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Diversity of Noctuid Caterpillars belonging to Subfamily Amphipyrynae, Catocalinae, Cuculiinae, Heliiothinae, Noctuinae and Plusiinae on Host Crops/Plants of Jammu & Kashmir State (India)

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ABSTRACT

This paper deals with a total of 22 species of 14 genera, belonging to noctuid moth caterpillars, under subfamily Amphipyrynae (2 spp.), Catocalinae (1sp.), Cuculiinae (3 spp.), Heliiothinae (2 spp.), Noctuinae (8 spp.) and Plusiinae (6 spp.). These noctuid species have been found to be feeding on 56 spp. of agricultural crops, economically important plants and water weed. Of the total caterpillar species, under 6 sub-families, 14 spp. of various sub-families, excepting Cuculiinae, are associated with different agricultural crops. This accounts for 63.63% of noctuid-fauna studied. The highest number of caterpillar species *i.e.* 13 (Cuculines, Heliiothines, Noctuines and Plusiines), feed on 28 spp. of medicinal / aromatic plants. This is followed by 8 spp. of noctuids, devouring vegetable crops (9 spp.). 6 spp. of caterpillars are associated with 4 spp. of cereal / food crops, 4 spp. with legumes (5spp.), 3 spp. feeding fodder crops (3 spp.), 2 spp. each associated with fruit crop/tree (2 spp.), ornamental plants (2 spp.) and rape seed, and 1 sp. each of caterpillar feeding on mulberry and common water hyacinth, belonging to different subfamilies of noctuid moths. An up-to-date systematic Checklist of noctuids, associated with crops and plant species, has been provided. Besides, species diversity of noctuid-fauna on host crops/ plants, has been included.

Introduction

The adult moth lays eggs on the host/ food plant species on which the larval stages, known as caterpillars feed. The caterpillars of some moths are major pests of agricultural crops and also causing severe damage to the economically important plant species in J & K State. The Amphipyryne caterpillars show the presence of spiracular stripe, extends

around the anal plate. The head in these caterpillars, is usually partially retracted into the thorax. The Catocaline caterpillars are usually smooth. These are long and slender. They pupate in a rather scant silk cocoon. The Cuculiine caterpillars are brightly coloured and smooth, also showing spiracular stripe, extending around the anal plate.

The caterpillars in case of the subfamily

Heliiothinae bear numerous fine stripe tipped granules and often raised. These mostly feed on flowers and seeds of crops. The caterpillars of Noctuines are smooth fleshy, with brownish colour of various shades. Many genera of this subfamily like *Agrotis* cause severe damage near ground level to the host crops or plants. The Plusiine caterpillars are mostly green, with two to three or sometimes four pair of white longitudinal stripes. These caterpillars also cause severe damage to the field crops and other economically important plantations in J & K State.

Materials and Methods

The database provided in this paper pertains to species of noctuid moth caterpillars of six sub-families, feeding on diverse agricultural crops and plant species (more than 56 spp.), prevalent in the vast areas and localities of Jammu and Kashmir State. This State is located in the northern part of Indian sub-continent, in the vicinity of Karakoram mountain and Western Himalayan ranges. J & K State is divided into three geographically and climatically different Provinces, viz. Ladakh (cold arid), Kashmir (temperate climate) and Jammu (subtropical climate). This State is of great zoogeographical importance as well as rich in biodiversity.

In this paper, a first attempt has been made to consolidate the scattered information on noctuid caterpillars (Amphipyrids, Catocalines, Cuculines, Heliiothines, Noctuines and Plusiines), with regard to their host / food plant species and is being provided in the form of updated systematic checklist, with information on caterpillar biodiversity. The data pertaining to taxa in this paper, has been updated in the light of latest nomenclatural / systematic changes. For the purpose of updating of faunal taxa and their diversity, relevant published works (national and international), besides online information on taxonomic surveys and latest checklists and catalogues, have been consulted. The important publications and online databases consulted are: Anon. (1974, 2017a, 2017b); Beccaloni *et al.*,

(2016); Kitching and Rawlins (1998); Robinson (1999); Robinson *et al.*, (2001); Ziegler (2017). The faunal records of valid noctuid caterpillar species, with their host crop / plant species are given in the Systematic checklist. The synonymies of the taxa are listed under the valid species, given in the parentheses. The Checklist also provides the references pertaining to authors recording and describing taxa from different regions and localities of J & K State, are in the form of code numbers, given in the long brackets in front of each listed species. The key to the code numbers, is cited at the end of the Checklist.

