Population Densities of Three Mite Species on Wheat in Sharkeia Governorate, Egypt

A.S. Abd-Elwahab*, M.M.H. Kandeel and N.A. Omar
Faculty of Technology and Development, Zagazig University, Egypt.
*Email of corresponding author: as8386839@gmail.com

Abstract

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Population densities of *Petrobia tritici* Kandeel, El-Naggar & Mohamed (Tetranychidae), *Tarsonemus bilobatus* Suski (Tarsonemidae) and *Typhlodromus athiasae* Porath & Swirski (Phytoseiidae) were carried out on wheat in two districts (Zagazig and Diarb-Nigm), Sharkia Governorate, Egypt during two successive growing seasons (2020/2021 and 2021/2022). The densities of the two species, *P. tritici* and *T. athiasae* increased gradually forming two population peaks for both seasons in Zagazig region; the first one was recorded at February3rd and December 2nd with 15 and 13 individuals/leaf and January 19th and December 5th with 6 and 4 individuals/leaf for both species. The second peak was recorded on March 5th and February3rd with 20 and 125 individuals/leaf and on March 20th and February 3rd with 12 and 9 individuals/leaf for both species. With respect to *T. bilobatus,* only one peak was recorded on February 3rd with 19 individuals/leaf in the 1st season, whereas two peaks were recorded on January 4th and February 3rd, with 12 and 5 individuals/leaf during the 2nd season. In Diarb-Nigm district, *P. tritici* and *T. athiasae* produced two population peaks, the first one was on January 19th with 15 and 16 individuals/leaf and December 20th with 6 and 2 individuals/leaf for both species, respectively, whereas the second peak was recorded on March 20th with 25 and 71 individuals/leaf and February 3rd with 10 and 4 individuals/leaf for both species, respectively. On the other hand, *T. bilobatus* produced three peaks during January, February and March with 11.6, 5.23 and 3.26 individuals/leaf for both seasons, respectively. The results obtained showed insignificant correlations between the three mite species and the climatic factors during both seasons, except for highly significant negative correlation (r= -0.75) recorded between relative humidity and the number of *P. tritici* and highly significant positive correlation (r= 0.79) recorded between relative humidity and the number of *T. bilobatus* during the 2nd season in Zagazig region. The explained variance in Zagazig area during the second season for the three parameters was 36% for *T. athiasae,* and 65% for *P. tritici* and 67% for *T. bilobatus*.

Keywords: Population dynamics, wheat plant, climatic parameters, *Petrobia tritici*, *Tarsonemus bilobatus*, *Typhlodromus athiasae*.

Introduction

Wheat, *Triticum aestivum* L. (Poales: Poaceae) is the most important cereal food crop for human and domestic animals worldwide. Recently, some mite species have been found associated with wheat plants in different growing regions causing a significant damage, especially in the mid and northern Delta, (Ibraheem *et al*., 2007; Kalmosh, 2018). The economic importance of the mite pests is due to their harmful effect of wheat which will be used for human consumption by reducing the flour quality and the negative impact on human health. The present study aimed to learn more about the mite species, their food preference, and their ability to cause food spoilage, in addition to their natural enemies at different locations in Egypt.

Information on the occurrence of the pest and their natural enemies offers a good tool in decision-making within integrated pest management programs (IPM) (Rahmani *et al*., 2010). Seasonal abundance trends are usually influenced by various biotic factors such as natural enemies, host plant and weeds, and abiotic factors such as weather conditions. However, abiotic factors may determine the total population size at local or regional levels. Seasonality of the abiotic factors may also affect the dynamics of predator–prey models (Gotoh *et al*., 2004; Kitashima & Gotoh, 2003; Scheffer *et al*., 1997).

Many authors carried out ecological studies of the mites associated with wheat in Egypt and worldwide (Ibraheem *et al*., 2007; Jun *et al*., 2021; Kalmosh, 2018; Kalmosh & Yassin, 2018; Kalmosh & Mohamed 2020). The objective of the current study was to study: (i) The population densities of the two phytophagous mite species (*P. tritici* and *T. bilobatus*) and a predatory mite (*T. athiasae*), (ii) Evaluate the effect of some climatic factors (i.e., temperature, relative humidity and wind speed) on these three mite species at two districts in Sharkia Governorate, Egypt.

