Chapter

Description of a New Species of the Genus *Anagrus* (Hymenoptera: Chalcidoidea: Mymaridae): A Biocontrol Agent as an Alternative to Insecticide Use

Shireen Saleem and Shoeba Binte Anis

Abstract

Although insects are economically important as they produce honey, silk, act as pollinators and also play an important role in functioning of an ecosystem, yet insect population is declining very fast. One of the possible causes of insects decline is excessive use of pesticides. Control of pest with synthetic chemicals or pesticides result in several issues and complications. These chemical pesticides or insecticides can also cause toxic effects on beneficial organisms like honeybees and butterflies which are important pollinators. So, biocontrol agents can be used as best alternative to control pest without harming beneficial organism and non-target insects or other organism as majority of biocontrol agents are host specific. Biological control agents including predators and parasotoids are natural enemies of insect pests. Present chapter deals with the description and illustration of one new species *Anagrus (Anagrus) sololinearis* sp.nov from India. This new species belongs to genus *Anagrus* (Hymenoptera: Chalcidoidea: Mymaridae). Genus *Anagrus* is considered as one of the important and most promising biocontrol agents in insects as it is an egg parasitoid.

Keywords: *Anagrus*, biocontrol agent, new species

1. Introduction

Insects belonging to phylum Arthropoda are the most biodiverse group of fascinating creatures and can be found in aquatic as well as terrestrial habitats. Although insects are economically important and are key pollinators, yet they are declining at global level. Several studies have been carried out in different regions which reported a substantial decline in insect populations. Several researchers studied insects decline and possible causes of their decline at global level. Recent studies, reviews and causes of insects decline were mainly based on researches from the United States or Europe. A group of European researchers in October 2017 reported that insect abundance had declined by more than 75% within 63 protected areas in Germany over the course of 27 years [1]. Stork [2]; Habel et al. [3]; Forister et al. [4]; Bayo & Wyckhuys [5]; Wagner [6]; Eggleton [7]; Klink et al. [8] and Wagner et al. [9] made noteworthy and remarkable contributions regarding the review and study of insects decline and

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causes of decline at global level. Insect's populations are being declining at various rates across space and time, the decline in abundance on an average is thought to around 1–2% per year. Loss of insect diversity and abundance is expected to provoke cascading effects on food webs and to jeopardize ecosystem services [1].

Insects play a very important role in food chain and food web of an ecosystem. Butterflies and bees are considered as good pollinators. Termites and dung beetles act as decomposers. Insect's products like honey and silk are commercially important. There is an unending list of insect's economic importance and key role in ecosystem and therefore, their decline is a matter of concern and there is also a great need to find the causes of decline. There are various causes of insects decline. Some possible causes of insects decline include intensive farming, urbanization, change in climate as well as use of pesticides. Excessive use of pesticides including insecticides on agricultural crops can be toxic to a host of other organisms including beneficial insects as well as other non-target species. Pesticides have severe impact on environment too [10]. Integrated pest Management (IPM) combines the use of biological, cultural and chemical practices in agriculture to control pests. It focuses on use of natural predators, parasites and parasitoids. IPM is the best approach as it sustainably manages insects by focusing mainly on prevention rather than treatments and without doubt, it is also an environment friendly approach.

Biological pest control, an important method of IPM involves the use of another living organism to kill a pest. As no chemicals are involved, therefore no environment contamination occurs as it happens with use of chemical pesticides. One of the advantages of biological pest control also lies in the fact that the pests do not develop resistance against biocontrol agents. Biological control agents including predators and parasotoids are natural enemies of insect pests. Order hymenoptera of class Insecta form an extremely diverse group with over 1, 15,000 described species comprising almost 10% of the species diversity on the earth [11]. The order Hymenoptera includes sawflies, bees, ants and wasps, and together they directly affect human health and agriculture through diverse roles such as pollinators, pests and parasitoids [12]. The Chalcidoidea is a large hymenopteran superfamily, the majority of which are entomophagous parasitoids with hosts in a wide range of insect orders [13, 14]. Family Mymaridae belonging to superfamily Chalcidoidea includes the smallest known insects, all parasitoids in the eggs of other insects [15] except for two that parasitize larvae of a species of family Eulophidae [16]. So far, many insect species have been successfully used as biocontrol agents against various pests on agriculturally important crops. Biocontrol agents can be used as best alternative to control pest without harming beneficial organism and non-target insects or other organism as majority of biocontrol agents are host specific.