Results and Discussion

Annotated Systematic Checklist of Noctuid caterpillars and their associated host crops / plants

Super family: Noctuoidea
Family 1: Noctuidae
Subfamily 1: Amphipyridae

Tribe 1: Amphipyridini

Amphipyra monolitha Guenee [14]
Host / food: *Juglans regia* (walnut)

Tribe 2: Stiriini

Subtribe: Stiriina
Chalocopasta sp. [19]
Host / food plant: *Oryza sativa* (paddy)
Subfamily 2: Catocalinae

Tribe: Catocalini

Catocala spona (Linnaeus) [19]
Host / food plant: Paddy
Subfamily 3: Cuculiinae

Tribe: Cuculliini

Cucullia (Cucillia) cineracea (Freyer)
(= *Cucullia cineracea* Freyer) [23]
Host / food plant: *Artemisia* sp.

Cucullia (Cucullia) splendida (Stroll)

(= *Cucullia splendida* (Stroll) [8, 23]

Host / food plant: *Artemisia*

Cucullia verbasci Linnaeus [14]

Host / food plant: *Verbascum thapsus*

Subfamily 4: Heliothinae

Tribe 1: Heliothini

Helicoverpa armigera (Hubner) [4, 6, 11, 20, 21]

(= *Heliothis armigera* Hubner) [14, 17, 18, 26, 27, 28, 29]

Host / food plant: *Atropa acuminata*, *Aquilegra nivalis*, Brassicas vegetables,

Chickpea (*Cicer arietinum*), Chilly (*Capsicum*), *Datura stramonium*, *Hyoscyamus niger*, *Inula racemose*, *Lavatra* sp., Linseed (*Linum usitatissimum*), Maize (*Zea mays*), *Mentha arvensis*, *Nepeta* sp., Pea (*Pisum sativum*), Pearl millet (*Pennisetum glaucum*), *Picrorhiza kurroa*, Potato (*Solanum tuberosum*), *Rheum cashmeriana*, *Salvia sclarea*, *Saussurea costus*, *Sorghum* sp., Soybean (*Glycine max*), Tomato (*Solanum lycopersicum*), Wheat (*Triticum aestivum*).

Heliothis petigera Denis and Schiffermuller [17, 26]

Host / food plant: *Hyoscyamus niger*

Subfamily 5: Noctuidae

Tribe 1: Noctuini

Agrotis exclamationis (Linnaeus) [19]

Host/ food plant: Paddy

Agrotis flammata Schiffer-Muller [26]

Host / food plant: *Atropa belladonna*

Agrotis segetum Schiffer-Muller

(= *Euxoa segetum* Schiffer-Muller) [18, 26]

Host / food plant: *Mentha arvensis*

Agrotis ipsilon (Hufinagel): [6, 7, 14, 15, 16, 17, 18, 20, 22, 26, 30]

Host / food plant: *A. belladonna*, Brinjal (*Solanum melongena*), cabbag (*Brassica oleracea* var. *capitata*), Cauliflower (*Brassica oleracea* var. *botrytis*), Chily, Gram, Hops (*Humulus lupulus*), Knolkhol (*Brassica oleracea* var. *gongylodes*), Linseed (*Linum usitatissimum*), Maize, Onion (*Allium cepa*), Potato (*Solanum tuberosum*), *P. kurroa*, *Solanum aviculare*, *Sorghum*, sp., Tomato.

Tribe 2: Leucaniini

Mythimna separata (Walker) [25]

(= *Mythimna (Pseudaletia) separata* Walker)

(= *Pseudaletia separata* Walker) [22]

Host / food plants: Rye (*Secala cereale*), *Trifolium pratense*, *Melilotus alba*

Tribe 3: Prodeniini

Spodoptera exigua (Hubner) [24]

(= *Laphygma exigua* Hubner) [18]

Host / food plants: *Brassica oleracea*, *Mentha arvensis* and *Nepeta cataria*

Spodoptera litura (Fabricius) [3, 6, 12, 13]

(= *Podentia litura*)

Host / food plants: Cabbage, Cauliflower, Knol Khol, mango tree (*Magnifera indica*), *Morus* spp. (Mulberry), Onion, Turnip (*Brassica rapa*), water hyacinth (*Eichhornia crassipes*)

Spodoptera mauritia (Boisduval) [24]

Host / food plant: *Brassica oleracea*

Subfamily 6: Plusiinae

Tribe: Argyrogrammatini

Argyrogramma signata (Fabricius)

(= *Plusia signata*) [6]

Host/ food plants: cabbage, cauliflower, spinach (*Spinacia oleracea*), pea, potato, tomato

