FIRST REPORT OF THE PREDATORY SPIDER, OXYOPES LINEATUS LATREILLE (ARANEA: OXYOPIDAE) FEEDING ON THE TOMATO LEAF MINER, TUTA ABSOLUTA (MEYRICK) (LEPIDOPTERA: GELECHIIDAE)

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ABSTRACT

The Lynx spider belonging to the family Oxyopidae is an important hunting spider. Members of this family are all predatory in nature, attacking many herbivorous pests. This is the first report on the occurrence of the predatory spider, Oxyopes lineatus (Aranae: Oxyopidae) predating on tomato leaf miner, Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae) from Iran. Oxyopes lineatus was found in both tomato greenhouses and open fields during the summer of 2015. The spider was observed to attack and consume T. absoluta. It would appear that this spider can be considered a natural control agent against tomato leaf miner, helping to naturally improve suppression of T. absoluta populations.

KEYWORDS:
Tomato leaf miner, spider, predator, natural control.

INTRODUCTION

The tomato leaf miner, Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae) has been reported to cause devastating yield losses up to 80-100% in tomato crops [1]. This can pose a potential threat to greenhouse and open-field tomato production systems [2]. The pest originated from South America but has been recently introduced into the Mediterranean region [2]. According to Baniameri and Cheraghain [3], T. absoluta was first reported in Iran in 2011 in Urmiyeh (Western Azerbaijan province) in the North West.

Studies related to basic biology and population development of T. absoluta are limited and mostly focused in South American countries where environmental conditions are conducive for the development of the pest [4]. Tuta absoluta is a multivoltine pest with seven life stages, being most destructive at the larval stage where the pest makes larval galleries in plant parts, including leaves, terminal buds, flowers and fruits [5-7].

Tuta absoluta is an oligophagous pest and although it is inclined to attack tomato plants, it can also infest other Solanaceous crops such as potato, eggplant, tobacco and wild Solanaceous weeds [8]. Since the pest prefers apical buds, flowers or fruits, and forms a black frass, it is easily detectable. The pest only attacks the aerial part of potato plants and never the tubers [8-10].

Over recent years, non-chemical methods, in specific, use of natural enemies or biocontrol agents, have been widely considered as a measure to prevent the development of pesticide resistance [11-13]. Some of the biocontrol agents of tomato leaf miner have been reported to significantly suppress populations, thus maintaining them under economic injury levels [11-13]. Globally, approximately 20 hymenopteran parasitoid species have been documented [14-18]. Trichogramma achaea, a potential parasitoid of T. absoluta eggs, has already been released in commercial tomato greenhouses in the Mediterranean region of Europe [19]. Other egg parasitoids commonly used in Europe include Macrophorus pygmaeus (Ramber) (commercially available as Macrophorus caliginosus) and Nesiocoris tenuis Reuter (Hem.: Miridae), with the latter being popular in the Mediterranean region of Europe [19]. Other biocontrol agents of T. absoluta are; the midid Dicyphus maroccamus Wagner, the nabid Nabis pseudoferus ibericus Remane, two phytoseiidae mite species, Amblyseius swirskii Athias-Henriot and Amblyseius cucumeris (Oudemans), and Stenomesius sp. (Hym.: Eulophidae), a larval parasitoid [19].

Spiders are naturally occurring invertebrates belonging to a predatory group that has limited information available on their potential to suppress herbivore populations. There are eighty-seven predatory families belonging to Aranea whose role in pest management has not been established [20]. Spiders from the family Oxyopidae are long-legged, diurnal, hunting arthropods with an ability of running rapidly on low vegetation and jumping
on their prey [21]. The genus Oxyopes Latreille, 1804, is globally distributed [22] and has been reported not to use silk threads to catch its prey [23]. Oxyopes lineatus is a predominantly European spider, present in Portugal, Spain, France, Italy, Slovenia, Belgium, Czech Republic, Slovakia, Switzerland, Turkey, Romania, Ukraine, and southern Russia [24]. The spider is generally found near the ground on small plants, particularly on bushes and grasses, where it chases and seizes its prey with a single leap [25]. Oxyopes lineatus preys on Diptera, Hymenoptera, Homoptera, Thysanoptera, Lepidoptera, Orthoptera, Coleoptera, Araneae and Acari [26]. Oxyopes lineatus is also a myrmecophagic spider, with roughly 20% of its diet being worker ants [26]. The aim of this study is to report on the predatory behavior of O. lineatus on T. absoluta.

**MATERIALS AND METHODS**

This investigation was carried out in both greenhouse (about 200²) and tomato farms in Hamedan (34° 52’ N 48° 32’ E) west of Iran during the summer of 2015. Adult spiders were collected by use of an aspirator inside the tomato fruit worm cages. Specimens were placed in separate vials containing 75% ethyl alcohol and brought back to the laboratory for identification. The identifications and drawings were done by means of a SZX9 Olympus stereomicroscope with a camera lucida (Fig 1). Voucher specimens of O. lineatus were deposited in the Department of Medical Entomology, School of Public Health, Tehran University of Medicine. Identification was carried out using the identification keys developed by Heimer and Nentwig [27] and Roberts [21].