Materials and Methods

Population densities of phytophagous and predacious mites on wheat

Bread Wheat, *T. aestivum* was planted in the first week of November in Zagazig and Diarb-Nigm districts during two growing seasons (2020/2021 & 2021/2022). The total area cultivated with wheat was one feddan (4200m^2) in two districts, carefully chosen and divided into four plots. Conventional agricultural practice was followed, and no pesticides treatments were applied during the experiment.

Samples were collected in the 3rd week of November and continued fortnightly until the end of the season around the 1st week of April. Fifty wheat leaves per plot were randomly collected in the morning in both districts, Zagazig and Diarb-Nigm. All collected samples were transferred into the laboratory for examination using a stereoscopic binocular microscope with 40-100X magnification. The number of the phytophagous individuals (*P. tritici* and *T. bilobatus*) and their predator mite (*T. athiasae*) were counted until the end

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of the growing season. All mite species were identified based on the illustrated world keys obtained by Evans (1992) for identification *T. athiasae*; Kandeel *et al*. (2007) for *P. tritici* and to Mahunka (1972) for *T. bilobatus*.

Weather data

During both seasons, climatic factors (temperature, relative humidity and wind speed) were obtained from Central Laboratory for Agricultural Climate, Giza. The daily values of relative humidity and temperature were averaged over two-week periods (Figure 1).

Statistical analysis

The data were statistically analyzed according to Snedecor & Cochran (1980) and a microcomputer program, Costat Statistical Software (2004).

Results and Discussion

Population densities of the two phytophagous and one predacious mite

Population densities of the mites on wheat, *P. tritic*, *T. bilobatus* Suski and *T. athiasae* in Zagazig and Diarb-Nigm districts during the two growing seasons, 2020/2021 and 2021/2022 are shown in Figure 2.

In Zagazig district, the infestation with *P. tritici* started on the 20th and 2nd of November, with 3 and 1 individuals/leaf for both seasons, respectively. The population increased gradually forming two peaks, the first on February 3rd in 2021 and December 2nd in 2022 with 15 and 13 individuals/leaf for the two seasons, respectively. The mites population then decreased to 6 and 11 individuals/leaf, then increased again to reach a second peak on March 5th, 2021 and February 3rd, 2022, of 20 and 125 individuals/leaf in both seasons, respectively. Whereas in Diarb-Nigm district, *P. tritici* completely disappeared on November 20th, then reappeared slowly on December 19th to reach the first peak of 15 and 16 individuals/leaf for both seasons. The population then increased further to reach a second peak on March 20th with 25 and 71 individuals/leaf in both seasons, respectively. At the end of the second season, the mean number of the mite species was the highest during April (2022) to reach 209 individuals/leaf (Figure 2).

These results are consistent with those obtained earlier by Ibraheem *et al.* (2007). Kalmosh (2018) reported two peaks for *T. urticae* and *P. tritic*, with the highest peaks of 37.47 and 20.36 individuals/leaf on 26th and 3rd March for *T. urticae* at Sharkia and Beheira governorates, respectively.
Kalmosh & Mohamed (2020) reported that *T. cucurbitacearum* appeared 35 days after sowing, and infestation started on October 11, 2016 followed by five peaks on October 18th, November 23th, December 28th, January 11th and February 2nd with a mean numbers of 28.6, 22.3, 21, 19 and 22.3 individuals/square inch, respectively.

