



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2017; 5(2): 1418-1421

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Received: 04-01-2017

Accepted: 05-02-2017

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A taxonomic revision of subgenus *Andrena* (*Chlorandrena*) (Hymenoptera: Andrenidae: *Andrena*) of India

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Abstract

In India *Andrena* (*Chlorandrena*) subgenus is represented by only one species, *Andrena* (*Chlorandrena*) *taraxaci* Giraud, 1861. The present investigation was aimed to redescribe this species with new taxonomic technologies and methods, provide diagnostic characters for this subgenus and to establish species key. In the present investigation *Andrena taraxaci* was redescribed from India for the first time along with photographs with advance microscopic technologies i.e., LEICA DFC 425C stereo-zoom microscope using LAS3.8 software. Identification keys of male and female were also provided for easy and fast identification. Moreover, diagnostic characters for this subgenus were established for Indian species. This kind of investigation helps in further improvement of taxonomic science especially Indian perspective.

Keywords: *Andrena*, *Chlorandrena*, India

Introduction

Order Hymenoptera, comprises with more than 1, 15,000 described species and worldwide 17,000 species of bees under Superfamily, Apoidea have been described [7]. The family Andrenidae is currently represented by 4 subfamilies and 5 genus worldwide. To date *Andrena* genus contains about 1443 valid species worldwide [4]. The researchers recently studied genus *Andrena* as well its subgenus nicely [1, 11, 3, 14, 15, 12, 16, 13, 10]. In India only one genus *Andrena* is reported yet which is comprises 23 subgenus and 51 species. The only comprehensive work on Indian bees was that of Bingham (1897) [2] who included all the different types, viz., social/non-social bees under a single family Apidae and used characters like shape of the tongue and nature of pubescence on the body and integument colour for their segregation. But, now a day's Andrenidae is a clearly distinct family of non apis bees and *Andrena* is a genus of this family. Also, a number of new characters have been included in taxonomy of *Andrena*. As a results of this 96 subgenus have been formed till date and in India 23 subgenus are present. The taxonomic revision of this subgenera in the Indian context was totally lacking. So, the aim of present study was to revise the subgenus with new technologies, methods and amalgamation of new characters with old characters more comprehensively. So, we formulated the topic entitled "A taxonomic revision of subgenus *Andrena* (*Chlorandrena*) (Hymenoptera: Andrenidae: *Andrena*) of India. This kind of research will helpful in conserving the biodiversity of natural insect fauna especially wild bees like Andrenidae. Because, *Andrena* bees are potent pollinators of crops especially mustard, apple and other temperate crops where honey bees fails to pollinate due less cold hardiness. The present investigation was aimed to redescribe this species with new taxonomic technologies and methods, provide diagnostic characters for this subgenus and to establish species key.

2. Materials and Methods

This study was undertaken at Indian Agricultural Research Institute, New Delhi during the period of 3rd August, 2012 to 20th June, 2015.

2.1 Materials

The base materials for the present study was based on specimens which were obtained from following different sources-

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2.1.1 National Pusa Collection (NPC), Division of Entomology, Indian Agricultural Research Institute, New Delhi

The identified and unidentified specimens were available here used as base materials for current studies.

2.1.2 Personal collection

Personal collections were obtained from different parts of country. These collections were done from Rajasthan, Delhi, Uttarakhand, Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir and Punjab.

2.2 Methods

2.2.1 Collection, killing, mounting, relaxing and preservation

Specimens were collected from insect net. Live bees were put in killing bottle. Killing bottle was made of glass bottle with air tight cap in which cotton swabbed with benzene. Then, pinning was done. Pinned specimens were separated, labeled and stored in insect box for further studies. For relaxing of specimens we used plastic box with air tight cap. Cotton placed on the bottom, above it butter paper placed.

2.2.2 Methods of study

The whole specimens were studied in detail under LEICA EZ4 stereo zoom binocular microscope. Where ever needed dissections were made. In case of mouth parts, genitalia and hidden sterna almost require dissection because we cannot do in whole specimens. First, specimens were softened in a moist relaxing box for overnight. For preparation of mouthparts, the complete head was removed after removing both antenna from the body and put in 10 % KOH for about 3-4 hours at room temperature. After washing in distilled water first mandibles were removed then, labium and a pair of maxilla was removed and studied in 75 % ethanol. After that all structures of proboscis were stored in 75 % ethanol. Male genitalia, S7 and S8 were removed from the abdomen of fresh or relaxed specimens using a hooked insect pin and were put in 10 % KOH for about 5-6 hours at room temperature. Genitalia, S7 and S8 were cleared and examined and then stored in 75 % ethanol. This method was slight modification of Dubitzky, 2005. For photographs LEICA DFC 425C stereo-zoom microscope using LAS3.8 software was used. All files were processed with Microsoft publisher.