![Figure 1](image)

(A) Female and (B) Male Oxyopes lineatus
RESULTS AND DISCUSSION

The spider was observed to predate on *T. absoluta* (Figs 2a, b). In this research, about 50-60 spiders were collected from the research greenhouse. The spiders were identified using the key as follows (taken from Heimer and Nentwig [27] and Roberts [21]):

1a. *O. globifer*. Colouring dark brown, with a large and blackish band peripherally and a yellowish colour in the middle part of the sternum; legs are yellowish, have brownish and blackish spots at the articulation; centre section of epigyne dark brown.

1b. *O. heterophthalmus*. Colouring dark brown, dorsally whitish; legs black with bright hairs; centre section of epigyne reddish-brown; male palp has large and conspicuous tibial apophysis.

1c. *O. lineatus*. Colouring yellowish-light brown with white design; in both sexes, a pair of dark stripes usually runs from the anterior median eyes, down over the clypeus, and along the front of the chelicerae.

**General description of *Oxyopes lineatus*.** *Oxyopes lineatus* is a medium-sized lynx spider that in adult stage measures 6-8 mm and 4-5 for females and males, respectively [25, 28]. The spider is yellowish to light brown in colour with a pattern of white markings. It is sexually dimorphic, with males being conspicuously smaller in size than females [25]. *Oxyopes lineatus* is an ambush-hunting spider that preys on insects and other small animals. The spider has long legs which facilitate rapid movement and does not use a web to trap its prey.

The spider attacks its prey by jumping like a cat, hence its name 'lynx' spider. These lynx spiders have a more developed eyesight than spiders in other families, except Salticidae [29], and are capable of locating their prey from a distance of up to 10 cm [30]. They inject venom from their fangs, paralyze and consume their prey [31]. They are diurnal and prefer sunshine where they can be seen running and jumping over leaves and grasses. The spiders have a total of eight eyes; a pair of two large eyes in front, a pair, smaller in size below them, a pair, medium-sized, high up on the side of the head and the last pair is large in size and looks above and backward. With this kind of eye combination, the spider has an almost 3600 views of its surroundings. According to Huseynov [26], the spiders feed during the day and night. Studies done on *O. lineatus* indicate that it is a polyphagous predator feeding on a total of nine arthropod orders [26, 32]. [Fig. 1] [Fig. 2].

Implementation of a successful biological control program requires acquiring knowledge of a suitable biocontrol agent that naturally thrives in the specific region. Although spiders are among the most important naturally occurring biocontrol agents in different habitats [33], their role is less known. Apart from reducing pest density, they stabilize populations due to their top-down effects, microhabitat use, prey selection, polyphagy, functional and numerical responses, and obligate predatory feeding strategies [34]. A number of families of spiders are commonly found in agroecosystems and a majority have been reported to prey on major crop pest species [35-44]. Spiders may be regarded as the most important biocontrol agents of crop pests such as aphids, leafhoppers, plant hoppers, flea hoppers, and caterpillars [45]. However, a spider species that acts as a biocontrol agent in one
location could prey on beneficial insects in another location [34]. It is therefore imperative that further research is done to establish the extent of predation in an array of crops, climatic conditions and management approaches before conclusions concerning their efficiency as biological control agents are validated [36, 46]. There are some agroecosystems that spiders have been shown to capture important pest species. According to a study by Jeyaravarthi et al. [34], in non-commercial cranberry bogs, hunting spiders comprised 61% of total spider fauna; with 87% being lycosids. These spiders were reported to mainly prey on Collembola and small Diptera, which are not cranberry pests. However, there were very few hunting spiders that captured pest insects such as cranberry weevils or Lepidoptera larvae. A majority of these spiders captured their prey near the ground, their microhabitat being on or near the ground surface.

There are three important factors that contribute to spider migrations from an ecosystem. These include: inappropriate climatic conditions, shortage of food resources and disturbance(s) in ecosystems [47]. Although humans have no control on the inappropriateness of climatic conditions, a reduction in disturbance of ecosystems can significantly increase the diversity and density of spiders [48-49]. Pesticide use and crop harvesting are some forms of human disturbances to spider ecosystems or habitats [50]. In spite of this, use of some selected pesticides can be an effective way to protect spiders in agroecosystems [47]. Since these predators are not host-specific, they feed on all small invertebrates including beneficial insects. This situation has led to a limited comprehensive research on their effectiveness as a pest control method. There is need for more research on their role in biological control of invertebrate pests. In particular, further research on *O. lineatus* to determine its potential and efficiency as biocontrol agent for *T. absoluta* is recommended.

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REFERENCES


[16] Luna, M.G., Pereyra, P.C. and Sánchez, N.E. (2012a) Biological control of *Tuta absoluta* (Lepidoptera: Gelechiidae) in protected tomato crops in Argentina. IOBC-WPRS Bulletin. 80, 177-182.


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