One of the important and most promising biocontrol agents in insects is genus *Anagrus* which is an egg parasitoid. Many of its species have been used successfully to control leafhoppers on apple, rice & grape [17–19]. Prior to use as biocontrol agent in integrated pest management, correct identification at generic as well as at species level is a very necessary step. Taxonomy basically deals with the identification and classification. Present work includes the description and illustration of a new species *Anagrus (Anagrus) sololinearis* sp.nov. of promising biocontrol agent genus *Anagrus* (Hymenoptera: Chalcidoidea: Mymaridae) from India.

2. Material and methods

The insect specimens collected by sweeping, mounted on cards, and after card mounting, slides were prepared by adopting the procedure given by Noyes [20].

Body color was noted down from the card-mounted specimen. Only body length was taken from card mounted specimen and is given in millimeters (mm). Other measurements (of slide mounted specimens) are relative, and were taken from the divisions of a linear scale of a micrometer placed in the eyepiece of a compound microscope Nikon Eclipse E200. These measurements were taken at 400 × magnification (1 division = 0.00274 mm) of the microscope.

Photographs of slide mounted specimens were taken by the digital camera "Leica, DFC295" fitted over a compound microscope (Leica, DM2500). Line diagrams were made using Nikon Eclipse 80i at 400 × at zoom 9 and 11.

The following abbreviations were used:

F1, F2 and F3 = funicle segments 1, 2, 3 etc. of antenna.
OOL = minimum distance between a posterior ocellus and an eye margin.
POL = minimum distance between the two posterior ocelli.
FWL = Fore wing length.
FWW = Fore wing width.

The following acronym is used for the depository:

ZDAMU = Insect Collections, Department of Zoology, Aligarh Muslim University, Aligarh, India.

3. Results and discussion

3.1 *Anagrus* Haliday

Anagrus Haliday, 1833: 346. Type species *Ichneumon atomus* Linnaeus, 1767:941, designated by Westwood, 1840:78 [21, 22].

Brief diagnosis: Female antennal clava entire, scape with transverse folds; each mandible tridentate. Axillae of mesosoma advanced into side lobes of mesoscutum. Forewing with posterior margin (behind venation) only slightly lobed. Posterior scutellum short and divided by a longitudinal sulcus in two lobes. Posterior scutellum about as long as or slightly longer than anterior scutellum. Foretibial spur comb-like [23–26].

3.2 *Anagrus (Anagrus) sololinearis* sp.nov.

3.2.1 Description

Length (excluding exserted ovipositor). 0.40 mm. Body light yellow. Head yellowish; eyes black. Antenna pale brown. Fore and hind wing hyaline. Legs light yellow. Gaster yellowish brown, posterior two-third part of gaster blackish brown (**Figure 1**(**1**–**4**)).

3.2.1.1 Head

Almost triangular in frontal view, 1.7 × as broad as high (82:46); OOL 1.5 × POL (12:8); eye height about 2 × as long as malar space (37:18). Mandible brown, tridentate (**Figure 1**(**1**)). Antenna (**Figure 1**(**2**)) with scape swollen ventrally, 3.5 × as long as broad; pedicel 2 × as long as broad, 2.6 × as long as F1; F1 small, globular; F2 slightly shorter than following funicular segments; F3 and F5 exactly equal in length; F4 and F6 equal in length; F3- F4 each with 1 longitudinal sensillum; F5 without longitudinal

