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Taxonomic studies of family noctuidae (Lepidoptera) from district Multan, Punjab, Pakistan based on Genitalia characters

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Abstract

In present study 650 specimens were collected from diverse sites of District Multan and Muzaffargarh like Kot Addu, and Sinwaan. These specimens were collected with light trap. After collection specimens were killed in potassium cyanide poison then preserved in wooden box. To identify male and female genitalia the abdominal portion was removed from body of insect with the help of forceps by providing uphill jerk then dip into solution of KOH for twenty-four hour. Dissection of genitalia was done with fine needles under stereo microscope. As the result 7 noctuid species such as; *Helicoverpa zea*, *Helicoverpa armigera*, *Spodoptera litura*, *Spodoptera exigua*, *Chrysodeixis furihatai okan*, *Argrotis ypsilon*, and *Agrotis cineaia* belonging to different genus were described from District Multan. Identification was done with the help of available literature, keys, and monograph and internet resources. Figures of adults and genitalia were also provided.

Keywords: Male and female genitalia, noctuidae, lepidoptera, diagnostic characters, identification

1. Introduction

Brinjal in Lepidoptera 180,000 described which belong to 46 super families and one hundred and twenty-six families throughout the world (Rafi *et al.*, 2000) [1]. These include moth (Heterocera) (Shields, 1989) [2]. Although several estimates have been made from time to time, ranging from a 13,000 to the maximum of 20,000 (Vane Wrights, 1978) [3]. Noctuoidea containing 70 000 described species throughout the world. Tympanal organ is highly expert hearing apparatus that recognize the fix location of insane, this monophyly increase the confirmation that the tympanum may also include in getting of mating signals (Kitching and Rawlins, 1998) [4]. Luckily the monophyly of Noctuoidea is strongly confirmed that based on the presence of Meta thoracic tympanal organ which is unique apomorphic character (Miller, 1991) [5].

More ever the adult of some genera cause damage to fruit crops by piercing the fruit skin and suck juices (Banziger, 1987) [6]. Moths that belong to Noctuoidea family are most dangerous to crops and vegetables (Thakur *et al.*, 2013) [7]. Many crops in Pakistan are damaged by almost 75 insects of the order Lepidoptera which put 15 to 17% yield loss (Muhyuddin, 1981) [8]. The immature of Noctuoidea are brownish or dully green color while few species have bright color. Usually immatures are flat that has rounded and small head, also have some setae on their body. Noctuid's adult have mostly dully color and different in size and these moths engaged to light source (Macgregor *et al.*, 2015) [9]. During taking rest the adult of Noctuidae moths mimic under the trees and rocks with secure wing (Sandars, 1946) [10]. Noctuidae has nearly 29 subfamilies across the world.

The subfamily Hedeninae is largest having twenty four hundred species throughout the world (Speidel *et al.*, 1996) [11]. Mostly the larvae of this subfamily feed on broad leaf crops and vegetables. After feeding larvae pupate in soil in form of hard cocoons (Ronkay *et al.*, 2001) [12]. First time from Iran fauna there were two species identified one was *P.anannu* (Varga and Ronkay, 1991) [13] and second specie is *P.flora* (Hreblay, 1996) [14], they provided adult images and genitalia figures for proper identification. There were 21 species described from north and South America of genus *Capitarsia* on the difference between male and female genitalia characters (Angulo and Olivares, 2003) [15].

Genitalia structures of Noctuidae family was studied first time and contribute extremely to

“Fauna of British India Moths” with depiction of fourteen hundred and fifteen, and species along with two hundred and seventy three genera (Comstock and Needham, 1898; Staudinger and Rebel, 1901) [16, 17]. In the present study 7 Noctuid are identified *Helicoverpa zea*, *Helicoverpa armigera*, *Spodoptera litura*, *Spodoptera exigua*, *Chrysodeixis furihatai* okan, *Argrotis ypsilon*, and *Argrotis cinearia* belonging to different genus were described from District Multan. Species identification done based on their genitalia characters. These species cause serious losses to economically important crops, so identification is very important to develop control strategies.

