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Population fluctuations of thrips (Thysanoptera) and their relationship to the phenology of rice in Babolsar (Mazandaran Province, Iran)

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ABSTRACT. The objective of this study was to identify the species of thrips associated with rice crops in order to determine population fluctuation of the dominant species. Studies were conducted during the month of April to August in the year 2017 form different growth stages of rice in Babolsar city, Mazandaran Province (Northern Iran). Samplings were done from four fields located at two sites, Keyxa-Mahalle and Mir-Bazar. A total of seven species of thrips belonging to four genera and two families (Thripidae and Phlaeothripidae) were identified. Amongst them, *Haplothrips eragrostidis* Priesner was the dominant species accounting for 75.47% in abundance. This was followed by *Thrips hawaiiensis* Morgan comprising 6.47%. The other species include *Anaphothrips sudanensis* Trybom, *Frankliniella intonsa* (Trybom), *F. tenuicornis* (Uzel), *Thrips tabaci* Lindeman and *Haplothrips flavicinctus* (Karny) which comprised of 4.85%, 4.32%, 4.31%, 4.04% and 0.54% respectively. The maximum number of thrips species was found in the middle of July and minimum in the month of May. Assessment of thrips abundance in rice fields were started at the beginning of dough stage and were continued until complete maturity.

Key words: Rice, *Haplothrips eragrostidis*, abundance, phenology, Iran

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Introduction

Rice, *Oryza sativa* L. is the staple food of about two-third of mankind. The highest global production and consumption of rice is related to Asian countries (Lestari *et al.*, 2016). Although the area under cultivation of rice crop in Iran is not comparable to that of Asian countries, such as India and China, but 600,000 hectares of rice fields play a decisive role in food security and national income growth (Persley, 1996). Cereals have a rich and varied fauna because they provide a good habitat for the survival and production of a large number of insects (Andjus, 2004). The rice plant is subject to attack by more than 100 species of insects; 20 of them can cause economic damage. Together they infest all parts of

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the plant at all growth stages, and a few transmit viral diseases.

Thysanoptera, commonly named thrips, are tiny insects comprising about 6,000 species. They include insects with diverse life histories and habits. Most species feed on leaf, stem or flower tissues, though some feed on pollen and fungal hyphae or are predatory, and some are significant pollinators (Lewis, 1973; Williams, 2001). They feed on plant tissue by rasping and sucking sap, resulting in tissue scarification and depletion of the plant's resources (Welter *et al*., 1990).

However a little known about the thrips fauna associated with rice crops, but thrips have been recorded as pests of rice from most of the rice-growing countries of the world in all rice environments. The two most common species associated with rice are the Oriental rice thrips, *Stenchaetothrips biformis* (Bagnall) (Thripidae), *Haplothrips aculeatus* (Fabricius) and *Haplothrips ganglebaueri* Schmutz (Phlaeothripidae) (Chander, 1999). In Bangladesh, China, India, Indonesia, Japan, and Sri Lanka, *S. biformis* is now considered a major rice pest (Pathak & Khan, 1994). In Iran, a few specimens of the Oriental rice thrips was also collected on rice fields and recorded by Mirab-balou and Chen (2011). The other thrips species associated with rice are *H. tenuipennis*, *H. ceylonicus*, *Bolacothrips indicus* and *Anaphothrips sudanensis* (from India), and *H. aculeatus* and *Frankliniella intonsa* (from China) (Ane & Hussain, 2016).

Study on rice thrips has been mostly done under field conditions with natural level of infestation (Atwal & Dhaliwal, 2002). Abundance is an ecological concept referring to the relative representation of a species in a particular ecosystem. It is usually measured as the large number of individuals found per sample (Bartelt *et al*., 2001).

Material and methods

The study sites was carried out at Keyxa-Mahalle (36° 64′ N 52° 61′ E) and Mir-Bazar (36° 54′ N 52° 63′ E) in Babolsar city, Mazandaran Province, North Iran (Fig. 1). Thrips specimens were collected every week from rice fields (two fields in each site) from their nurseries, seedling and panicle stage (Fig. 2) during the month of April to August in the year 2017. Specimens were collected by beating plants (20 plants in each field) onto a white dish tray. The thrips were then individually collected using a fine paint brush and transferred into vials filled with 75% ethanol alcohol and total numbers recorded. The method for preparing and mounting thrips on slides for microscopic identification follows Mirab-balou and Chen (2010).

