New Faunistic Records of Three Species of Family Encyrtidae (Hymenoptera: Chalcidoidea: Encyrtidae) from Haryana, India

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Abstract
The first records of three encyrtid wasp species—*Anagyrus aqilonaris* (Noyes & Hayat, 1984**)**, *Callipteroma sexguttata* Motschulsky, 1863 and *Apoleptomastix bicoloricornis* (Girault, 1915) were reported from Haryana, India. Detailed redescriptions are provided, which are based on morphology. Illustrations of various body parts were given to facilitate future identifications. These findings underscore the underexplored chalcid wasp diversity in Haryana and contribute to the taxonomy of family Encyrtidae and other allied families in northern India.

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Keywords: Encyrtidae, faunistic records, parasitoid wasps, Haryana, Chalcidoidea, taxonomy, biological control

Introduction

Encyrtidae is the largest Hymenopteran family belonging to superfamily Chalacidoidea. It includes 5171 described species in 518 genera globally and 771 species in 142 (Universal Chalcidoidea database website. https://ucd.chalcid.org.) genera from India. Specific regional studies in Haryana have been limited, leaving significant gaps in the understanding of local Chalcids diversity and their ecological roles, particularly species with potential for biological control application and IPM (Pilania *et al*., 2021) [11]. Previous entomological surveys have established fundamental knowledge regarding the distribution and host associations of Hymenopteran species, particularly within the superfamily Chalcidoidea (Ghost *et al*.,2023) [2]. The genus *Anagyrus aquilonaris* described by (Noyes and Hayat 1984) [9] and First time recorded from India by B.R. Subba Rao and M. Hayat in 1986 from Delhi & Uttar Pradesh and the genus *Callipteroma sexguttata* was first described by Motschulsky in 1863 and first recorded from India by Gupta, A. & Joshi, S. in 2013 from Andaman and Nicobar Island and the genus *Apoleptomastix bicoloricornis* was originally described by Girault in 1915 [3] and first recorded from India by B.R. Subba Rao and M. Hayat in 1986 from Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu & Uttar Pradesh

This paper documents the first record of *Anagyrus aquilonaris* (Noyes and Hayat 1984) [9], *Callipteroma sexguttata* Motschulsky, (1863), *Apoleptomastix bicoloricornis* (Girault 1915) [3] within the geographical confines of Haryana, India thereby contributing to the regional faunistic records of Chalcidoidea superfamily.

This improves the understanding of insect biodiversity and distribution, particularly for beneficial insects crucial for agroecological pest management and for biological pest control (Alvarez *et al*.,2021) [8]. The family Encyrtidae includes many parasitoid wasps that control populations of various phytophagous insect pest, thus minimising crop damage and regulate pest populations below the Economic threshold value and reducing dependency on synthetic pesticides. Most of the species of Tetracneminae parasitising Pseudococcidae, and species of family Encyrtidae, parasitise a wide range of coccids along with mites, ticks, and spiders.

Material and methods

The sample collected from different districts of Haryana by the sweep net from different ecosystem like agricultural and horticultural fields. The collected samples were sorted under the stereo-zoom microscope (Olympus SZX16). The encyrtids were preserved both as dry and wet, based on the methods given by Noyes (1982). Wet preservation is in 80% grade of Ethyl Alcohol and dry preservation was on a rectangular card with water-soluble glue. After card mount, slide mounts were prepared following the procedure given by Noyes. The photographs were taken by "DIGI1000 Dewiter" digital camera coupled to the compound microscope (Olympus CX41). Identification of the subfamily Tetracneminae insects done by the keys given by Hayat [6, 7] and further confirmed by the related research papers.

Abbreviations for Measurements

Head: HFW- Maximum width of head in front view, HFL- Medial length (height) of head in front view, TRL- Maximum length of torulus, TRD- Minimum distance between toruli, TMMD- Distance between torulus and mouth margin.
Antenna: SL- Scape length, excluding radicle length, SW- Scape width, PL- Pedicel length, PW- Pedicel width, FNL- Funicle length, FNW- Funicle width, CLL- Clava length.
Thorax: TL- Length of thorax, measured along midline from pronotum to propodeum, TW- Width of thorax at tegulae, PRL- Pronotum length, PRW-Pronotum width, MSCL- Mesoscutum length, MSCW- Mesoscutum width, STL- Scutellum length, STW- Scutellum width, PPL- Median length of propodeum, DBS- Distances between the two propodeal spiracles.
Wings: FWL- Fore wing length, FWW- Fore wing width, HWL- Hind wing length, HWW- Hind wing width.
Legs: MTL- Length of mid tibia, HTL- Length of hind tibia.
Gaster: GL- Gaster length, measured from base of TI to apex of TVII, GW- Gaster width, OVL- Ovipositor length.