Population densities of the tarsonemid mite, *T. bilobatus*

Infestation with *T. bilobatus* (Sayed) started on November 20th for both seasons. After that, the mite increased gradually to reach one peak on February 3rd (2021), with 19 individuals/leaf for the first season, whereas it reached two peaks in the second season on January 4th and February 3rd (2022) with 12 and 5 individuals/leaf in Zagazig, respectively. Whereas in Diarb-Nigm, the mite was first observed on December 5th, then it increased gradually to reach three peaks during both seasons (January4th, February3rd and March2nd) with 11, 5 and 3 individuals/leaf during the first season, whereas in the second season higher peaks were recorded on December 20th, February 18th and March 20th (Figure 2).

van der Walt *et al*. (2011) mentioned that the tarsonemid mites emerge from the mummies in spring in small numbers and colonize buds and blossoms. Karmakar *et al*. (2017) reported that no mite population was observed early on the crop during August, and scarce numbers of mites were noticed during August and the 1st week of September. The mite population increased gradually, and their peak numbers was reached during the crop ripening stage (35.60 mites/cm^2).

Population densities of the phytoseiid mite, *T. athiasae*

Collected information showed that no individuals were observed during the early tillering stage of wheat in Zagazig during 2020/2021 and 2021/2022 growing seasons. During the first growing season of 2020/2021, the population increased gradually reaching two peaks on January 19th and March 20th (2021) with 6 and 12 individuals/leaf, respectively. In the second season, the mite predator reached two peaks, the first was on December 5th (2021), with 4 individuals/leaf, then the population completely disappeared on January 4th and 19th (2022). The second peak was recorded on the 1st week of March (2022) with 9 individuals/leaf. In Diarb-Nigm district, no *T. athiasae* individuals were observed during the early tillering stage of wheat in both seasons. The population then increased gradually and two peaks were observed, the 1st on December 2nd, for both seasons with mean numbers of 6 and 2 individuals/leaf, respectively. The 2nd peak was observed on March 2nd (2021) and February 3rd (2022), with mean numbers of 10 and 4 individuals/leaf, respectively (Figure 2).

These results are in agreement with those reported earlier by El-Heneidy and Attia (1989) who indicated that the numbers of predators in wheat fields increased gradually towards the end of the growing season and peaked during April. Fahim & El-Saiedy (2021) observed that both temperature and relative humidity didn't significantly affect the population of the predatory mite, *Amblyseius swirskii* Athias-Henriot (Phytoseiidae). Kalmosh & Mohamed (2020) mentioned that the population of the predacious mite, *A. swirskii* had a single peak in Sharkia and Beheira governorates during two growing seasons.

Interrelation between the three studied taxa and climatic factors

The relationships between the populations of the phytophagous mites (*P. tritici* & *T. bilobatus*) and the predatory mite (*T.* athiasae) and the weather parameters (temperature, relative humidity and wind speed) are shown in Tables 1 and 2. Data revealed that there were insignificant relationships between the population of the three species and the climatic factors during both studied seasons and districts, except for a significantly negative correlation between relative humidity (R.H.%) and *P. tritici* population (r= -0.75), a highly positive significance correlation between R.H. (%) and the numbers of *T. bilobatus* (r= 0.79) during the 2nd season at Zagazig district. On the other hand, insignificant negative correlation was found between the numbers of the three mite species and wind speed during the 2nd season in Zagazig district. However, the correlation was insignificantly positive between all the studied mite taxa with wind speed and insignificantly negative with R.H. (%) for both seasons at Diarb-Nigm district.

Statistical analysis showed the presence of insignificant positive correlation between the populations of the two mite species (*P. tritici* & *T. bilobatus*) and temperature during the 1st season at Diarb-Nigm district, whereas it was insignificantly negative in the second season. In addition, the correlation was insignificantly negative between the population of the two species and R.H. (%) for the two studied seasons in the same district.

