A CONTRIBUTION TO THE DIPTERAN PARASITOIDS AND PREDATORS IN IRANIAN COTTON FIELDS AND SURROUNDING GRASSLANDS

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ABSTRACT: Dipteran predators and parasitoids have efficient role in biological control in cotton fields. The fauna of these beneficial insects in Iranian cotton fields and surrounding grasslands is studied in this paper. In a total of 30 Diptera of three families including, Asilidae (8 species), Syrphidae (6 species) and Tachinidae (16 species) were collected. Of these, 8 tachinid species are new records for Iran.

KEY WORDS: Diptera, Parasitoid, Predator, Asilidae, Syrphidae, Tachinidae, Cotton field, Iran

Biological pest control is an important IPM strategy that uses beneficial organisms to reduce pest populations (Ehler, 1998). Beneficial insects play an important role in moderating the damage caused by pests. Sometimes their effect can be most dramatic and almost complete, but more often their benefit is more subtle (Miller and Aplet, 1993). Beneficial insects are important because most of our damaging pests were imported into this country without their complement of native natural enemies. Generally, beneficial insects do not occur commonly unless there is a source of food. As a result, there is usually a lapse of time between the appearance of a pest insect population and the activity of beneficial insects. This is called lag time and many factors can influence its duration (Van Driesche and Bellows, 1996). Another general but important point is that the effect of beneficial insects is usually greater when more than one species is involved. Many species of beneficial insects can be important in cotton pest management programs (Botrell et al., 1998; Synder and Wise, 1999). At least 600 different species of beneficial insects have been identified in the cotton insect community. Some of these species are very common and others are only observed on occasion. Some species are only involved with one pest species while others are involved with many pest species (Hokannen and Pimentel, 1984; Greathead, 1995). Beneficial insects can be separated into two broad groups: predators and parasitoids. Best known as predators in the

cotton fields are the larvae of syrphid flies that prey primarily on aphids. Tachinid flies commonly parasitize many types of caterpillars, especially those which are exposed during feeding. Among the hundreds of beneficial species commonly devouring cotton pests are green and brown lacewings, pirate bugs, big-eyed bugs, assassin bugs, damsel bugs, spined soldier beetles, Staphylinid rove beetles, Carabid ground beetles, Collops beetles, lady beetles, six-spotted thrips, Tachinid flies, asilid flies, Phytoseiid mites, spiders and several dozen parasitic wasp species, including *Trichogramma* (Hooks, 2000; Lockwood, 2000). The challenge for the biocontrol research and extension community therefore is to enable small and medium scale farmers to access and use the wealth of biocontrol knowledge accumulated and to make this work for them. Failure to look at pest management problems and solutions from the point of view of smallholders, compounded by poor linkages between research, extension and farmers, is one of the reasons for the limited adoption of IPM, including biological control technologies, as many authors have analyzed, e.g. NRI (1995).

The fauna of beneficial insects, especially dipteran parasitoids and predators in Iranian cotton fields has not been studied so far. In this study we collected several dipteran predators and parasitoids of the three families including, Asilidae, Syrphidae and Tachinidae from different Iranian cotton fields and surrounding grasslands. Surely the results of these faunistic works can be used for advances of IPM in cotton fields with attention to sustainable agriculture.

MATERIALS AND METHODS

The dipteran parasitoids and predators were collected from the Iranian cotton fields and surrounding grasslands and were collected and studied for five crop seasons, 2000-2004. In order to carry out faunistic surveys on dipteran parasitoids and predators in Iranian cotton fields, firstly almost the major regions which included cotton fields were detected. Totally seven provinces including, Golestan (almost all regions), Mazandaran (eastern regions including Behshahr and Neka), Tehran (Varamin region), Semnan (Garmsar region), Fars (Darab region), Khorasan (Kashmar region) and Ardabil (Moghan region) were sampled. The materials were collected by light traps, suction traps, malaise traps, sweeping net, and also the preserved specimens in many collections. Also many tachinid parasitoids were collected by rearing the collected immature stages of Lepidoptera and Heteroptera from cotton fields and surrounding grasslands. All the specimens were collected by the first author and also some other Iranian researchers. The collected specimens were determined by the 2nd (Asilidae, Syrphidae) and 3rd (Tachinidae) authors.