Morphological terms used in this paper mainly followed Michener (2007) [7]. Abbreviations used were as follow: AS: antennal segment (scape = AS1), BL: body length, FWL: length of forewing, FOV: facial fovea, DLP: dorsal part of lateral propodeum, LP: lateral part of propodeum, LICD: lower inter compound eye distance, UICD: upper inter compound eye distance, PMX: maxillary palpus, PLB: labial palpus, PLR: process of labrum, PT: propodeal triangle, S: metasomal sternum and T: metasomal tergum.

2.3 Statistical analysis: No statistical analysis involved in this study

3. Results and discussion

Subgenus *Andrena* (*Chlorandrena*) was erected by Giraud, 1799 [5] based on Type species: *Andrena humilis* Imhoff, 1832 [6]. In the world it was described by Giraud (1861) [5], Perez (1890) [9] and Morice (1899) [8]. Recently this subgenus along with this species was redescribed by Xu and Taduchi, 2002 [16] from Eastern Asia and eight species are recognized along with two new species i.e., *Andrena* (*Chlorandrena*) *talina* and

Andrena (*Chlorandrena*) *yunnanica* are described from China. A key to species of *Chlorandrena* in eastern Asia was also provided. Later on, Taduchi revised the *Chlorandrena* from Central Asia with species, *Andrena* (*Chlorandrena*) *humilis* Imhoff, 1832. *Andrena* (*Chlorandrena*) subgenus is represented in India by only one species i.e. *A. taraxaci*. These kinds of redescription (current as well old) from India were totally lacking. So, there was a need to revision of this subgenus along with its species. So, in this research paper this species was first time redescribed with photograph and identification keys of both male and female were also provided. Also, we provided diagnostic characters of subgenus *Andrena* (*Chlorandrena*) first time for Indian species for easy identification of this subgenera species.

3.1 Diagnostic characters of *Andrena* (*Chlorandrena*)

Female: Hind femur a row of peg like projections, Facial fovea long, upper part broad, narrow lower part, strongly depressed, extend upper part beyond compound eyes; mandible normally long, not crossing apically in repose; propodeal triangle upper 1/3rd basally weakly finely wrinkled, basal strongly tessellated to granulated; process of labrum rectangular, basal half yellow, apically black, slightly emarginated apically, hind trochanter flocculus complete, tibial scopa long, dense, yellow upper half part bilaterally branched pubescence, pygidial plate triangular without raised triangular area medially, prepygidial and pygidial pubescence yellow, hind tibial spur curved sword like (Fig. 1).

Male: Process of labrum trapezoidal with slight emargination apically, clypeus black, convex, strongly tessellated with minute dense punctation, PT dull, basal 3/4th finely rugose, apical 1/4th densely tessellated to granulate. Inner hind tibial spurs serrate, apex straight and pointed. S8 basal part wide, apical narrow, long, basal apical part a prominent triangular process on both sides, semicircular emargination at junction of basal and apical part, dorsal lobe of gonocoxite apically pointed (Fig. 2).

3.2 Redescription of *Andrena* (*Chlorandrena*) *taraxaci* Giraud, 1861

Female: BL: 9.709 mm, FWL: 7.879 mm

Structure. Head: Head oval, 1.16 times wider than long in frontal view. Mandibles long, crossing over apically in repose, bidentate, distance between apical and preapical teeth less. Bristles of paramandibular area well developed. PLR trapezoidal with weak emargination apically. Cross section of galea slightly convex. UICD/ LICD = 0.98. PLR L/W = 0.28. Apex of galea rounded, slightly convex on outer margin. Length of maxillary palpus slightly longer than galea. PMX2 longer as PMX1. Galeal blade normal straight hairs. Hairness of stipes sparse. Glossa short, labial palpi as long as glossa. PLB4 longer than PLB3. Clypeus convex, shiny, finely wrinkled and tessellate with dense punctation. Clypeus 1.84 times broader than long. Frons dull with longitudinal notches between dense punctation. Frontal line present. Vertex weakly shiny, hind margin rounded and flat in frontal view. Malar space well developed. Facial fovea parallel sided reaching from lower margin of antennal insertion to nearly hind margin of lateral ocelli, narrower, depressed whole length, anterior narrower than posterior. FOV 4.68 times longer than broad. Paraocular carina present. Median frontal line present. Antenna 12 segmented, basal segments longest remaining more or less similar size.