Where more than 100 thrips were collected, 100 specimens were mounted and for all other samples all collected thrips were mounted. The total number of each thrips species in each sample was estimated using the proportions found in the sub-samples. Adults of thrips species were identified, and the larvae were not identified to species, because their determination is not possible.

Alpha diversity analysis

Thrips diversity (Shannon index), dominance (Simpson's index), and evenness (E index) were calculated using the PAST software (Hammer *et al*., 2001). Shannon-Wiener's Index is the most commonly used index in ecology of communities (Ludwig & Reynolds, 1988) and allows comparisons between communities:

$$H' = -\sum_{i=1}^{s} \frac{n_i}{N} \ln \frac{n_i}{N}$$

in which, *ni*- number of specimens of i-species per sample, N- number of all the species per sample, and s- number of species in community.

Domination coefficient informs what percentage out of the total amount of the collected specimens for a given area is constituted by specimens of particular species. It was calculated by Kasprzak and Niedbala (1981) formula:

$$D_i = \frac{n_i}{N} 100\%$$

in which, n_i- number of specimens of a given species in a given area and N- number of all the specimens collected from a given area. The analyses were done using SPSS version 11.

Results

In this study, both terebrantian and tubuliferan thrips were found from four rice fields at two collection sites. From the 822 thrips specimens that were collected, seven thrips species belongs to four genera and two families (Thripidae and Phlaeothripidae) were identified. The species that was most frequently found in the rice crops was *Haplothrips eragrostidis* (75.47%) followed by *T. hawaiiensis*, *A. sudanensis*, *F. intonsa*, *F. tenuicornis*, *T. tabaci* and *H. flavicinctus*, respectively (Fig. 3).