The length of the insect habitus is in millimeter and all other measurements are relative measurements only.

Taxonomy

***Anagyrus aquilonaris* (Noyes & Hayat, 1984)**

Cremesina aquilonaris Noyes & Hayat, 1984: 261-262. Figures
Leptanusia varicornis Shamim & Shafee, 1985b: 309. Figures
Anagyrus crassipennis Shamim & Shafee, 1989: 41-43. Figures
Anagyrus aquilonaris (Noyes & Hayat, 1984) in Noyes & Hayat, 1994: 91.

Redescription

Female: Body length 1.02-1.59 mm. Body dorso-ventrally compact with orange red to brick red coloration. Head frontovertex, malar space absolutely coral orange with sparsely disperse white setae. Eyes densely setose. Flagellum with dark brown radicle; scape widened and flattened, primarily dark brown except subapical white band and dorsal white color stripe; pedicel with white apex and dark brown base; flagellum with F1, F6 (or F5 and F6), clava brown (fig.3); F2-F5 white. Mesosoma with pronotum, mesoscutum, axillae, scutellum entirely orange red and significantly setose. Tegulae pale brown. Mesopleuron anterior one-third orange red, posterior two-third pale tortilla. Forewing infuscate. Legs with coxa; trochanter; femur; tibia Pale brown; tarsi off white in color. Gaster dark orange red to brick red coloration
Head: Head (fig.1) in front view broader than long. Frontovertex 0.5× of head width. Occipital margin round and smooth; each toruli separated from mouth margin by half of its diameter. Eye setae present. Mandible with two-pointed spear shaped teeth. Antenna (fig.3) with 6 funicle segments; scape with 2.15× as long as broad; pedicle 0.7× of F1 length; clava 3 segmented with pointed apex. Relative measurement: HFW, 55; HFL, 46; TRL, 6; TRD, 12; TMMD, 3; SL, 28; SW, 13; PL, 10; PW, 4; FNL1, 13; FNW1, 5; FNL2, 9; FNW2, 4; FNL3, 8; FNW3, 4; FNL4, 8; FNW4, 4; FNL5, 7; FNW5, 4; FNL6, 7; FNW6, 4; CLL, 20.
Mesososma: Mesosoma (fig.4) 2.25× of scutellum length. Mesoscutum 0.52× longer than wide without notular lines. Setation sparsely present on mesoscutum, scutellum and axilla with ripple striation Propodeum medially one-third of scutellum, spiracles near to almost anterior one-third of propodeum. Fore wing (fig.2) 2.5x as long as broad with reduced post marginal vein. Relative measurement. TL, 63; TW, 57; MSCL, 25; MSCW, 48; STL, 28; STW, 28; DBS, 48. FWL,120; FWW, 47; HWL, 87; HWW, 15; MTL, 53; HTL, 48.
Metasoma: Gaster (fig.5) slightly longer than thorax with metacercal plates situtated at proximal of one-fifth of gaster; having 3 long metacercal bristles each. ovipositor not exerted; paratergites present; TVIII longer than broad; ovipositor nearly as long as mid tibia. Relative measurement GL, 80; GW, 55; OVL, 57.
Material examined: INDIA: HARYANA: Palwal; 1 female (on slide under 4 coverslip), 22.ix.2024, Coll. U.D. Singh.
Distribution: Andhra Pradesh, Assam, Bihar, Delhi, Haryana (present record), Jammu & Kashmir, Jharkand, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, Uttaranchal
Comments: The above redescription is based upon the original description given by (Noyes and Hayat 1984). *Anagyrus aquilonaris*, newly recorded specimen from Indian state of Haryana more or less matches with the characters given by (Noyes & Hayat 1984). Several variants of *Anagyrus aquilonaris* recorded from different parts of India.

***Callipteroma sexguttata* Motschulsky, 1863**

Callipteroma sexguttata Motschulsky, 1863: 37. (valid)
Leptomastix guttatipennis io Girault, 1919a: 165.