2. Materials and Methods

2.1 Collection and preservation

Keeping in mind to learn about the importance of Noctuid's moths from different region of Pakistan, like Multan, Muzaffargarh and Kabeer Wala. Survey tour was organized during February 2018 to May 2018 from different sites of District Multan like Muzaffargarh, Kot Addu and Sinwaan. Samples were also collected from Multan. Mostly the sited localities were divided in fruits, vegetable crops, sugarcane, wheat, and cotton growing area of Muzaffargarh. The adult moths were collected with tapering light trap (20 watt, 220Volt), which were fixed at diverse localities and deliberated one of the finest methods to collect lepidopteron moths from vast enclosure of region. Total 650 specimens were collected from these regions. From March to May due to favorable environment a maximum population of adult moths were collected in highly populated gardens, forest and agricultural crops. Tours for collection were arranged before monsoon season.

These collected samples were killed in poisonous KCN jar; these samples were removed from the jar immediately after they were killed to protect scale on body of adult moth and avoid from discoloration. After to kill these samples were

soaked under butter papers for 2 hours in petri dishes to make softer the all body parts. These soften samples were pinned with various entomologically related pins according to size of samples and spread properly on thermophore sheet making a groove in which specimen abdomen were placed and wings spread by soft strips then stay them in same position for two days. Each specimen was properly labelled to point out location, specimen number, and collector name and collection date. After that these samples were preserved in a wooden box. DDT was also placed in boxes to preserve these specimens from ants and another predatory pest.

3. Results and Discussion

3.1 *Agrotis cinerea*

3.1.1 Diagnostic characters

Male antenna is relatively pectinated. Forewing light brown to light gray in color, un subdivided and simple stigmata differentiable, claviform stigma missing, cross lines separate and rough hind wings light cream in color with discal spot. Females are generally darker with filiform antenna.

3.1.2 Wing-span 33–40 mm

3.1.3 Male genitalia

Costal margin to some extent curved medially. Cucullus a little thick than Sacculus, basally oval, claspers thickened. Vesica three time longer than aedeagus, basal enlargement small. There is also apical swelling present.

3.1.4 Female genitalia

Female ovipositor is short. Frontal apophysis prolonged interiorly, appendix bursae two times longer than corpus bursae. And, C. bursae look like a drop.