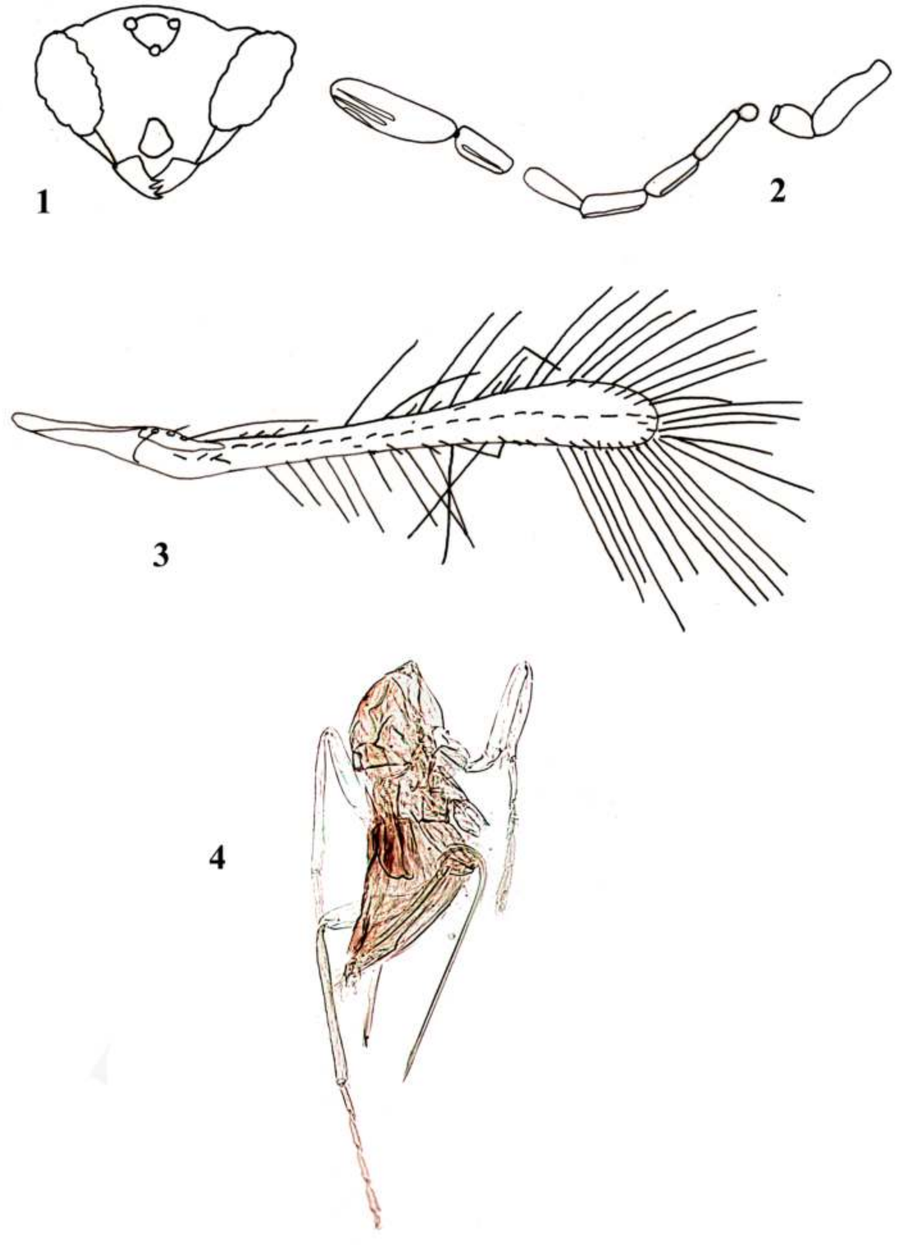

Figure 1.
(1–4) Anagrus (Anagrus) sololinearis sp.nov. Female: 1, head; 2, antenna; 3, fore wing; 4, body (mesosoma and metasoma).

sensillum; F6 with 1 longitudinal sensillum; clava 3.5 × as long as broad, slightly longer than combined lengths of F5 and F6; clava with 3 longitudinal sensilla (**Figure 1**(**1**)).

3.2.1.2 Mesosoma

Mid lobe of mesoscutum without adnotaular setae. Mesoscutum with distinct notauli. Fore wing (**Figure 1**(**3**)) 9.2 × times as long as broad; forewing disc with bare area and with only 1 median row of setae in broadest part; marginal fringe about 3 × the wing width; distal and proximal macrochaetae in ratio 5.2:1 (**Figure 1**(**4**)).

3.2.1.3 Metasoma

Slightly longer than mesosoma, about 1.1 × as long as mesosoma length (80: 70); ovipositor strongly overlapping mesophragma anteriorly and posteriorly slightly exserted beyond apex of gaster; ratio of total ovipositor length to length of its exserted part 4.0:1; external plates of ovipositor each bearing 1 seta; ovipositor 2.3 × as long as fore tibia length (**Figure 1**(**4**)).