Redescription

Female: Body length 1.3-2.5 mm. Body dorso-ventrally concise, without metallic shine, largely dark brown. Head vertex, frons, gena completely matt dark brown. Flagellum with redicle black; scape, pedicel, funicle segments and clava dark brown; each funicle segment clearly longer than wide. Mesosoma with pronotum, mesoscutum, scutellum, tegulae, mesopleuron entirely dark brown, axilla black with silver white setae. Forewings infuscate. Legs with coxa, trochanter, femur, tibia brown; tarsi pale brown. Gaster dark brown to black.
Head: Head (fig.6) in front view slightly as broader as longer; vertex with polygonal reticulate striation; frontovertex 0.5× of head width; occipital margin round and regular; each toruli separated from mouth margin by about of its own diameter; eye setae present; Mandible with 2-pointed teeth with subequal in length. Antenna (fig.11) with 6 funicle

segments, scape with 12.75× as long as broad. Pedicle 0.26× of F1. Each funicle segments clearly longer than broad with densely setose. Clava 3 segmented with rounded apex with 10 sensilla. Relative measurement: HFW, 68; HFL, 67; TRL, 9; TRD, 14; TMMD, 7; SL, 51; SW, 4; PL, 10; PW, 5; FNL1, 38; FNW1, 5; FNL2, 31; FNW2, 5; FNL3, 28; FNW3, 4; FNL4, 25; FNW4, 5; FNL5, 22; FNW5, 5; FNL6, 19; FNW6, 5; CLL, 40.

Mesososma: Mesosoma (fig.7) 3.6× of scutellum length. Pronotum entire. Mesoscutum nearly half as long as wide without notular lines. Setation sparsely present on mesoscutum; axillae separated and with reticulate striation. Scutellum with polygonal reticulate sculpture. Spiracles located close to anterior part of the propodeum. Fore wing (fig. 8) 3.1× as long as broad with well-developed venation. Relative measurement TL, 98; TW, 74; MSCL, 37; MSCW, 64; STL, 27; STW, 28; PPL, 27; DBS, 50; FWL, 250; FWW, 80; HWL,148; HWW, 22; MTL, 130; HTL, 96.

Metasoma: Gaster (fig.10) slightly shorter than thorax with metacercal plates situtated at proximal within one-fourth of gaster; having 4 long metacercal bristles each. Ovipositor very slightly exerted; paratergites present; TVIII longer than broad; ovipositor 0.16× long as mid tibia. Relative measurement GL, 94; GW, 71; OVL, 22.

Material examined: INDIA: HARYANA: Mewat, 1 female (on slide under 4 coverslips), 24.ix.2024, Coll. U.D. Singh; HARYANA: Palwal, 1 female (on card), 22.ix.2024, Coll. U.D. Singh.

Male: Funicle segments with long setae; clava entire and pointed. Pattern on forewing almost similar to female.

Material examined: INDIA: HARYANA: Palwal; 1 male (on slide under 4 coverslip), 22.ix.2024, Coll. U.D. Singh.

Comments: The above rediscription is based upon the original description given by Motschulsky (1963). *Callipteroma sexguttat*a recently discovered encyrtid from the Indian state of Haryana matches with the characters given by Motschulsky (1963). *Callipteroma sexguttat*a is close to the *C. testacea* but showing difference on the marking pattern on the forewing.

Distribution: Andaman and Nicobar, Delhi, Haryana (present record), Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh.

Apoleptomastix bicoloricornis (Girault, 1915)

Leptomastix bicoloricornis Girault, 1915m: 152.

Xiphomastix ranchiensis Shamim & Shafee, 1984a: 24. Figures

Redescription

Female: Body length 2.44 mm. Body compact, not dorso-ventrally flattened; largely dark brown to black. Head vertex, frons, gena completely matt black with white setae scattered sparingly. Flagellum with radicle black; scape dark brown with white marking; pedicle with black base and lighter colouration towards apex; funicule segment F1 with base white and rest black; F2 white completely with apex black. Mesosoma with pronotum, mesoscutum, axillae, scutellum, tegulae, mesopleuron entirely black; mesocutum and scutellum with white setae distributed arbitrarily. Forewings hyaline. Legs with coxa, trochanter black; femur basal part black with densely setose and apex brown; tibia with pale yellow color; tarsi off white in color. Gaster completely dark brown