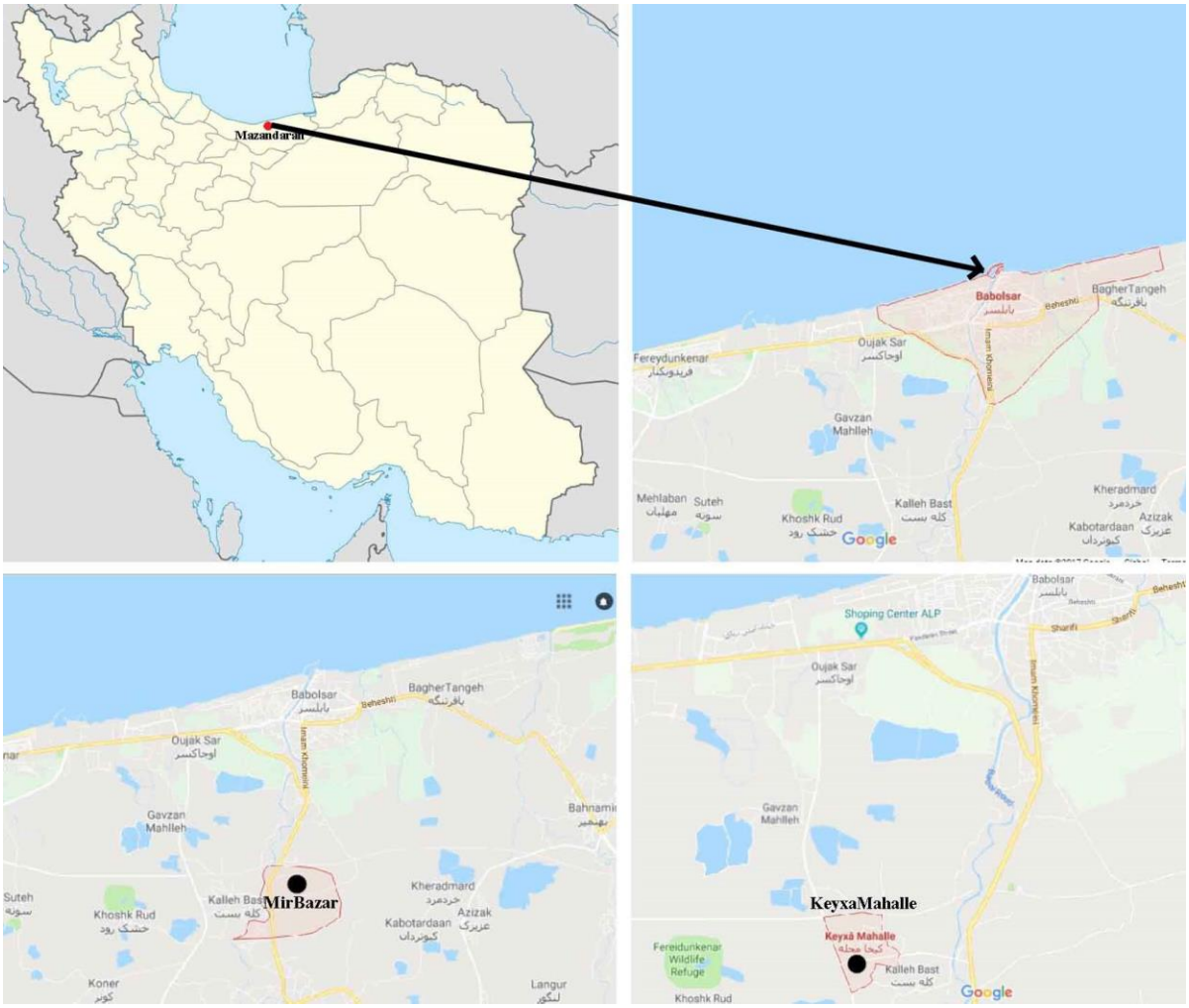

Figure 1. Collection sites of thrips in Babolsar, Mazandaran province, 2017.

Figure 2. The growth stages of the rice in Babolsar, Iran, 2017.

Our findings indicate that first higher numbers of immature thrips was observed in the middle of June but the population declined because of farmers' used of insecticides. The findings were similar to those of Kharbangar *et al.* (2014), where the mean abundance of thrips was highest in the month of July and lowest in the month of November in Meghalaya. Assessment of thrips abundance in rice fields were started at the beginning of dough stage and were continued until complete maturity (Fig. 5).

The results of the diversity indices (Table 1) showed that the highest value of Shannon-Weiner, Shannon evenness and Simpson, according to the rice growth stages, was related to the rice dough stage, while the highest Margalef was associated with the heading stage. In this study, the values of Shannon-Wiener index varied between a minimum of 0.85 at stem stage and a maximum of 1.35 at dough stage. This index values can typically range from 1.5 to 3.5. Lower values of this range indicate the presence of stress in the environment and instability and more than it indicates an increase in biodiversity in the region (Ajmal khan, 2004). In our study, this value was affected by heavy rains, intense winds and insecticides, too.

Discussion

Knowing thrips species that occur on rice is very important for this crop in Babolsar city, and perhaps for the entire north of Iran, since these insects have become important pests in the rice crop in recent years, especially in Asian countries (Ane & Hussain, 2016).

However, the Oriental rice thrips, *Stenchaetothrips biformis* is the most abundant species on rice in the Asian countries, Africa, Europe and Oceania (Nugaliyadde & Heinrichs, 1984; Dale,

1994; Pathak & Khan, 1994; Bambaradeneya & Edirisinghe, 2008; Kharbangar *et al.*, 2013, 2014; Singh & Singh, 2014) but here we didn't find any specimens from Babolsar city. In Brazil, three species i.e. *Frankliniella rodeos*, *Neohydatothrips* cf. *paraensis* and *F. schultzei* was recorded as the most abundant thrips on rice fields (Cavalleri *et al.*, 2010). In Iran, *H. eragrostidis* is appearing specific to Poaceae (Minaei & Mound, 2008). It widespread in Egypt in the flowers of various Poaceae (Priesner, 1965), and was recorded from Iran by Alavi and zur Strassen (2002) from soybean fields in Golestan Province.

Members of the *A. sudanensis* and *H. flavicinctus* are normally found on plants of the grass family Poaceae (Jacot-Guillarmod, 1974; Minaei & Mound, 2008), *Thrips* and *Frankliniella* species breed almost exclusively in flowers, with many considered to be host specific (Priesner, 1964). They are particularly associated with the flowers of Asteraceae, but considerable numbers are found in the flowers of Poaceae and Juncaceae or Cyperaceae (Mound & Masumoto, 2005).

The number of females comprised about 75% of the total abundance. In Iran, *T. tabaci* population is composed of females; because the male of this species is very rare (Nault *et al.*, 2006). But, in this study, we found several male specimens on rice fields. An average sex ratio of *H. eragrostidis* was 73%. In this study, the maximum number of thrips species was found in the middle of July and minimum in the month of May (Fig. 4).