Thysanoplusia orichalcea (Fabricius)
(= *Plusia orichalcea*) [1, 5, 8, 9, 10]
Host / food plants: *Atropa acuminata*, Brassicas vegetables (cabbage, cauliflower, Knol-khol), Cow pea (*Vigna unguiculata*), Fenugreek (*Trigonella foenum – graecum*), Green beans (*Phaseolus vulgaris*), *Inula racemose*, *Indigo* sp., *Mentha piperata*, Onion, Pea, Potato, Parsley, ‘Ajwain’ (*Carum copticum*), *Rumex nepalensis*

Trichoplusia ni Hubner [2, 24]

Host/ food plant: Brassicas vegetables, Black mustard (*Brassica nigra*), Legumes

Tribe: Plusiini

Autographa nigrisigna (Walker) [18]

Host/ food plants: *Mentha* sp., *Nepeta cataria*, *Salvia moorcroftiana*

Autographa gamma (Linnaeus) [19]

Host / food plant: Paddy

Diachrysia chryson (Esper)
(= *Autographa chryson* Esper) [18, 26]

Host / food plants: *Anethum graveolens*, *Mentha* sp., *Nepeta cataria*, *Salvia moorcroftiana*,

Key to the numerical in long brackets in front of the above listed taxa

1 = Ahmad and Trag (1981), 2 = Anon(1974); 3 = Bhatia and Sharma (2008); 4 = Bhat *et al.*, (2009); 5 = Bhat *et al.*, (2010); 6 = Bhat *et al.*, (2011); 7 = Bhat and Zaki (2008); 8 = Dar *et al.*, (2015); 9 = Dar and Kirti (2015); 10 = Fletcher (1920); 11 = Gupta *et al.*, (2006); 12 = Gupta *et al.*, (2015); 13 = Khan *et al.*, (2004); 14 = Kirti *et al.*, (2014); 15 = Lone and Zaki (1999); 16 = Mathur(1962); 17 = Mathur and Anand (1964); 18 = Mathur and Srivastava (1967); 19 = Now-Bahaar and Bhat(2011); 20 = Pandey *et al.*,(2006); 21 = Pandey *et al.*, (2007); 22 = Rishi (1973); 23 = Ronkay and

Ronkay (2009); 24 = Sadhotra and Tripathi (2009); 25 = Singh and Manchanda (1981); 26 = Srivastava (1982); 27 = Thakur *et al.*, (1995); 28 = Wani *et al.*, (1997); 29 = Wani *et al.*, (1998); 30 = Zaz (1999).

As per the above given annotated checklist, a total of 22 species, under 14 genera of noctuid moth caterpillars, pertaining to subfamily Amphipyridae, Catocalinae, Cuculiinae, Heliiothinae, Noctuinae and Plusiinae, is prevalent in vast areas and localities of Jammu and Kashmir State.

The various caterpillar species, belonging to these families, covering as many as 10 tribes, feed on more than 56 species of host crops and plant species of different families.

These included agricultural crops (legumes / pulses), fruit tree/ crops, cereal crops, fodder/ forage and vegetables, economically important plants (ornamental, medicinal / aromatic, oil-seed, mulberry) and water weed (water hyacinth).

The Amphipyridine moth caterpillars included two species, *Amphipyra monilitha* and *Chalocopasta* sp. of tribe Amphipyridini and Stiniini respectively. The Catocaline (tribe Catocalini) included single species, viz. *Catocala sponsa*. The Cucullines moth caterpillars, under tribe Cuculliini, existing in these region, covered three species belonging to genus *Cucullia*. The Heliiothines (Tribe Heliiothini) caterpillars, viz. *Helicoverpa armigera* and *Heliothis peltigera*, feeding on wide variety of host crops and economically important plants. Noctuines having caterpillars of three tribes (Noctuini, Leucaniini, Prodeniini), incorporated as many as 8 species, under three genera (*Agrotis*, *Mythimna*, *Spodoptera*), as potential pests of agricultural crops, occurring in the wide areas and localities of J & K State.

The Plusiines of this region are represented by 6 species, belonging to 5 genera- *Argyrogramma* (1 sp.), *Thysanoplusia* (1 sp.), *Trichoplusia* (1sp.) (Tribe Argyrogrammatini); *Autographa* (2 spp.), *Diachrysia chryson* (Tribe Plusiini). These noctuids are found to be pests of agricultural importance and medicinal / aromatic plant species.