These results are consistent with those obtained by Fahim & El-Saiedy (2021) who indicated that the relative humidity did not significantly influence the population of *T. urticae* in all cultivars tested. Richard *et al*. (2022) reported that the climate-change effects on pest species are complex and include direct and indirect effects. Pal & Karmakar (2017) reported that the mite population is significantly correlated with temperature, relative humidity and sunshine hours. In addition, Hoque *et al*. (2010) indicated that the mites required both wind and light as proximate cues for initiating the aerial dispersal behavior at times that appear to be most favorable for becoming airborne. Kalmosh (2018) made the same conclusion when investigated the population densities of *T. urticae* and *P. tritici* infesting wheat in Sharkia and Beheira governorates in Egypt. Furthermore, Patel & Ghetiya (2015) reported a highly significant positive correlation between population of *T. urticae* with morning and evening relative humidity (r= 0.42 & r= 0.76), but not with temperature and wind speed. Kanika & Geroh (2014) reported that *T. urticae* population was positively correlated with wind speed during the 2011 and 2012 seasons (r= 0.59 & 0.52). They also showed significant positive correlation with temperature (r= 0.56), whereas it was negatively correlated with relative humidity (r= -0.81).

Statistical analysis of the data obtained in this study showed relatively high effect, as partial regression (E.V.%) for the three tested climatic factors was 36% for *T. athiasae* during the 2nd season at Zagazig district. To the contrary, there was a relatively high multiple correlation for the tested climatic factors of 65 and 67% for *P. tritici* and *T. bilobatus* during the 2nd season at Zagazig district (Table 2). These results are in full agreement with Kalmosh (2018) who reported high effect (5.18%) of temperature on *P. tritici* as pest on wheat plants at Sharkia Governorate.

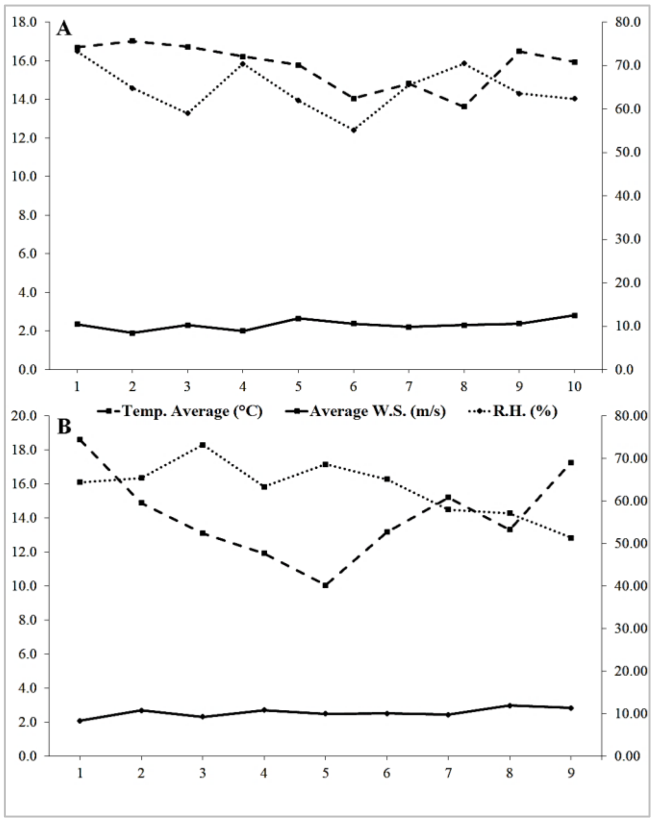

Figure 1. Weather factors during seasons 2020/2021 (A) and 2021/2022 (B).

Table 1. Simple correlation coefficients and partial regression between some environmental variables and mite populations on wheat in two districts, Sharkia Governorate, Egypt.