3.1.5 Material examined

Punjab: Multan: *Agrotis cinerea*, B.Z. U, 3 ♂; 1 ♀, 26.ii.2018 Mudassir Hamza

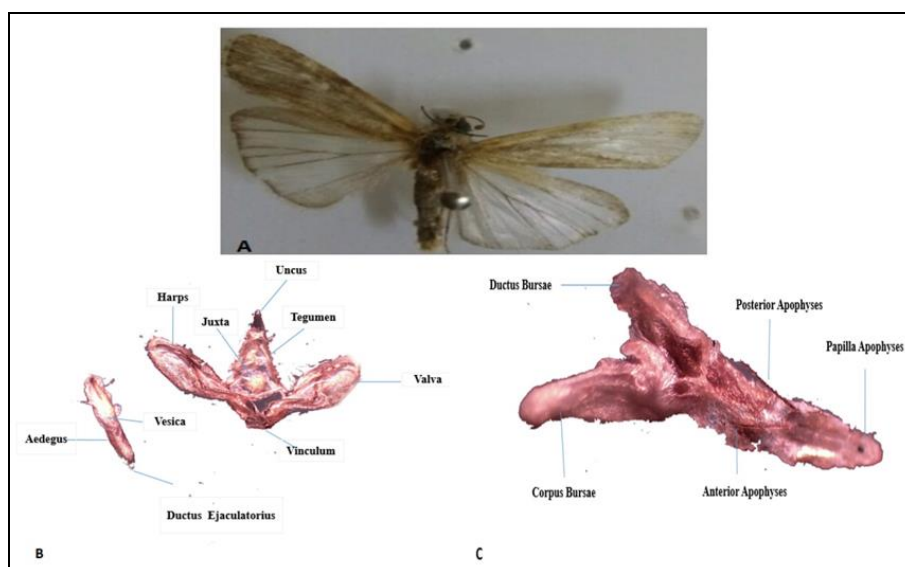


Fig 1: Adult of *Agrotis cinerea* complete body view (B) Male genitalia of *Agrotis cinerea* (C) Female genitalia of *Agrotis cinerea*

3.2 *Agrotis ypsilon*

3.2.1 Diagnostic characters

In male Antennae pectinated forewings light to dark brownish in color, stigmata centred with blackish spot, black flurry designed spot present on ostium of stigma, also two slight

flurry shaped spots at sub terminal zone. These structures are missing in others specie. Black section exists among the orbicular stigmata and reniform. Sub terminal and terminal area is bright. Hind wing white but darker at terminal area. Antenna filiform.

3.2.2 Wing-span 36–43 mm**3.2.3 Male genitalia**

Valve stretched out, basal one-third is slender and widened; claspers are sharp. Aedeagus is broader at the base. Vesica is stretched and cylindrical with tiny hardened groove, 6 times longer to aedeagus, cylindrical basal enlargement, turn over laterally and top swelling faintly bigger than vesical tube.

3.2.4 Female genitalia

Not found.

3.2.5 Material examined

Punjab: Multan: *Agrotis ypsilon*, B.Z.U, 4♂, 28.ii.2018
Mudssir Hamza.

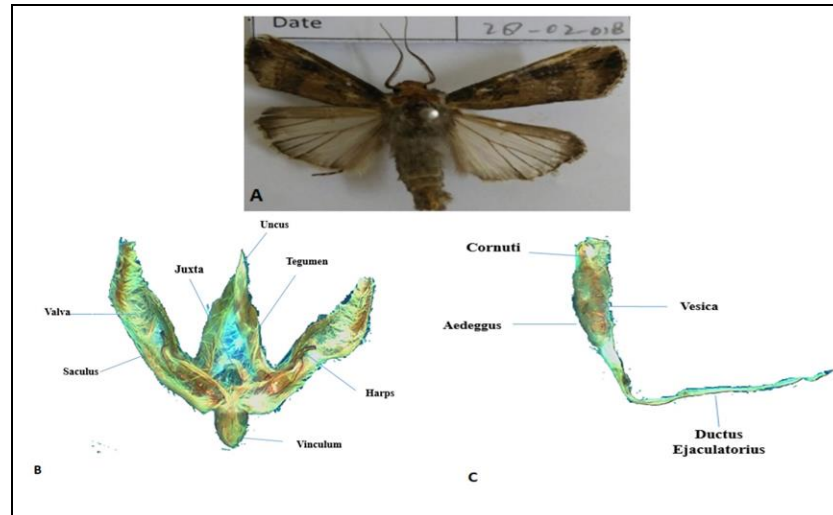


Fig 2: Adult of *Agrotis ypsilon* complete body view (B) Male genitalia of *Agrotis ypsilon* (C) Aedeagus of Male genitalia

3.3 *Chrysodeixis furihata***3.3.1 Diagnostic features**

- Body usually golden brown in color and forewings are brownish excluding white silvery symbols centrally located, engaged by a metallic white lobe. Pale brownish hindwings in color. Frons deeply produced and palpi are well developed. Segmented basal part is shorter than 2nd, far ahead three times the 3rd segment, short and coiled proboscis. Hindwings is smaller than forewings, apical edge notched by apical angle and sub-round, R3 and R4 veins mostly tailed, one anal vein existing, hindwings through frontal edge undulated, apical edge definitely undulated, M1 and Rs veins union and evolving from upper angle of cell, also 1A and 2A anal veins are present.

