; bursae copulatrix bag like, oval towards distal extremity; ductus bursae thread like; bursae copulatrix with rows of spinules on both the sides with several minute oval sclerotized patches grouped together towards one side and covers 1/2 of the bursa copulatrix.

Materials examined

INDIA: Karnataka: Yadgir, Bheemaranagudi, 1♂, 30.vii.2014, reared on sapota, Ravikiran.; Bheemaranagudi, 1♀, 11.viii.2014, reared on sapota, Ravikiran.; Bheemaranagudi, 1♂, 30.vi.2015, reared on sapota, Parvathi.; Kavadinatti, 1♂, 23.vii.2015, reared on sapota, Nagaharish.; Kavadinatti, 1♂, 24.vii.2015, reared on sapota, Nagaharish.; Raichur, Raichur, 1♀, 25.vii.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 1♂, 1♀, 29.vii.2015, reared on sapota, Nagaharish.; Yadgir, Bheemaranagudi, 1♀, 4.viii.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 1♂, 19.viii.2015, reared on sapota, Nagaharish.; Yadgir, Kavadinatti, 1♂, 2♀, 21.viii.2015, reared on sapota, Nagaharish.; Kavadinatti, 2♂, 23.viii.2015, reared on sapota, Nagaharish.; Raichur, Raichur, 1♀, 24.viii.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 1♂, 2♀, 24.viii.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 2♀, 25.viii.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 2♀, 25.viii.2015, reared on sapota, Nagaharish.; Yadgir, Kavadinatti, 3♀, 26.viii.2015, reared on sapota, Nagaharish.; Raichur, Raichur, 1♂, 2♀, 26.viii.2015, reared on sapota, Nagaharish.; Yadgir, Kavadinatti, 1♂, 2♀, 29.viii.2015, reared on sapota, Nagaharish.; Yadgir, Bheemaranagudi, 1♂, 29.viii.2015, reared on sapota, Nagaharish.; Yadgir, Kavadinatti, 1♂, 1♀, 30.viii.2015, reared on sapota, Nagaharish.; Raichur, Raichur, 2♂, 1♀, 30.viii.2015, reared on sapota, Nagaharish.; Raichur, 1♂, 31.viii.2015, reared on sapota, Nagaharish.; Yadgir, Bheemaranagudi, 1♀, 31.viii.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 1♂, 1♀, 01.ix.2015, reared on sapota, Nagaharish.; Raichur, Raichur, 3♂, 1♀, 04.ix.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 1♂, 1♀, 04.ix.2015, reared on sapota, Nagaharish.; Raichur, Raichur, 2♂, 05.ix.2015, reared on sapota, Nagaharish.; Bidar, Bidar, 2♀, 06.x.2015, reared on sapota, Nagaharish.; Bidar, 2♀, 07.x.2015, reared on sapota, Nagaharish.; Raichur, Raichur, 2♂, 1♀, 08.x.2015, reared on sapota, Nagaharish.; Raichur, 3♀, 09.x.2015, reared on sapota, Nagaharish.; Yadgir, Kavadinatti, 1♂, 10.x.2015, reared on sapota, Nagaharish.; Kavadinatti, 1♂, 11.ix.2015, reared on sapota, Nagaharish.; Kavadinatti, 2♀, 12. x.2015, reared on sapota, Nagaharish.

Euzophera perticella* Ragonot, 1888 (Plate 3)*Description**

Head with the frons smoothly curved and flat; labial palpi upturned, closely appressed to face, reaching beyond frons; antennae thickened in male, simple in female, about three-fourths the length of fore wing costa; ocelli small; legs with the mid and hind tibiae fringed with hairs on outer side. Fore wings pale rufous, the coastal area to beyond middle and the apical area suffused with grey; a black line from middle of costa very strongly dentate, hind wings whitish; the marginal area tinged with fuscous.

Male genitalia

Uncus inverted 'U' shaped, fringed laterally with rows of short non stiff hairs; tegumen broad, bulged out posteriorly where its arms end in bluntly curved point; vinculum broadly 'U' shaped in outline with lateral arms slender and posteriorly swollen; valvae with hairs towards dorsal region covers up to 2/3 of the portion; phallus short and same size throughout its length; the lateral arms of gnathos united at middle into a pointed structure.

Female genitalia

Posterior apophysis stout and anterior apophysis weakly developed and both equal in length; bursa copulatrix more or less globular with ridges on it; signum patch type; ductus bursae long and equal in size anteriorly and posteriorly, with slight constriction at middle.

Materials examined

INDIA: Karnataka: Yadgir, Nagnoor, 1♀, 1♂, 02.viii.2015, reared on brinjal, Anildev.; Nagnoor, 5♀, 3♂, 03.viii.2015, reared on brinjal, Anildev.; Nagnoor, 4♀, 4♂, 04.viii.2015, reared on brinjal, Anildev.; Nagnoor, 1♂, 1♀, 05.viii.2015, reared on brinjal, Anildev.; Nagnoor, 5♂, 2♀, 06.viii.2015, reared on brinjal, Anildev.; Nagnoor, 3♂, 4♀, 07.viii.2015, reared on brinjal, Anildev.; Nagnoor, 4♂, 2♀, 09.viii.2015, reared on brinjal, Anildev.; Nagnoor, 3♂, 10.viii.2015, reared on brinjal, Anildev.; Nagnoor, 1♂, 2♀, 16.viii.2015, reared on brinjal, Anildev.; Nagnoor, 1♀, 24.ix.2015, reared on brinjal, Anildev.; Nagnoor, 1♂, 1♀, 20.x.2015, reared on brinjal, Anildev.