		Simple correlation (r)						Partial regression											
		2020/2021			2021/2022			2020/2021						2021/2022					
Mite species	**District**	**r1**	**r2**	**r3**	**r1**	**r2**	**r3**	**b1**	**a1**	**b2**	**a2**	**b3**	**a3**	**b1**	**a1**	**b2**	**a2**	**b3**	**a3**
Petrobia	Zagazig	-0.60	-0.19	0.33	-0.12	-0.75	-0.56	-3.08	58.47	-0.21	23.59	7.43	-7.32	-3.80	135.74	-8.31	614.66	181.52	-384.07
tritici	Diarb-Nigm	0.03	-0.29	0.62	-0.20	-0.60	0.53	0.19	7.11	-0.44	38.51	19.31	-34.91	-1.73	44.36	-1.84	137.67	47.06	-101.11
Tarsonemus	Zagazig	-0.35	-0.48	-0.01	0.01	0.79	-0.58	-1.96	39.81	-0.57	45.53	-0.34	9.69	0.01	3.76	0.43	-23.68	-9.13	27.29
bilobatus	Diarb-Nigm	0.05	-0.06	0.44	-0.35	-0.35	0.31	0.15	0.45	-0.04	5.07	-5.55	15.74	-1.16	26.67	-0.41	36.04	10.45	-16.87
Typhlodromus	Zagazig	0.10	-0.32	0.32	-0.27	0.05	-0.20	0.30	-1.35	-0.20	16.44	4.26	-6.62	-0.29	6.42	0.02	1.01	-2.26	8.09
athiasae	Diarb-Nigm	-0.18	-0.13	0.10	0.16	-0.59	0.31	-0.54	12.66	0.08	-1.26	1.27	1.23	0.14	0.17	-0.19	14.16	2.79	-4.94

r1= simple correlation between temperature average and *Petrobia tritici*, *Tarsonemus bilobatus*, and *Typhlodromus athiasae*, r2= simple correlation between humidity average and *P. tritici*, *T. bilobatus*, and *T. athiasae*, r3= simple correlation between average wind speed and *P. tritici*, *T. bilobatus*, and *T. athiasae*, b1= partial regression between temperature average and *P. tritici*, *T. bilobatus*, and *T. athiasae*, b2= partial regression between humidity average and *P. tritici*, *T. bilobatus*, and *T. athiasae*, b3= partial regression between average wind speed and *P. tritici*, *T. bilobatus*, and *T. athiasae*, a1=intercept between temperature average and *P. tritici*, *T. bilobatus*, and *T. athiasae*, a2= intercept between humidity average and *P. tritici*, *T. bilobatus*, and *T. athiasae*, and a3= intercept between average wind speed and *P. tritici*, *T. bilobatus*, and *T. athiasae*.

It can be concluded from this study that the mites *P. tritici* and *T. athiasae* had two population peaks in both districts during the two studied growing seasons, whereas, *T. bilobatus* reached 1 and 2 peaks in Zagazig during the first and second seasons and reached three peaks in both seasons in Diarb-Nigm district. No significant correlation was observed between the population densities of the three mite species and the climatic factors during both seasons, except a highly significant negative correlation observed between R.H. and *P. tritici* population; highly significant positive correlation between *T. bilobatus* population and R.H. during the 2nd season at Zagazig district. The explained variance for the climatic parameters was 36% for *T. athiasae*, and 65% and 67% for *P. tritici* and *T. bilobatus*, respectively, in the 2nd season in the Zagazig district.

Table 2. Explained variances and the effects of climatic parameters on the mite populations on wheat at Sharkia governorate, Egypt.

	Zagazig district				Diarb-Nigm district			
	2020/21		2021/2022		2020/2021		2021/2022	
Mite species	**R^2**	**E.V.%**	**R^2**	**E.V.%**	**R^2**	**E.V.%**	**R^2**	**E.V.%**
Petrobia tritici	0.41	41	0.65	65	0.42	42	0.47	47
Tarsonemus bilobatus	0.37	37	0.67	67	0.24	24	0.30	30
Typhlodromus athiasae	0.18	18	0.19	19	0.07	07	0.36	36