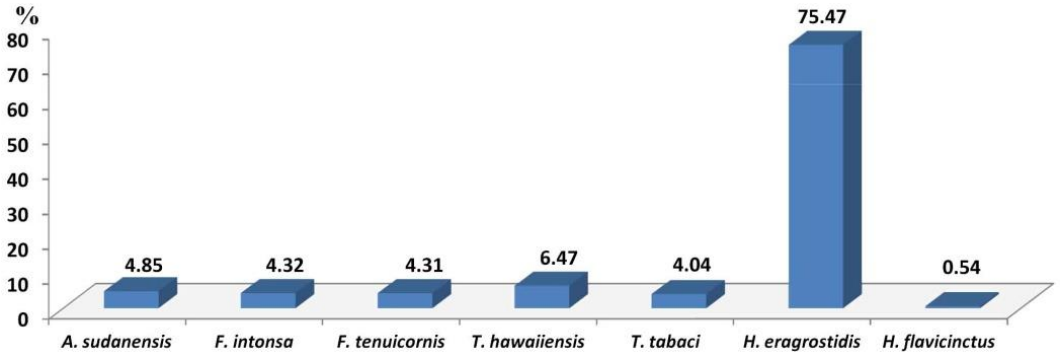

Figure 3. The frequency of thrips in rice fields in Babolsar, 2017.

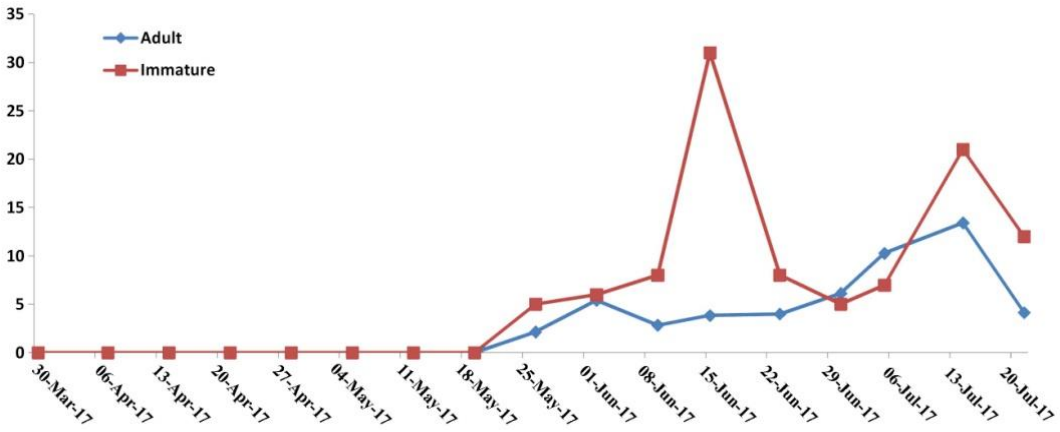

Figure 4. The proportion of thrips species collected on rice fields in Babolsar, 2017.

Knowing what species of thrips are present in a given area or agroecosystem is a key step in determining what control measures a grower should implement. For example, *T. tabaci* is known to be quickly resisted as well as to be less susceptible to many pesticides (Bielza, 2008). The grass thrips, *H. eragrostidis* was dominant on rice fields in Babolsar, after that the species *A. sudanensis* and *T. hawaiiensis* classified as dominant species. According to the results of Ramezani (2009), *H. ganglbaueri* was the dominant species on grain crops (wheat, barley, maize and rice) in Khuzestan province, Iran. The flower thrips, *F. intonsa* is a common thrips in this study and rice farms of other countries like as China. In addition, *A. sudanensis* was the same species on rice fields in Babolsar and India (Kharbangar *et al*., 2013, 2014).