Table 1. Species Diversity of Noctuid Caterpillars belonging to sub-family Amphipyridae, Catocalinae, Cuculiinae, Heliiothinae, Noctuninae, Plusiinae on different kinds of Host/Food plants and crops.

Host agricultural crop / plant of Noctuid caterpillars	No. of Genera and (species) of caterpillars of Noctuid sub- families						Total no. of Genera (species)
	AM	CA	CU	HE	NO	PL	
Legume/Pulse crops.	-	-	-	+	+	+	4(4)
Legume (general)	-	-	-	-	-	1(1)	1(1)
Chick pea (gram)	-	-	-	1(1)	1(1)	-	2(1)
Cowpea	-	-	-	-	-	1(1)	1(1)
Green Bean	-	-	-	-	-	1(1)	1(1)
Soybean	-	-	-	1(1)	-	1(1)	1(1)
Fruit Tree / Crop	+	-	-	-	+	-	2(2)
Walnut	1(1)	-	-	-	-	-	1(1)
Mango	-	-	-	-	1(1)	-	1(1)
Ornamental Plant	-	-	-	+	-	+	2(2)
<i>Indigo</i>	-	-	-	-	-	1(1)	1(1)
<i>Lavatera</i>	-	-	-	1(1)	-	-	1(1)
Mulberry (<i>Morus spp.</i>)	-	-	-	-	1(1)	-	1(1)
Water weed (<i>E.crassips</i>)	-	-	-	-	1(1)	-	1(1)
Rape seed (<i>B.napus</i>)	-	-	-	1(1)	-	1(1)	2(2)
Food / Cereal crop	-	+	-	+	+	+	6(6)
Paddy	-	2(2)	-	-	1(1)	1(1)	4(4)
Pearl millet	-	-	-	1(1)	-	-	1(1)
Maize	-	-	-	1(1)	1(1)	-	2(2)
Wheat	-	-	-	1(1)	-	-	1(1)
Fodder / Forage crop	-	-	-	+	+	-	3(3)
Rye	-	-	-	-	1(1)	-	1(1)
<i>Sorghum</i>	-	-	-	1(1)	1(1)	-	2(2)
<i>T. pratense</i>	-	-	-	-	1(1)	-	1(1)
Medicinal / Aromatic Plants	-	-	+	+	+	+	9(13)
<i>A.graveolens</i>	-	-	-	-	-	1(1)	1(1)
<i>Artemisia sp.</i>	-	-	2(2)	-	-	-	2(2)
<i>A. acuminata</i>	-	-	-	(1)	-	-	1(1)
<i>A. belladonna</i>	-	-	-	-	1(2)	-	1(2)
<i>A. nivalis</i>	-	-	-	1(1)	-	-	1(1)
<i>B. nigra</i>	-	-	-	-	-	1(1)	1(1)
<i>C. copticum</i>	-	-	-	-	-	1(1)	1(1)
<i>D. stramonium</i>	-	-	-	1(1)	-	-	1(1)
<i>H. lupulus</i>	-	-	-	-	1(1)	-	1(1)
<i>H.niger</i>	-	-	-	1(1)	-	-	1(1)
<i>I. racemose</i>	-	-	-	1(1)	-	1(1)	2(2)
<i>L. usitatissimum</i>	-	-	-	1(1)	1(1)	-	2(2)
<i>M.arvensis</i>	-	-	-	1(1)	2(2)	-	3(3)
<i>M.piperata</i>	-	-	-	-	-	1(1)	1(1)
<i>Mentha sp.</i>	-	-	-	-	-	2(2)	2(2)
<i>M. alba</i>	-	-	-	-	1(1)	-	1(1)
<i>N. cataria</i>	-	-	-	-	1(1)	2(2)	3(3)
<i>Nepeta sp.</i>	-	-	-	1(1)	-	-	1(1)
<i>P. kurvoa</i>	-	-	-	1(1)	1(1)	-	2(2)
<i>R. nepalensis</i>	-	-	-	-	-	1(1)	1(1)
<i>R. cashmeriana</i>	-	-	-	1(1)	-	-	1(1)