Mesosoma: Pronotum shiny, the apical transverse groove notched in the middle. Scutum dull, strongly tessellate, distinct and dense punctation. Scutellum shiny, smooth and dense large punctation. Metanotum shiny and densely punctate. Propodeal triangle basally finely rugosely areolated, apically densely tessellated to granulate, punctured and meet at propodeal vertical furrow. Propodeum slight declivous upper part while lower part strongly declivous. Declivous part shiny, finely rugosely and dense punctation. LP and DLP finely rugose, densely punctate. Mesepisternum smooth, shiny, strongly tessellated and densely punctate. Mesepisternum and metepisternum smooth, shiny with dense very minute punctation. Forewing three submarginal cell, second recurrent vein joining at 3rd submarginal cell distinctly before 3rd submarginal cross veins. Inner hind tibial spurs serrate, distinctly broadened nearly whole length. Inner side of hind femur with a row of peg like projection. Tibia and basitarsus slender. Claws apically bidentate.

Metasoma: Profile of T₁ distinctly separated into declivous basal region and horizontal posterior region. Declivous region and horizontal region of T₁ smooth and shiny. T₂, T₃, T₄ and T₅ similar to horizontal region of T₁. Depression of marginal zone well developed. T₁–T₄ apical fasciae present. S₁–S₄ shiny, smooth with dense minute punctation. Pygidial plate triangular, apically truncate without raised area medially.

Integument colour: Mandibles, maxilla, labium, process of labrum, clypeus, genal area, antenna, ventral mesosoma, legs and pronotum reddish brown. Vertex, frons, dorsal mesosoma deep black legs reddish brown. Dorsal mesosoma deep black. Compound eyes pale whitish and ocelli brown. Tegulae brownish transparent. Wings gray colour.

Pubescence: Pubescences of body bilaterally branched on both sides. Pubescence of galeal blade, glossa, stipes and lacinia normal straight hairs. Hairs of stipes sparse. Head pubescences dense long black, dorsal mesosoma short and sparse pubescences, ventral, pleural mesosoma long dense silvery white hairs, legs densely golden yellowish pubescences. Trochanter floculus complete. Marginal and disc metasomal pubescence sparse.

Male: BL: 9.382 mm. FWL: 7.012 mm.

Structure. Head: Head oval, 1.14 times broader than long. Mandibles long, straight, bidentate and shiny. Process of labrum shiny, trapezoidal with slight emargination apically. PLR L/W = 3.69. UICD/LICD = 1.084. Cross section of galea slightly convex. Apex of galea rounded, slightly convex on outer margin. Length of maxillary palpus slightly longer than galea. PMX2 as long as PMX1. Galea ridge a row of bristles. Galeal blade normal straight hairs and densely punctate. Hairiness of stipes sparse. Glossa short, labial palpi as long as glossa. PLB4 longer than PLB3. Clypeus times as wider as long, shiny, distinctly densely punctate and strongly tessellate. Disc of clypeus convex. AS3/AS1 = 0.43. Frons longitudinally notched with dense punctation between them and densely tessellated. Vertex tessellated.

Mesosoma: Pronotum shiny, the apical transverse groove notched in the middle. Scutum shiny, strong densely tessellate with distinct minute punctation. Scutellum smooth, shiny, strongly tessellate, distinct large punctation. Metanotum dull to weakly shiny punctation similar to scutum. Propodeal triangle dull, basal 3/4th finely rugose, apical 1/4th densely

tessellated to granulate. DLP, LP, as well as declivous part of propodeum weakly rugosely tessellate and dull. Mesepisterna densely punctate with minute punctation, shiny. Metepisternum weakly rugose. Legs slender, claws bidentate. Inner hind tibial spurs serrate, apex straight and pointed.

Metasoma: Abdominal tergum granulated, shiny and large size punctation. Disc of abdominal tergum and marginal zone convex. Pygidial plate present. Male S7 two distinct apical lobes fused medially. S7 apex of apical lobes not truncate, conspicuous hair fringe of long hairs medioapically. S8 process apically broadened without deep emargination. Ventral S8 flat with strongly developed subapical process. S8 basal parts densely haired. Inner margins of gonocoxite completely separated by pennies valve. Dorsal lobe of gonocoxite strongly developed. Apical margin of gonocoxite pointed. Inner margin of dorsal lobe parallel sided. Digitus of volsella small, reduced, often hardly visible behind cuspis. Shape of digitus rounded. Gonoforeceps about as broad as dorsal base with ventral margin distinctly narrower than basal part. Inner margin of apical part of gonoforeceps slightly convex. Shape of pennies valve more or less triangular continuously becomes narrower apically. Apex of pennies valve (dorsal and lateral view) pointed.

Integument colour: Head, antenna and thorax deep black. Compound eyes pale white, ocellus reddish brown colour. Proboscis, ventral mesosoma and legs reddish brown. Tegulae brownish transparent. Abdominal tergal disc deep black, marginal zone reddish brown.