3.3.2 Wing-span 36 – 38 mm**3.3.3 Male Genitalia**

Males has stretched tegmen, bulky uncus, V shape saccus lacking saccular process, simple, bulky and tapering paramere, large and tube-shaped aedeagus, and large membranous connective lobe with thorn like cornute.

3.3.4 Females Genitalia

Not found.

3.3.5 Material examined

Punjab: Multan: *Chrysodeixis furihata*, B.Z. U, 4 ♂, 24.ii.2018 Mudassir Hamza

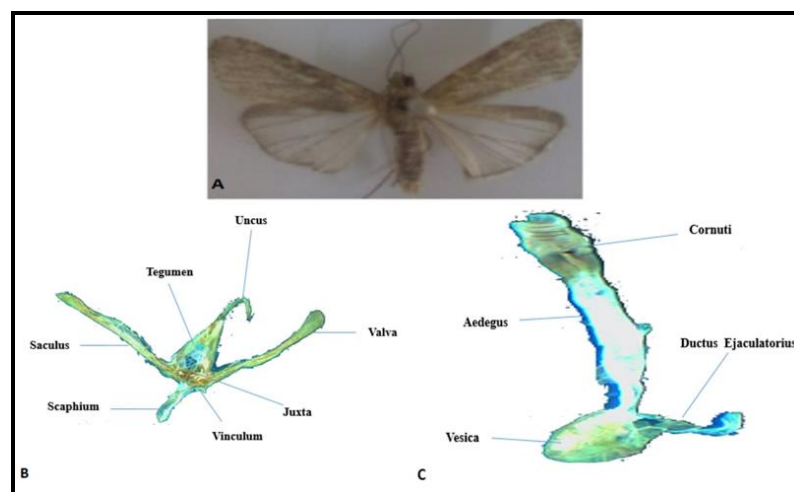


Fig 3: Adult of *Chrysodeixis furihata* complete body view (B) Male genitalia of *Chrysodeixis furihata* (C) Aedeagus of Male genitalia

3.4 *Helicoverpa armigera***3.4.1 Diagnostic Characters****3.4.2 Forewings**

In female forewing dark-brown but males have lighter and

grey colour wings. A dark band present between outer transversal and sub-marginal outlines transversal lines. A black colour spot expressing the reniform. A border line series of dark spots is present.

3.4.3 Hind wings

Lighter in colour and pale-yellow with brown band before outer edge. Black round spot located in the mid of wing.

3.4.4 Male Genitalia

Uncus small and modest, extensive sclerotized and apex with shrill spines. Tegumen elongate, sharp and distal at tops and proximal portion is v-shaped. Vinculum u-shaped. Saccus smaller, Sacculus well developed, extended, compacted and symmetrical. Valva elongated, highly sclerotized and fringed

with dense hairs. Rows of spines are present on corona interiorly. Juxta is rectangular shaped but divided medially. Aedeagus elongated and consistently sclerotized. Vesica is an irreversible sac like. Cornuti usually 10-11 in number which are visible on the puffy Vesica within the aedeagus.