RESULTS

This faunstic survey indicated that there are diverse fauna of dipteran parasitoids and predators in Iranian cotton fields. Totally 30 species in three families including, Asilidae, Syrphidae and Tachinidae were identified. Among the collected species in this research, 8 tachinid species including, *Aplomyia confinis* (Fallén), *Blondelia nigripes* (Fallén), *Dionomelia hennigi* Kluger, *Goniophthalmus halii* Mesnil, *Heraultia albipennis* (Villeneuve), *Peleteria meridionalis* Robineau-Desoidy, *Peleteria umbratica* Zimin and *Phryxe caudata* (Rondani) are newly recorded from Iran. The list of species is below.

Family ASILIDAE

Robber flies (Insecta: Diptera: Asilidae) comprise a large and widespread family of insects. The adults are often active flies of considerable size and readily attract attention (Geller-Grimm, 2005). Asilid adults attack insects of almost all orders, from wasps, bees, and flies to dragonflies and grasshoppers; even some spiders are eaten (Lavigne, 2001; Hayat, 1997). Shelly (1986) reported that of the nine Neotropical Asilidae species he studied, diet constituents were more than 85% composed of insects from the orders Diptera, Coleoptera, Hymenoptera, Homoptera, and Lepidoptera. Furthermore, larger species tended to consume a greater diversity of prey taxa. Some species, especially the smaller ones, do not catch their victims in flight, but await small insects which, by chance, fly within their reach. In this research totally eight asilid species were collected from Iranian cotton fields.

1. *Anarolius jubatus* Loew, 1844
Material examined: Ardabil province: Moghan (2♂), July 2002. Predator of a snout moth (Lepidoptera: Pyralidae).

2. *Dysmachus dasyproctus* Loew, 1871
Material examined: Khorasan province: Kashmar (1♀, 2♂), August 2000. Predator of *Evania hunteri* Mani. Mazandaran province: Behshahr, Neka (2♀, 1♂), September 2001. Predator of *Brachygaster minutus* (Olivier) (Hym.: Evaniidae).

3. *Dysmachus stylifer* (Loew, 1854)
Material examined: Golestan province: Ali-Abad (2♀, 2♂), September 2001. Predator of *Liris niger* (Fabricius) (Hym.: Sphecidae).

4. *Machimus rusticus* (Meigen, 1820)
Material examined: Semnan province: Garmsar (3♀), June 2001. Predator of *Systropha curvicornis* (Scopoli) (Hym.: Halictidae).

5. *Stenopogon callosus* (Pallas in Wiedemann, 1818)
Material examined: Tehran province: Varamin (2♀, 1♂), July 2001. Predator of *Helicoverpa armigera* (Lep.: Noctuidae) and *Xylocopa* (*Copoxyla*) *iris* (Christ) (Hym.: Anthophoridae).

6. *Stenopogon sabaudus* (Fabricius, 1794)
Material examined: Khorasan province: Kashmar (2♂), August 2002. Predator of *Palarus variegatus* Shmid & Egger (Hym.: Sphecidae).

7. *Stenopogon laevigatus* (Loew, 1851)
Material examined: Golestan province: Gonbad, Ali-Abad, Gorgan (2♀, 3♂), September 2001. Predator of *Evania stenochela* Kieffer and *Zeuxevania splendidula* (Costa) (Hym.: Evaniidae).

8. *Stenopogon xanthotrichus* (Brullé, 1832)
Material examined: Semnan province: Garmsar (1♀, 1♂), June 2001. Predator of *Nezara viridula* L. (Het.: Pentatomidae).

Family SYRPHIDAE

Flower flies are a large, diverse group of insects. Many species are important pollinators of flowering plants. In addition, the immatures of numerous species are predators of destructive aphids and other plant bugs. Hoverflies can be found in every biotope but not in deserts. Each species tends to prefer a certain type of habitat and is limited to a distinct range within the country (Schneider, 1969; Vockeroth and Thompson, 1987). The fauna of Iranian Syrphidae was studied very well (Dousti and Hayat, 2006; Ghahari et al., 2008). Totally 6 syrphids were collected from Iranian cotton fields as following.

1. *Episyrphus balteatus* (De Geer 1776)
Material examined: Golestan province: Ali-Abad (5♀, 3♂), September 2001.