Pubescence: Male more densely pubescent than female. Pubescence throughout the body bilateral branched. Pubescence of galeal blade, glossa, stipes and lacinia normal straight hairs. Hairs of stipes sparse. Head and thorax long silvery white hairs. Abdominal sternum less pubescent than tergum. Tergum densely pubescent with long pale white hairs. Pale white apical fasciae of long hairs present from T₁–T₄ covering entire marginal zone. Prepygidial and pygidial fimbria blackish brown.

Specimens examined: 4 ♀♀, INDIA: Rajasthan: Kota, 30.XI.2012, on *Brassica campestris*, Lokesh coll., 3 ♀♀, INDIA: Bihar: Pusa, 08.V.1942, NPC, 2 ♂♂, INDIA: Rajasthan: Kota, 30.XI.2012 on *Brassica campestris*, Lokesh coll., 12.IV.1942, NPC. 2 ♂♂, INDIA: Bihar: Pusa, 12.IV.1942, NPC.

Distribution: Bihar, Rajasthan.

Key to female

Facial fovea short, narrow, strongly depressed, extend upper part beyond compound eyes; mandible normally long, not crossing apically in repose; propodeal triangle upper 1/3rd basally weakly finely wrinkled, basal strongly tessellated to granulated; process of labrum rectangular, basal half yellow, apically black, slightly emarginated apically.....*A. taraxaci*

Key to male

Clypeus black, convex, strongly tessellated with minute dense punctation; S8 basal part wide, apical narrow, long, basal apical part a prominent triangular process on both sides, semicircular emargination at junction of basal and apical part; dorsal lobe of gonocoxite apically pointed.....*A. taraxaci*

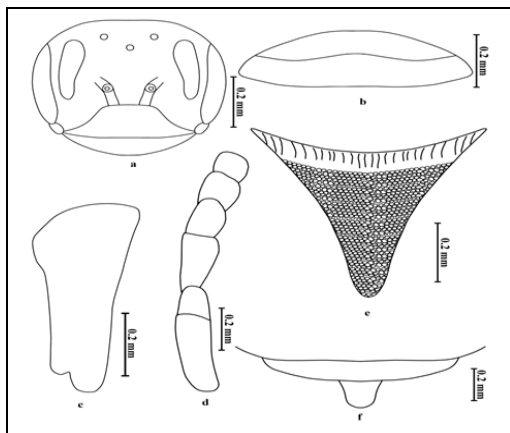


Fig. 1. *Andrena taraxaci* Giraud (female): (a) Head; (b) Process of labrum; (c) Mandible (d) Antenna; (e) Propodeal triangle and (f) Pygidial plate.

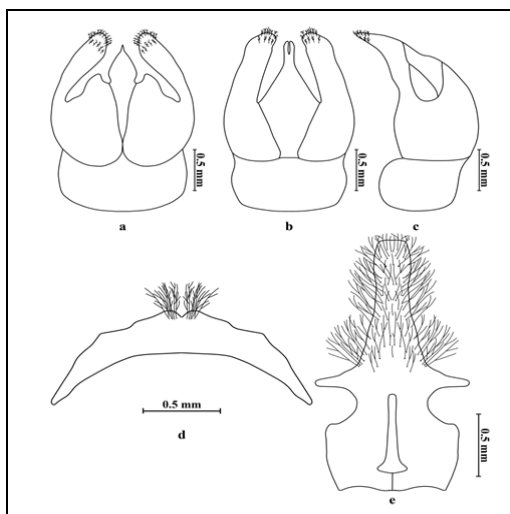


Fig 2: *Andrena taraxaci* Giraud (male): (a) Genitalia dorsal view; (b) Genitalia ventral view; (c) Genitalia lateral view; (d) Antenna; (e) S7 and (f) S8.

4. Conclusion

In India *Andrena* (*Chlorandrena*) subgenus is represented by only one species, *Andrena* (*Chlorandrena*) *taraxaci* Giraud, 1861. The present investigation redescrbe this species from India first time along with photographs with advance microscopic technologies i.e., LEICA DFC 425C stereo-zoom microscope using LAS3.8 software. Identification keys of male and female to both were separately also provided here for easy and fast identification. Also, diagnostic characters for this subgenus were established here for Indian species. This kind of investigation helps in further improvement of taxonomic science.

5. Acknowledgement

I want to give acknowledgement to Indian agricultural research institute, New Delhi for admitting me for doing Doctorate degree and provide such a good facilities for research. I also acknowledged to University Grant Commission for giving me financial assistance in form of Rajiv Gandhi National Fellowship.

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