R^2= Multple regression, E.V. (%) = Explained variance

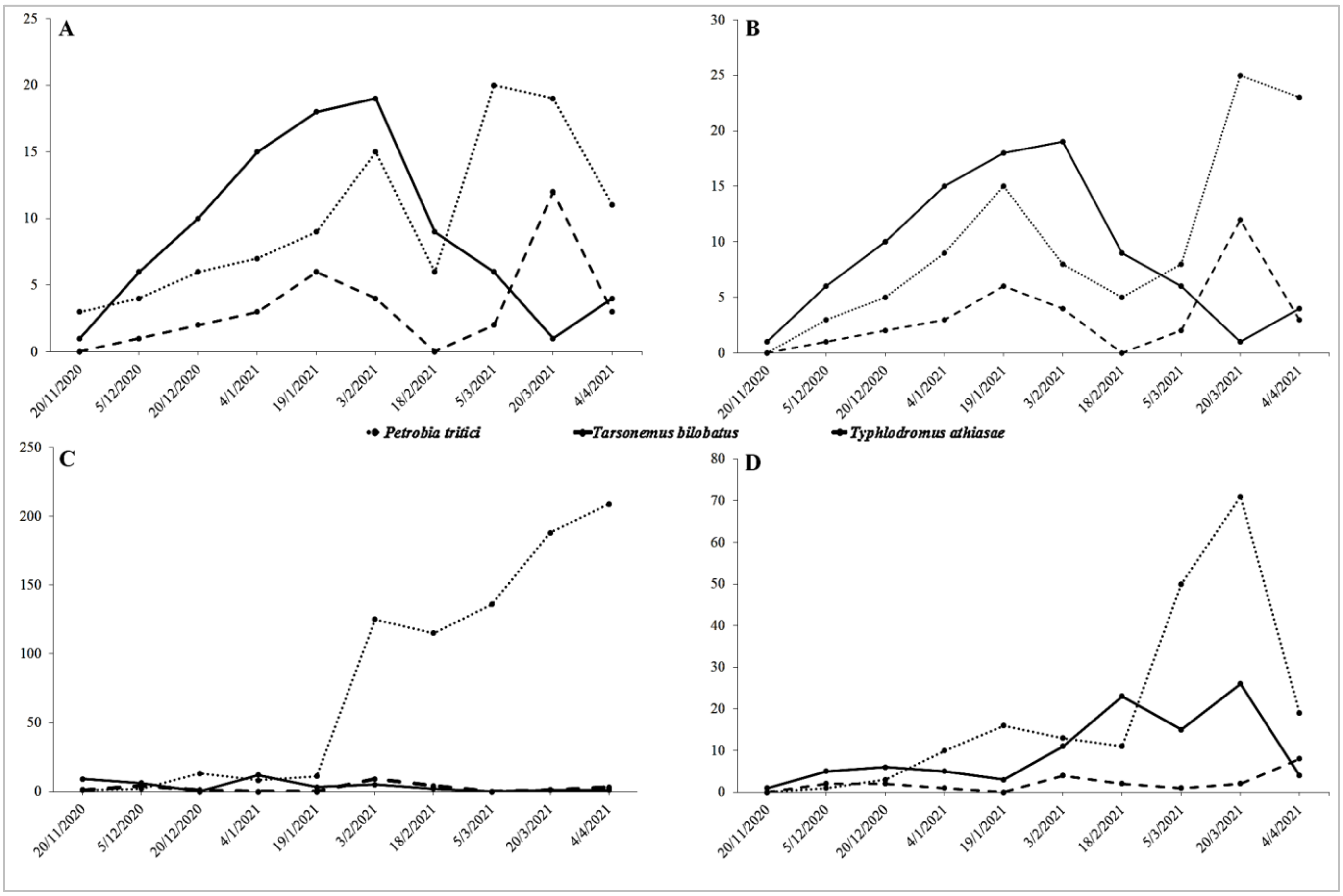

Figure 2. Seasonal abundance of mites inhabiting wheat at (A) Zagazig and (B) Diarb-Nigm districts during 2020/2021 season, (C) Zagazig and (D) Diarb-Nigm districts during 2021/2022 season.