3.4.5 Material examined

Punjab: Multan: *Helicoverpa armigera*, B.Z.U, 1♂, 2.iii.2018
Mudassir Hamza

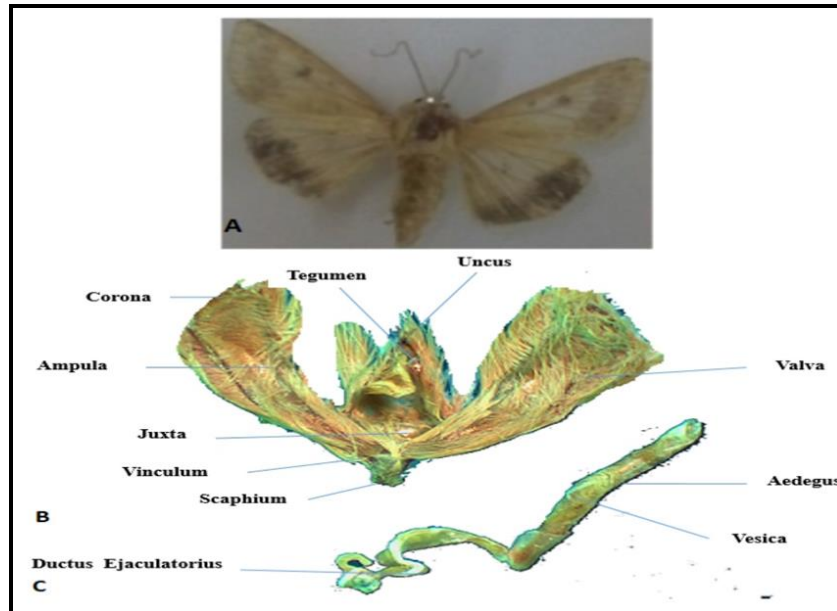


Fig 4: Adult of *Helicoverpa armigera* complete body view (A) Male genitalia of *Helicoverpa armigera* (B) Ductus Ejaculatorius of adult *Helicoverpa armigera* (C)

3.5 *Helicoverpa zea*

3.5.1 Diagnostic Characters

3.5.2 Forewings

A sub basal black line present in forewing from Costa to vein 1. Black and whitish spots are present on orbicular and Reni form stigmata outlined. A dark dentate mark present below the cell. Hind medial line split from Costa.

3.5.3 Hind wings

Covered with magenta ochreous and long black and whitish patch outside it. A wide black marginal band mostly with whitish spots in the center of border. On underside it is softer;

the orbicular and Reni form stigmata are dark black.

3.5.4 Female Genitalia

Well-developed, round in size and protected with long dense setae ovipositor. Anterior apophyses are smaller in length than posterior apophyses. Ductus bursae are shorter and very sclerotized lengthwise wrinkles on it. Corpus bursae are broader and coiled in shape, singum are not present.

3.5.5 Material examined

Punjab: Multan: *Helicoverpa zea*, B.Z. U, 1♀, 26.ii.2018
Mudassir Hamza

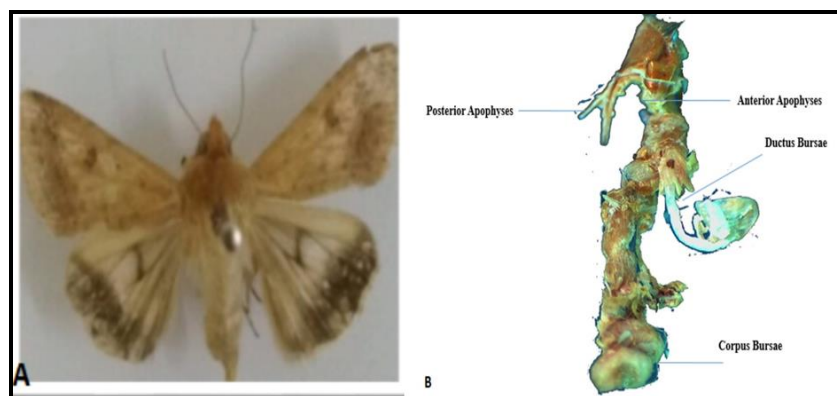


Fig 5: Adult of *Helicoverpa zea* (A) Female genitalia of *Helicoverpa zea* (B)

3.6 *Spodoptera exigua*

3.6.1 Diagnostic characters

Adult pale and brown in color, forewings by sub basal, upright medial paired line are also present and sometime show blurry appearance. Small spot is present on Orbicular. Round and pale in color. Reni form spot which is typically less conspicuous and almost with shady center. Sub peripheral line is pale, angle is formed below Costa and roughly slender dark lines before it at middle. Semi hyaline and white hindwings. Females usually darker than males

3.6.2 Head

Head is smooth and covered with scale. Fron is broader than its length and elevated beyond the eyes. Labial palpi is modest in size and smaller than half of 2nd segment. Well-developed proboscis with dorso cross cilia. In males antennal base is broader than frons and ciliate.