2. *Eupeodes* sp.
Material examined: Semnan province: Garmsar (1♀), June 2001.

3. *Eupeodes corollae* (Fabricius, 1794)
Material examined: Fars province: Darab (1♂), June 2003.

4. *Scaeva albomaculata* (Macquart, 1842)
Material examined: Khorasan province: Kashmar (1♀), August 2002.

5. *Scaeva pyrastri* (Linnaeus, 1758)
Material examined: Ardabil province: Moghan (1♀), July 2002. Fars province: Darab (1♂), June 2003.

6. *Sphaerophoria scripta* (Linnaeus, 1758)
Material examined: Golestan province: Gorgan (1♀, 1♂), July 2003.

In addition to the above mentioned syrphids, many other species were collected from the cotton fields but they do not have predatory behavior. They are mostly an inhabitant of various types of moist, decaying, vegetable matter, including cow dung and garden compost heaps or aquatic/subaquatic, found in a wide range of aqueous and semi-aqueous, organically rich, rotting materials, including cow-dung, slurry etc. (Speight, 2006) These species are as follows:

Eristalis arbustorum (Linnaeus, 1758)
Material examined: Khorasan province: Kashmar (1♀, 1♂), August 2002.

Eristalis tenax (Linnaeus, 1758)
Material examined: Golestan province: Gorgan (1♂), July 2003.

Neascia podagrica (Fabricius, 1775)
Material examined: Golestan province: Gonbad (1♂), July 2003.

Syritta pipiens (Linnaeus, 1758)
Material examined: Mazandaran province: Behshahr (1♀, 1♂), September 2002. Fars province: Darab (1♂), June 2003.

Family TACHINIDAE

The Tachinidae are one of the most speciose families of Diptera, with approximately 10,000 described species worldwide (Irwin et al., 2003). One of the few traits that unites this diverse assemblage of flies is that all tachinids (with known life histories) are parasitoids of insects and other arthropods. In this respect, they are second only to the

parasitic Hymenoptera (e.g., Ichneumonoidea, Chalcidoidea) in diversity and ecological importance as insect parasitoids (Stireman et al., 2006). Because of their predominance as parasitoids of the larval stage of Lepidoptera and other major groups of insect herbivores (e.g., Heteroptera, Scarabaeidae, Chrysomelidae, Symphyta), tachinids often play significant roles in regulating herbivore populations and structuring ecological communities, both natural and managed (Tschorsnig and Richter, 1998). Of the order of 100 species have been employed in biological control programs of crop and forest pests, and many of these programs have been met with partial or complete success (Grenier, 1988). However, introduced tachinids have also been implicated in devastating effects on nontarget organisms (Boettner et al., 2000). In this study, totally 16 tachinid species were collected from different cotton fields of Iran. Of these, 8 species are newly recorded from Iran. *Aplomyia confinis* (Fallén), *Blondelia nigripes* (Fallén), *Dionomelia hennigi* Kluger, *Goniophthalmus halii* Mesnil, *Heraultia albipennis* (Villeneuve), *Peleteria meridionalis* Robineau-Desoidy, *Peleteria umbratica* Zimin and *Phryxe caudata* (Rondani)

1. *Aplomyia confinis* (Fallén, 1820)
Material examined: Khorasan province: Kashmar (2♀), August 2002. Reared from a lepidopteran larva (Noctuidae). New record for Iran.

2. *Blondelia nigripes* (Fallén, 1810)
Material examined: Mazandaran province: Behshahr (2♀, 1♂), September 2002. Reared from a lepidopteran larva (Pyralidae). New record for Iran.

3. *Carcelia iliaca* (Ratzeburg, 1840)
Material examined: Golestan province: Gonbad (3♀), October 2003.

4. *Carcelia lucorum* (Meigen, 1824)
Material examined: Tehran province: Varamin (1♀, 2♂), July 2000. Reared from a lepidopteran larva (Noctuidae).

5. *Dionomelia hennigi* Kluger, 1978
Material examined: Semnan province: Garmsar (1♀, 1♂), June 2001. New record for Iran.

6. *Drino vicina* (Zetterstedt, 1849)
Material examined: Ardabil province: Moghan (2♀), July 2002. Reared from a lepidopteran larva (Noctuidae).