الملخص

عبد الوهاب، أحمد سمير، محمد محمد حسن قنديل ونبيل عبد الله عمر. 2024. الكثافة العددية لمجتمع ثلاثة أنواع من الحَلَم على القمح في محافظة الشرقية، مصر. مجلة وقاية النبات العربية، 42(1): 19–24. https://doi.org/10.22268/AJPP-001217

أُجريت دراسة لتذبذب الكثافة العددية في مجتمعات ثلاثة أنواع من الحَلَم: *Petrobia trtici* Kandeel, El-Naggar & Mohamed (Tetranychidae)، *Tarsonemus bilobatus* Suski (Tarsonemidae)، *Typhlodromus athiasae* Porath & Swirski (Phytoseiidae) على نبات القمح في منطقتي الزقازيق وديرب نجم، بمحافظة الشرقية، مصر خلال موسمي نمو متتاليين 2020/2021 و2021/2022. أظهرت النتائج في مدينة الزقازيق، ازدياد الكثافات العددية للنوعين *P. tritici* و *T. athiasae* تدريجياً مكوّنةً قمتين لكلا الموسمين، تمّ تسجيل القمة الأولى في 3 شباط/فبراير و 2 كانون الأول/ديسمبر لتصل إلى 15 و 13 فرداً/ورقة وفي 19 كانون الثاني/يناير و 5 كانون الأول/ديسمبر لتصل إلى 6 و 4 فرد/ورقة لكلا النوعين، على التوالي، بينما تمّ تسجيل القمة الثانية في 5 آذار/مارس، و 3 شباط/فبراير لتصل إلى 20 و 125 فرداً/ورقة وفي 20 آذار/مارس و 3 شباط/فبراير لتصل إلى 12 و 9 فرداً/ورقة لكلا النوعين على التوالي. أما فيما يتعلق بالنوع *T. bilobotus* فقد تمّ تسجيل قمة واحدة في 3 شباط/فبراير حيث وصلت الأعداد إلى 19 فرداً/ورقة، بينما سُجلت قمتان في (4 كانون الثاني/يناير و 3 شباط/فبراير) لتصل إلى 12 و 5 فرداً/ورقة لكلا النوعين *P. tritici* و *T. athiasae* في كلا الموسمين على التوالي. بالنسبة لمدينة ديرب نجم، شكّل النوعان *P. tritici* و *T. athiasae* قمتين في كلا الموسمين. كانت القمة الأولى في 19 كانون الثاني/يناير لتصل إلى 15 و 16 فرداً/ورقة وفي 20 كانون الثاني/ديسمبر لتصل إلى 6 و 2 أفراد/ورقة لكلا النوعين، على التوالي، بينما صادفت القمة الثانية في 2 آذار/مارس لتصل إلى 25 و 71 فرداً/ورقة وفي 2 آذار/مارس و 3 شباط/فبراير حيث وصلت الأعداد إلى (4 و 10) وأفراد/ورقة لكلا النوعين على التوالي. من ناحية أخرى، شكّل النوع *T. bilobotus* ثلاث قمم خلال أشهر كانون الثاني/يناير، شباط/فبراير وآذار/مارس وبلغت 6 و 11، 23 و 5، و 26 و 3 فرداً/ورقة لكلا الموسمين، على التوالي. بالنسبة للعوامل المناخية، أشارت النتائج إلى وجود ارتباط غير معنوي بين أنواع الحلم الثلاثة والعوامل المناخية خلال الموسمين باستثناء الارتباط بين النوع *P. tritici* والرطوبة الجوية النسبية حيث أظهر تأثيراً معنوياً سالباً (معامل الإرتباط = −0.75) وتأثيراً إيجابياً بمعنوية عالية (معامل الإرتباط = 0.79) بين الرطوبة النسبية الجوية و *T. bilobotus* خلال الموسم الثاني في منطقة الزقازيق. كانت نسبة التباين المشروح بالنسبة للعوامل الثلاثة هي: 36% للنوع *T. athiasae*، بينما كانت 65 و 67% للنوعين *P. tritici* و *T. bilobotus* على التوالي في الموسم الثاني بالزقازيق.

كلمات مفتاحية: التذبذبات العددية، نبات القمح، العوامل المناخية، *Petrobia trtici*، *Tarsonemus bilobatus*، *Typhlodromus athiasae*.

عناوين الباحثين: أحمد سمير عبد الوهاب*، محمد محمد حسن قنديل ونبيل عبد الله عمر. كلية التكنولوجيا والتنمية، جامعة الزقازيق، مصر. *البريد الالكتروني للباحث المراسل: as8386839@gmail.com

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