Head: Head (fig.14) in front view broader than long; vertex with sparsely distribution of sort seta; frontovertex 0.57× of head width with parallel reticulate sculpture; occipital margin rounded and not smooth; each toruli separated from mouth margin by 1.8× of its diameter; Mandible with 2 pointed teeth with lower mandible longer than upper. Antenna (fig.13) with 6 funicle segments, scape with 4.8×as long as broad. Pedicle 0.5× of F1 length. Each funicle segments clearly longer than broad with densely setose. Clava 3 segmented with rounded apex with 15 sensilla. Relative measurement: HFW, 61; HFL, 48; TRL, 9.5; TRD, 6.2; TMMD, 7.5; SL, 29; SW, 6; PL, 14; PW, 4; FNL1, 27; FNW1, 3; FNL2, 21; FNW2, 4; FNL3, 17; FNW3, 5; FNL4, 14; FNW4, 5; FNL5, 12; FNW5,6; FNL6, 11; FNW6, 6; CLL,21.

Mesososma: Mesosoma (fig.15) 3.2× of scutellum length. Pronotum entire. Mesoscutum 0.56× longer than wide without notular lines; polygonal reticulate striation on mesosuctum. axillae separated and with reticulate striation. Scutellum with longitudinal-reticulate sculpture. Propodeum medially one-third of scutellum, spiracles near to anterior of propodeum. Fore wing (fig.12) 3.4x as long as broad with well-developed venation. Relative measurement TL, 79; TW, 57; PRL, 47; PRW, 7; MSCL,28; MSCW, 50; STL, 24; STW, 27; PPL, 17; DBS, 30. FWL,150; FWW, 44; HWL,110; HWW, 23; MTL, 74; HTL, 55.

Metasoma: Gaster (fig.16) longer than thorax with metacercal plates situtated at proximal of one-fourth of gaster; having 3 metacercal bristles each. ovipositor exerted; paratergites present; TVIII longer than broad; ovipositor 1.5× longer than mid tibia. Relative measurement GL, 130; GW,56; OVL, 116.

Material examined: INDIA: HARYANA: Mewat, 1 female (on slide under 4 coverslips), 24.ix.2024, Coll. U.D. Singh; HARYANA: Palwal, 1 female (on card), 22.ix.2024, Coll. U.D. Singh

Male: Similar to female except Funicle segments with long setae; clava entire and pointed.

Material examined: INDIA: HARYANA: Palwal; 1 male (on card), 22.ix.2024, Coll. U.D. Singh.

Distribution: Andhra Pradesh, Bihar, Delhi, Haryana (present record), Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Maharashtra, Puducherry, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

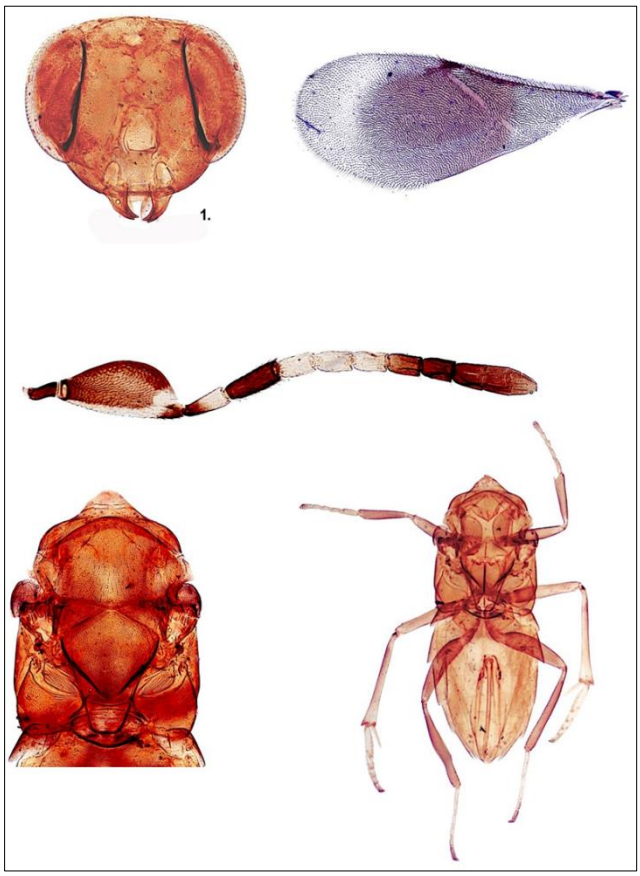

Fig 1-5: *Anagyrus aquilonaris* 1. head, 2. forewing, 3. antenna, 4. mesosoma 5. mesosoma & metasoma.