7. *Exorista fasciata* (Fallén, 1820)
Material examined: Mazandaran province: Behshahr (2♀), September 2002. Reared from a lepidopteran larva (Noctuidae).

8. *Exorista segregata* (Rondani, 1859)
Material examined: Golestan province: Ali-Abad (2♀), September 2001. Reared from a heteropteran nymph (Pentatomidae).

9. *Goniophthalmus halii* Mesnil, 1956
Material examined: Mazandaran province: Ghaemshahr (1♀), April 2004. Reared from a lepidopteran larva (Pyralidae). New record for Iran.

10. *Heraultia albipennis* (Villeneuve, 1920)
Material examined: Mazandaran province: Behshahr (1♂), September 2002. New record for Iran.

11. *Masicera sphingivora* (Robineau-Desvoidy, 1830)
Material examined: Semnan province: Garmsar (2♀), June 2001. Reared from a lepidopteran larva (Pieridae).

12. *Pales processionea* (Ratzeburg, 1840)
Material examined: Fars province: Darab (1♂), June 2003. Reared from a lepidopteran larva (Hesperiidae).

13. *Peleteria meridionalis* Robineau-Desoidy, 1830
Material examined: Golestan province: Ali-Abad (1♀, 1♂), September 2001. New record for Iran.

14. *Peleteria umbratica* Zimin, 1961
Material examined: Golestan province: Kordkoy (1♀), August 2003. New record for Iran.

15. *Phryxe caudata* (Rondani, 1859)
Material examined: Mazandaran province: Neka (2♀, 1♂), September 2002. Reared from a lepidopteran larva (Gelechiidae). New record for Iran.

16. *Tachina magnicornis* (Zetterstedt, 1844)
Material examined: Ardabil province: Moghan (1♀, 2♂), July 2002. Reared from a heteropteran nymph (Pentatomidae).

Biological pest control is an important IPM strategy that uses beneficial organisms to reduce pest populations. The results of this research indicated that there are diverse fauna of dipteran parasitoids and predators in the cotton fields which must be conserved. Application of wide spectrum pesticides is the main destructive factor on these beneficial insects. Supporting the natural enemies will result in their to augmentation and in this case application of insecticides will be reduced significantly and therefore we need sustainable agriculture. The proper recognition of the many different insects found in cotton fields is essential to the efficient management and, frequently, the profitability of the crop. Although more beneficial insect species than pest species occur in cotton, pest populations can reach tremendous levels and do extensive crop damage. To maintain pest populations below economic damaging levels, by efficient management of natural enemies, chemical suppression, or other means, requires a thorough understanding of their life cycles and relationships to host crops and to other organisms. There are several general approaches to using biocontrol agents: 1. 'Classical' biocontrol targets a non-native pest with one or more species of biocontrol agents from the pest's native range; 2. the 'New Association' or 'Neoclassical' approach targets *native* pests with non-native biological control agents; 3. 'Conservation', 'Augmentation' and 'Inundation' approaches maintain or increase the abundance and impact of biocontrol agents that are already present, and in many cases native to the area. Classical biocontrol is by far the most common approach for plant pests. Conservation and augmentation approaches show great promise on their own and especially for enhancing the impacts of classical biocontrol and other weed control measures as researchers and managers focus on managing to maximize native biological diversity in invaded ecosystems (Newman et al., 1998; Strong and Pemberton, 2000).

Successful biocontrol programs usually significantly reduce the abundance of the pest, but in some cases, they simply prevent the damage

caused by the pest (e.g. by preventing it from feeding on valued crops) without reducing pest abundance (Lockwood, 2000). Biocontrol is often viewed as a progressive and environmentally friendly way to control pest organisms because it leaves behind no chemical residues that might have harmful impacts on humans or other organisms, and when successful, it can provide essentially permanent, widespread control with a very favorable cost-benefit ratio. However, some biocontrol programs have resulted in significant, irreversible harm to untargeted organisms and to ecological processes. Of course, all pest control methods have the potential to harm non-target native species, and the pests themselves can cause harm to non-target species if they are left uncontrolled. Therefore, before releasing a biocontrol agent (or using other methods), it is important to balance its potential to benefit conservation targets and management goals against its potential to cause harm (Godfray, 1994; Rosenheim, 1998).

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