3.6.3 Thorax

Medially bowl-shaped tympanum with post spiracular hood is present, spiracle not discernable. Tympanal organ is well

developed and folded sclerite folded. Central tibia is basally tufted while hind tibia aproximal tufted.

3.6.4 Wing-span 24-26 mm

3.6.5 Female genitalia

Corpus-bursae rounded first and then to oval shape, aerial by means of strake complexity. Signums are smaller, lengthy and existing upper side of apical half of corpus-bursae. There are also elongated ductus bursae which is elongated than width and fine sclerotize at central half. Ostium-bursae is a little sclerotized, tapered at base and wider at base of ductus-bursae. Frontal apophysis is very small, subsequent apophysis are large and slender through a sharp tip spreading up to frontal edge of 8th segment of the abdomen. Smaller and bilobed papilla analis, and compressed with numerous macro and micro setae.

3.6.6 Material examined

Punjab: Multan: *Spodoptera exigua*, B.Z. U, 1♀, 12.ii.2018
Mudassir Hamza

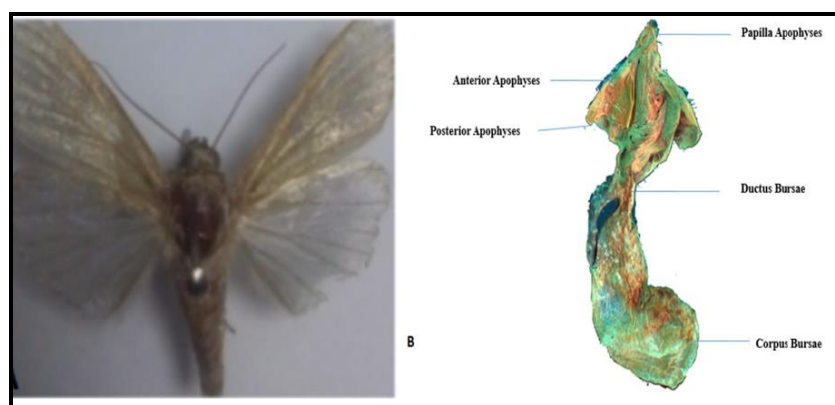


Fig 6: Adult of *Spodoptera exigua* (A) Female genitalia of *Spodoptera exigua*.

3.7 *Spodoptera litura*

3.7.1 Diagnosis

Head and thorax are light pale in colour also covered by a dark brownish spot, abdomen is also pale in colour. Forewings with few bands at basal region. A white band from coastline border domed in direction of terminal edge. Orbicular resembles letter (A). A longitudinal spot is presented on reniform. Adult males have grey black spot at sub terminal area. Bright and whitish hindwings with shady marginal line.

3.7.2 Head

Head is comparatively flat having lamellar scales on it. Frons is broader than length and elevated overhead the planes of eyes. Porrect and normal labial palpi are present. Proboscis is well-develop by dorso-lateral cilia and tip contains thin spines.

3.7.3 Thorax

Tympanum with post-spiracle hood and centrally curved and

spiracle found at central concavity. Tympanal sclerites are crumpled and digitate. Tarsi with well-known spines in three rows.

3.7.4 Wing-span 32-36 mm

3.7.5 Male genitalia

Uncus usually longer and somewhat hooked. Tegmen upturned U-shape and almost equal to length of uncus. Vinculum wider and smaller than tegmen and V-shaped. Vulva extended in length and well developed membranous with well differentiated parts. Clavus small. Ampulla is faintly curved, Juxta three-cornered by a slight base and sharp process. Coremata having two lobes one is smaller, and other one is longer.