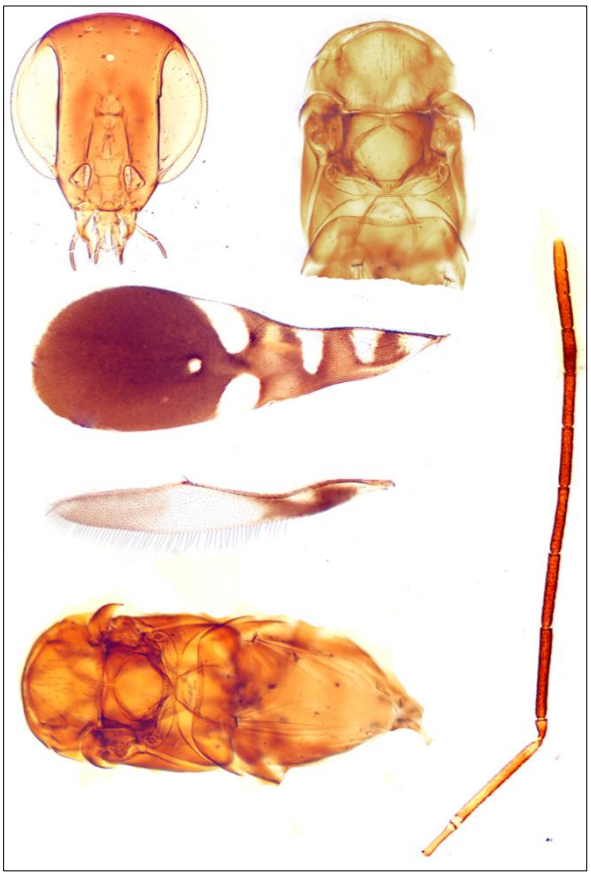

Fig 6-11: *Callipteroma sexguttata*, 6. head, 7. mesosoma, 8. forewing, 9. hindwing, 10. mesosoma and metasoma, 11. antenna

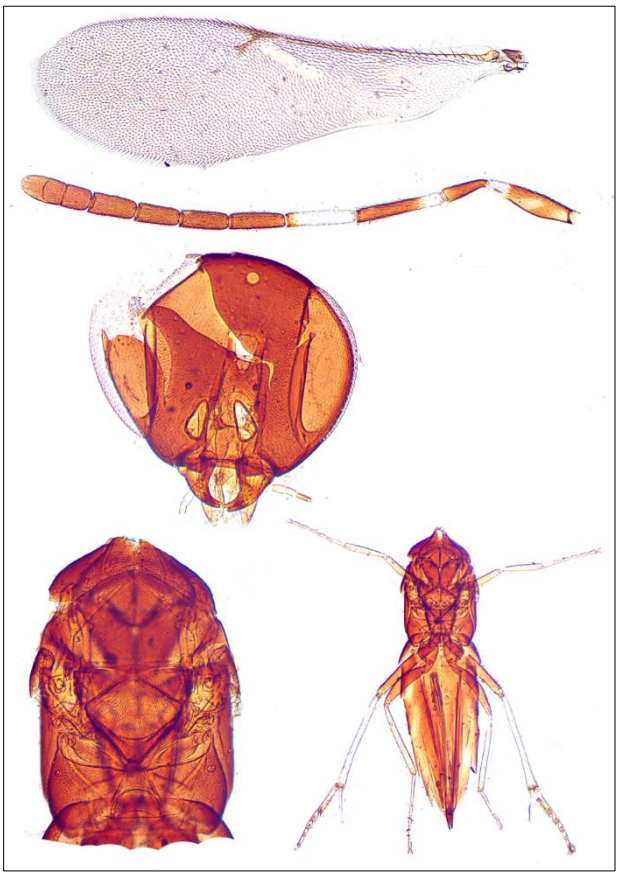

Fig 12-16: *Apoleptomastix bicoloricornis*, 12. forewing, 13. antenna, 14. head, 15. mesosoma, 16. mesosoma and metasoma

Conclusion

The documentation of these encyrtids species not only contributes to the faunistic records of Haryana but also provides a basis for future research into their ecological roles, particularly as potential biological control agents. Further studies are imperative to delineate their host ranges, life cycle, and population dynamics, which are essential for harnessing their full potential in sustainable pest managements.

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