Subfamily Epipaschiinae**Diagnosis**

Males of many species have a conspicuous scaled projection from the scape of the antennae; labial palpi with third segment always upturned and pointed; hind wing of both the sexes with median nerve not pectinated on upper side; in male genitalia, ventrally curved phallus at base usually extends beyond the ductus ejaculatorius; the tegumen weakly sclerotised.

Orthaga exvinacea* Walker (Plate 4)*Description**

Male with no process from basal joint of antenna, the maxillary palpi of male filiform; the basal two-thirds of fore wing being suffused with dull olive-green; a dark speck beyond the cell but no pink patch; the postmedial line regularly curved and crenulate; the outer area suffused with vinous and with a prominent series of dark marginal specks; hind wing with dark sub marginal line; underside of hind wing pale beyond the slightly curved postmedial line; the outer area fuscous.

Male genitalia

Uncus short, base narrow, apex arch shape / blade of an axe; valvae simple, broad and linear with dense hairs on the inner margin up to distal end; vinculum 'V' shaped with lateral arms slender and elongate; tegumen broad, more or less equal size with that of vinculum and inverted 'U' shape.

Female genitalia

Posterior apophysis short; posterior and anterior apophysis more or less equal in size; ductus bursae long and tubular, equal in size throughout; bursa copulatrix oval shape; sub apically bulged due to presence of sac like structures, one pair attached to either side of the bursa copulatrix; ductus bursae sclerotized towards proximal region.

Materials examined

INDIA: Karnataka: Bheemaranagudi, 1♀, 20.xii.2012, reared on mango, Shankaramurthy.; Bheemaranagudi, 2♂, 2♀, 20.xii.2012, reared on mango, Shankaramurthy.; Bheemaranagudi, 1♂, 6.viii.2014, reared on mango, Anildev.; Raichur, Raichur, 1♀, 13.viii.2015, reared on mango, Nagaharish.; Raichur, 1♀, 2♂, 19.viii.2015, reared on

mango, Nagaharish.; Raichur, 1♂, 1♀, 20.viii.2015, reared on mango, Nagaharish.; Raichur, 1♂, 3♀, 21.viii.2015, reared on mango, Nagaharish.; Raichur, 1♂, 1♀, 23.viii.2015, reared on mango, Nagaharish.; Raichur, 3♂, 1♀, 24.viii.2015, reared on mango, Nagaharish.; Yadagir, Kavadimatti, 3♂, 2♀, 24.viii.2015, reared on mango, Nagaharish.; Raichur, Raichur, 1♂, 2♀, 26.viii.2015, reared on mango, Nagaharish.; Yadagir, Kavadimatti, 3♂, 1♀, 26.viii.2015, reared on mango, Nagaharish.; Bidar, Bidar, 1♂, 27.viii.2015, reared on mango, Nagaharish.; Yadagir, Kavadimatti, 1♂, 1♀, 29.viii.2015, reared on mango, Nagaharish.; Bidar, Bidar, 2♂, 2♀, 29.viii.2015, reared on mango, Nagaharish.; Yadagir, Kavadimatti, 1♂, 2♀, 01.ix.2015, reared on mango, Nagaharish.; Bidar, Bidar, 2♀, 01.ix.2015, reared on mango, Nagaharish.; Yadagir, Kavadimatti, 1♂, 02.ix.2015, reared on mango, Nagaharish.; Bidar, Bidar, 2♀, 03.ix.2015, reared on mango, Nagaharish.; Bidar, 1♀, 1♂, 05.ix.2015, reared on mango, Nagaharish.; Raichur, 1♂, 05.xi.2015, reared on mango, Nagaharish.; Bidar, Bidar, 1♂, 08.ix.2015, reared on mango, Nagaharish.; Bidar, 1♀, 1♂, 09.ix.2015, reared on mango, Nagaharish.; Bidar, 1♀, 12.ix.2015, reared on mango, Nagaharish.; Bidar, 1♀, 2♂, 15.ix.2015, reared on mango, Nagaharish.; Raichur, Raichur, 1♂, 3♀, 25.xi.2015, reared on mango, Nagaharish.

Conclusion

In India, most of the pyralid taxonomists have undertaken taxonomic studies predominantly by relying on light trap collections and they did not made any efforts to associate species with their host plants except Nagaraj (2014) who made a first effort to survey and document the Pyraloidea fauna associated with major cereals of Hyderabad-Karnataka region for his *M. Sc.* research work [7]. So in the current study an attempt was made to survey and study the Pyralidae fauna associated with horticultural crops from zone- 1 and 2 of Karnataka. The current study was carried out by host based taxonomy, which helps in accurate identification of the pest species and authentication of its host from representative locations. The morphological and genital characters of poorly described species were studied in detail and discussed here.

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