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

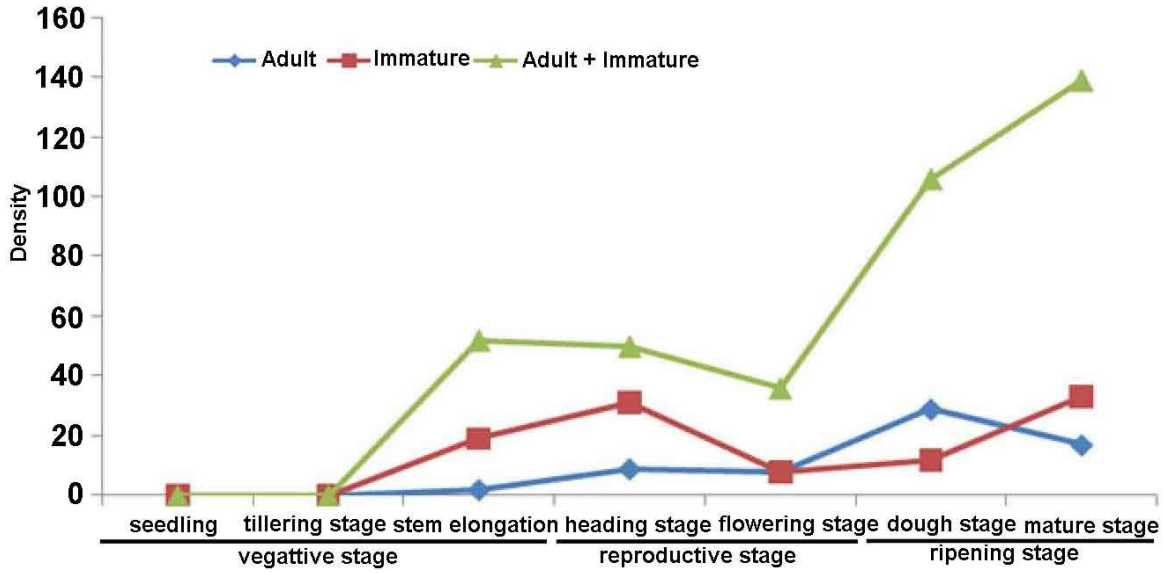

Figure 5. Population changes of *H. eragrostidis* in the rice fields in Babolsar, 2017.

Table 1. The numerical value of diversity indices in rice fields, according to the rice growth stages.

Diversity indices	Seedling stage	Tillering stage	Stem stage	Heading stage	Flowering stage	Dough stage	Mature stage
Shannon-Wiener	0	0	0.85	1.11	1.27	1.35	1.22
Simpson	0	0	0.46	0.62	0.70	0.73	0.65
Margalef	0	0	0.85	1.01	0.90	0.66	0.64
Evenness	0	0	0.58	0.76	0.89	0.96	0.85

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تغییرات جمعیت و ارتباط تریپس‌ها (Thysanoptera) با فنولوژی برنج در بابلسر (استان مازندران، ایران)

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چکیده: هدف از این مطالعه، شناسایی گونه‌های تریپس مرتبط با مزارع برنج و تعیین نوسانات جمعیت گونه‌ی غالب است. مطالعات در طی ماه‌های فروردین تا مرداد سال ۱۳۹۶ از مراحل مختلف رشد برنج در بابلسر، استان مازندران (شمال ایران) انجام شد. نمونه‌برداری‌ها از چهار مزرعه واقع در دو منطقه شامل کیخامحله و میربازار انجام شد. در مجموع هفت گونه تریپس متعلق به چهار جنس و دو خانواده (Thripidae و Phlaeothripidae) شناسایی گردید؛ که در بین آنها *Haplothrips eragrostidis* Priesner با فراوانی ۷۵/۴۷ درصد به عنوان گونه غالب بوده و بعد از آن *Thrips hawaiiensis* Morgan با ۶/۴۷ درصد فراوانی دارا می‌باشد. گونه‌های دیگر شامل *Anaphothrips sudanensis* Trybom، *Frankliniella intonsa* (Trybom)، *F. tenuicornis* (Uzel)، *Thrips tabaci* Lindeman و *Haplothrips flavicinctus* (Karny) نیز به ترتیب دارای فراوانی ۴/۸۵، ۴/۳۲، ۴/۳۱، ۴/۰۴ و ۰/۵۴ درصد بوده‌اند. حداکثر تعداد تریپس‌ها در اواسط تیر ماه و حداقل در اردیبهشت ماه می‌باشد. فراوانی جمعیت تریپس‌ها همزمان با مرحله‌ی پر شدن دانه‌های برنج آغاز و تا مرحله رسیدگی برنج ادامه یافت.

واژگان کلیدی: برنج، *Haplothrips eragrostidis*، فراوانی، فنولوژی، ایران.