3.7.6 Material examined

Punjab: Multan: *Spodoptera litura*, 3♂,
B.Z.U.1. iii.2018 Mudassir Hamza.

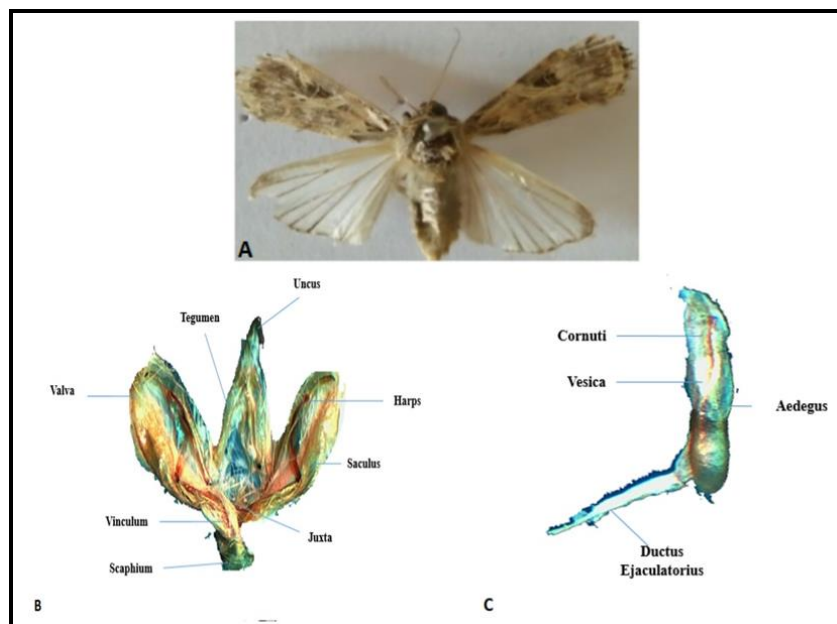


Fig 7: Adult of *Spodoptera litura* (A) Male genitalia of *Spodoptera litura* (B) Adeagus of male genitalia (C)

The summary of this study shows that 7 species of family Noctuidae were identified *Helicoverpa zea*, *Helicoverpa armigera*, *Mythimna unipunctata*, *Hadena jahangiri*, *Spodoptera litura*, *Spodoptera exigua*, *Chrysodeixis furihatai* okan, *Argrotis ypsilon*, and *Agrotis cinearia* belonging to different genus were described from District of Multan. Taxonomic characters of some cut worms of family Noctuidae were studied. Four species were identified using their genitals and wing venations as identifying tools. They provided the key to study the genital morphological characters (Thakur *et al.*, 2013) [7]. (Shaheen, 2013) [19] Describe that there were 24 species which belong to 5 different genus on the basis of head appendages like proboscis and palpi, wings venations and genital characters of both male and female species. (Hacker and Gulani, 2013) [20]. reviewed genus *Hadena* Schrank and this review contained supplementary and additional notes on species of genus *hadena* and also those which are closely related to this genus. (Mikola, 1998) [21] Described genus *Xylomoia* by identifying seven new species of this genus *Xylomoia*, also identified the difference between male and female genital characters of these seven species. (Bayer, 1960) [22] Identified six species belonging to genus *Prodenia*, *Lyphagama* and *Spodoptera* from South Africa.

4. Conclusion

The summary of this study shows that 7 species of family Noctuidae were identified *Helicoverpa zea*, *Helicoverpa armigera*, *Spodoptera litura*, *Spodoptera exigua*, *Chrysodeixis furihatai* okan, *Argrotis ypsilon*, and *Agrotis cinearia* belonging to different genus were described from District of Multan. Noctuidae considered as most destructive insect pest of agriculturally important crops. *Helicoverpa Armigera* serious pest of cotton bolls and decrease yield in all over Pakistan. Multan is cotton belt in Punjab Pakistan so to control these species identification is very important. This study was specially conducted to adopt control strategies after proper identification of these species.

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