3.2.1.4 Relative measurements (on slide)

Scape length, 32; scape width, 9; pedicel length, 16; pedicel width, 8; F1, 6; F2, 17; F3, 20; F4, 21; F5, 20; F6, 21; clava length, 43; clava width, 12; FWL, 212; FWW, 23; marginal fringe, 70; distal macrochaeta length, 37; proximal macrochaeta length, 7; fore tibia length, 48; ovipositor length, 114; exserted ovipositor length, 28.

3.2.1.5 Material examined

Holotype, female (on slide). INDIA: ORISSA [=ODISHA]: Puri Matia Pada, 1.xii.2007, coll. FR Khan (ZDAMU).

Paratypes, 4 females: 1 female (on slide, same data as holotype) (ZDAMU). 3 females (on slides). INDIA: ODISHA = ORISSA: Pur Chandanpur, 29.xi.2007, coll. FR Khan (ZDAMU).

3.2.1.6 Etymology

The species name based on single row or line of setae present on fore wing.

3.2.1.7 Hosts

Unknown.

3.2.1.8 Distribution

India: Odisha.

3.2.1.9 Male

Unknown.

4. Comments

This new species belongs to "*atomus*" species group of *Anagrus* s. str., and can be distinguished from other species of *atomus* group by its unique combination of characters i.e. presence of longitudinal sensilla on F3 & F4; F5 without longitudinal sensillum; bare area present on fore wing disc; fore wing disc with only one median row of setae. *A. (A.) sololinearis* sp. nov. is similar to *A. (A.) frequens* Perkins in having fore wing disc with bare area and F4 with 1 longitudinal sensillum but differs from it in the following characters: F5 without longitudinal sensillum; only one median row of setae present on fore wing disc; fore wing about 9.2 × as long as broad; ratio of total ovipositor length to length of its exserted part 4.0:1. In *A (A.) frequens*, F5 with longitudinal sensillum; 2 rows of setae present on forewing disc;

fore wing more than 10.5× as long as broad; ratio of total ovipositor length to length of its exserted part more than 5.0:1.

5. Discussion

In the present work, a new species *Anagrus (Anagrus) sololinearis* sp.nov. belonging to genus *Anagrus* (Hymenoptera: Chalcidoidea: Mymaridae) was described and illustrated from India. Genus *Anagrus* is considered as most promising biocontrol agent against various insect pests as many of its species have been used successfully to control leafhoppers on apple, rice & grapes [17–19]. Minute fairy fly insect *Anagrus* can serve as best alternative to insecticide use if there is a correct identification of species of this parasitoid as well as its host.

6. Conclusion

Present work gives a brief idea about the role of insects as important components of an ecosystem as well as beneficial on a commercial basis by producing honey and silk. Due to such great importance of insects, their decline at global level is a cause of concern. Several studies by researchers carried out at global level confirmed the decline of these important fascinating creatures in different regions at varying rates to some extent. There is a need to find out the possible causes of insects decline. Excessive use of pesticides including insecticides on agricultural crops is also a cause and can be toxic to a host of other organisms including beneficial insects as well as non-target species. Pesticides can also have severe impact on environment. The present study also emphasizes on preference of biocontrol agents over pesticides or insecticides use. Biocontrol agents can be used as best alternative to control pest without harming beneficial organism and non-target insects or other organism as majority of biocontrol agents are host specific.

One of the important and most promising biocontrol agents in insects is genus *Anagrus* (Hymenoptera: Chalcidoidea: Mymaridae) which is an egg parasitoid. In the present work, a new species *Anagrus (Anagrus) sololinearis* sp.nov. from India is identified, described and illustrated. This species belongs to genus *Anagrus* (Hymenoptera: Chalcidoidea: Mymaridae). Genus *Anagrus* is an important egg parasitoid and promising biocontrol agent.

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Author details

Shireen Saleem* and Shoeba Binte Anis
Section of Entomology, Department of Zoology, Aligarh Muslim University, Aligarh, Uttar Pradesh, India

*Address all correspondence to: shireen.ento@gmail.com

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