<i>Rheum sp.</i>	-	-	-	1(1)	-	-	1(1)
<i>S.costus</i>	-	-	-	1(1)	-	-	1(1)
<i>S. sclarea</i>	-	-	-	1(1)	-	1(1)	2(2)
<i>S. moorcraftiana</i>	-	-	-	-	-	2(2)	2(2)
<i>S. aviculare</i>	-	-	-	-	1(1)	-	1(1)
<i>T. foenum-graecum</i>	-	-	-	-	-	1(1)	1(1)
<i>V. thapsus</i>	-	-	1(1)	-	-	-	1(1)
VEGETABLES	-	-	-	+	+	+	8(8)
BRASSICAS	-	-	-	+	+	+	6(8)
<i>B.oleracea</i>	-	-	-	-	2(2)	1(1)	3(3)
Cabbage	-	-	-	1(1)	2(2)	2(2)	5(5)
Cauliflower	-	-	-	1(1)	2(2)	1(1)	4(4)
Kale	-	-	-	1(1)	-	1(1)	2(2)
Knolkhol	-	-	-	-	2(2)	-	2(2)
Turnip	-	-	-	1(1)	1(1)	2(2)	4(4)
OTHER VEGETABLES							
Brinjal	-	-	-	-	1(1)	-	1(1)
Chilly	-	-	-	1(1)	1(1)	-	2(2)
Onion	-	-	-	-	2(2)	1(1)	3(3)
Pea	-	-	-	1(1)	1(1)	2(2)	4(4)
Potato	-	-	-	1(1)	2(2)	1(1)	4(4)
Raddish	-	-	-	-	-	1(1)	1(1)
Spinach	--	-	-	-	-	1(1)	1(1)
Tomto	-	-	-	1(1)	1(1)	1(1)	3(3)

AM = Amphipyridae; CA = Catocalinae; Cu = Cuculiinae; HE = Heliiothinae; No = Noctuinae; PL = Plusiinae; + = present; - = absent

Diversity and Species richness of Host agricultural crops / plants of Caterpillars

Of the 22 noctuid species, under 6 sub-families, occurring in J & K State, 14 spp. of various sub-families excepting Cuculiinae, are associated with agricultural crops of various kinds and this accounts for 63.63 % of the total noctuid caterpillar-fauna studied. The same percentage of caterpillars of four sub-families is also seen in case of other host plant species, however, not pertaining sub-family Amphipyridae and Catocalinae. The analysis of number of noctuid caterpillar species, feeding on different kinds of crops and plants, has shown highest number of caterpillar species, *i.e.* 13 (9 genera), under sub-families as Cuculiinae, Heliiothinae, Noctuinae and Plusiinae. These species are found to be devouring about 28 species of medicinal / aromatic plants belonging to different families. Of these medicinal /aromatic plants, *Mentha* spp. (*M. arvensis*, *M. piperata* and *Mentha* sp.) and *Nepeta* spp., have highest number

of associated caterpillar species (Heliiothines, Noctuines, Plusiines) as 6 spp. and 4 spp. respectively. Other medicinal / aromatic plants serving as host / food plants for the noctuids of different subfamilies are given Table 1.

After medicinal/ aromatic plants, Brassicas and other vegetables (brinjal, chilly, onion, pea, potato, raddish, spinach, tomato), are observed to be source of food material for 8 species of 8 genera of caterpillars (Heliiothine, Noctuine, Plusiine).

These caterpillar species have been found to be feeding on 9 spp. of vegetable, including brassicas vegetables, *Brassica oleracea* and its varieties, such as cabbage, cauliflower, kale, knol khol and turnip (Table 1). *Brassica oleracea* and its varieties, are alone affected by 8 species under 8 genera of various caterpillar species, under aforementioned sub-families. Cabbage is associated with highest number of species *i.e.* 5, followed by cauliflower, turnip, pea, potato, serving food for 4 species each

of caterpillar. The number of species of caterpillars associated with other vegetables is given in Table 1.

The cereal / food crops (paddy, millet, maize and wheat) are associated with the caterpillars of moths of 6 spp. (6 genn.), belonging to subfamilies, viz. Catocalinae, Heliiothinae, Noctuinae and Plusiinae). The legume / pulse crops, are serving food for 4 spp. (4 genn.) of caterpillars of Heliiothinae, Noctuinae and Plusiinae. 2 spp. pertaining to Heliiothinae and Noctuinae feed on chick pea (gram) and rest of the pulse crops: cow pea, green pea and soyabean, serving food to one species each of Plusiine (Table 1).

The fodder / forage crops (rye, sorghum, clover), showed their association with 3 species of caterpillars (Heliiothines, Noctuines). This is followed by 2 spp. each of caterpillars, feeding on fruit tree/ crop (walnut, mango), ornamental plants (*Indigo*, *Lavatera*) and rape seed, pertaining to subfamilies- Amphipyrrinae, Heliiothinae, Noctuinae and Plusiinae. Besides these, mulberry and water weed (water hyacinth), found to be associated with one species each of subfamily Noctuinae (Table 1).

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