Journal of Phytopathology and Pest Management 2(3): 18-31, 2015
pISSN:2356-8577 eISSN: 2356-6507
Journal homepage: http://ppmj.net/

Impact of planting dates and some weather factors on population fluctuation and occurrence percentage of aphids and thrips on wheat crop in Egypt

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Abstract

Three planting dates of wheat (Nov., 15th, Dec., 1st and Dec., 15th) were evaluated during 2012/ 2013 and 2013/2014 seasons at Al Ziton village, Beni-Suief Governorate to determine their effect on the population fluctuation of aphids; *Rhopalosiphum* padi, *Schizaphis graminum, Rhopalosiphum maidis and Sitobion (Macrosiphum) avenae* and thrips; *Thrips tabaci*. Results indicated that planting of wheat seeds in the second planting date (Dec., 1st) led to slight infestation of aphids and thrips with mean numbers of 15.52 and 5.74 individuals /10 tillers, for the two seasons. The population fluctuation of aphids and thrips were affected by delaying planting date, as the wheat plants planted at the early planting date (Nov., 15th) were found to be infested by a little numbers of aphids in the first inspection. On the contrary, the infestation of aphids postponed for 8 and 2 weeks & 8 and 6 weeks in the second and third planting dates in the two studied seasons, respectively. On the other hand, the infestation of thrips postponed for 3 & 1 weeks and 6 & 4 weeks in the second and third planting dates in the two seasons, respectively. The highest infestation rate of aphids on wheat plants were recorded at the last period of growth (ear head formation) in the three tested planting dates as the occurrence percent were 48.57, 87.55 and 76.06 % for the three planting dates, in the first season and were 92.94, 89.02 and 88.71 % in the second season. The highest infestation rate of thrips occurred during tillering stage in the 1st and 2nd planting dates, as occurrence percent were 76.58 and 78.69 % in the first season and 91.09 & 86.67 % in the second season. On the other hand, the highest infestation rate of thrips at the 3rd planting date were recorded during the ear head formation, showing occurrence percent of 94.84 and 91.15 % in the two seasons, respectively. The population density of aphids and thrips were greatly influenced according to the change in weather factors. The combined effect of temperature and relative humidity on the population density of aphids on wheat plants were 20.44, 37.53 and 30.12 for the three tested planting dates, in the first season and were 27.39, 25.65 and 25.81 % in the second seasons, respectively. The combined effect of two climatic factors together on the population density thrips decreased by delaying planting date of wheat, as E.V.% were 90.52, 35.04 and 28.34 % to the three tested planting dates in the first season and 54.68, 51.28 and 31.04 in the second season, respectively.

Key words: wheat, aphids, thrips, planting dates, growth stage, population fluctuation, climatic factors.

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Introduction

Wheat (*Triticum aestivum* L.) is a convenient, nutritious and economical source of food. It provides about 20% world food calories and food for nearly 40% of the world's population. The cereal is grown on 23% global cultivated area is for great importance in bread, diet, pharmaceutics and other industries. Wheat is important product of international trade for worldwide market (Istvan, 2006).Various factors like late sowing, traditional method of seedbed preparation, poor quality seed, imbalance use of fertilizer, water shortage and especially poor insect control were responsible for the low production of wheat (El-Gizawy, 2009). However, aphids and thrips were considered two of the important pests attacking wheat plants and causing sever reduction in the yield **(**Slman, 2002; Slman et al., 2002).
During the last few years, cereal aphid became serious insect pests attacking wheat plants in Egypt. These pests cause serious damages to the plants either directly by sucking plant juice or indirectly as a vector of diseases (Abdel-Aziz et al., 2002; Slman, 2002). Aphids are the limiting factors in wheat production in Upper Egypt which cause severe damage and reduce the yield from 4.24 to 21.89 % (Amin et al., 2007), 20% (Ghanem et al., 1984) and 25 % (National Bulletin of Wheat Research Program, 2004). The most important and economic cereal aphid species in Egypt were; *Rhopalosiphum padi* (Linnaeus), *Schizaphis graminum* (Rondani), *Rhopalosiphum maidis* (Fitch) and *Sitobion (Macrosiphum) avenae* (Fabricius) (El- Heneidy & Adly, 2014). This work aims to study the influence of three planting dates of wheat, plant growth stages and the effect of certain climatic factors on the population fluctuation of aphids and thrips.

Materials and methods

This experiment was carried out at Al-Ziton village, Nasser district, Beni Suief Governorate, during two successive winter seasons, 2012/2013 and 2013/2014. An area of about 1050 m^2 was cultivated with wheat variety (Sids 12). Seeds of wheat were sown in three planting dates at Nov., 15th, Dec., 1st and, Dec., 15th. The whole area was divided into 9 replicates (each replicate of about 116.7m^2). Each planting date was represented by 3 replicates. All replicates were distributed in a randomized complete block design. The normal agricultural practices were done without pesticides application. Sampling started after 15 days from sowing and continued at 7 days intervals for 22, 21, and 20 weeks to 1st, 2nd and 3rd planting dates, respectively. 10 tillers of each replicate were randomly taken and kept in a tightly closed paper bags, and transferred to the laboratory for inspections by stereomicroscope. The total number of aphid adults and nymphs (mainly; *R. padi, S. graminum, R. maidis and S. avenae*) and *Thrips tabaci* (Lind) were counted and recorded during the two studied seasons. The individuals of aphids were recorded according to El-Heneidy and Adly (2014), as the highest population of *R. padi* was recorded on the lower level of wheat plants, while the highest population of *R. maidis* and *S. graminum* was presented on the upper

level of the wheat plants. Three periods of wheat growth stages (seedling, tillering and ear head formation stages) had been taken into consideration in the three tested planting dates to evaluate their effect on the infestation rate of aphids and thrips. Every stage was differed according to planting date; (1): seedling stage was recorded throughout the first six weeks in all the three tested planting dates, (2): tillering stage was recorded during 10, 8 and 6 intermediate weeks for 1st, 2nd and 3rd planting dates, respectively and (3): ear head formation was calculated during the last 6, 5 and 4 weeks for the three tested planting dates, respectively. Weekly means of maximum and minimum temperature (ºC) and maximum & minimum of relative humidity(R.H.%) were obtained from the Central Laboratory for Agriculture Climate, and then recorded to correlate with the mean number of aphids and thrips in the three studied planting dates in both studied seasons. The differences between mean number of aphids and thrips in the three tested planting dates were analyzed according to Fisher (1950). The explained variance % and simple correlation between mean number of two pests and some climatic factors were estimated by using SAS program computer (SAS, Institute, 2008).

Results and Discussion

Effect of planting dates on the population density of aphids and thrips infesting wheat plants

Aphids: Data in Table (1) indicated that the wheat plants differed significantly in their degree of infestation with aphids according to dates of sowing (Nov., 15th, Dec., 1st and Dec., 15th). In the first season, 2012/2013, the obtained data revealed that there was significant difference between the recorded mean numbers of aphids at the three studied planting dates. The highest infestation of aphids was recorded on wheat plants planted at the early planting date (Nov.,15th) followed significantly by wheat plants in the second planting date (Dec., 1st), showing seasonal mean numbers of aphids 15.91 and 11.10 individuals / 10 tillers, respectively. On the contrary, the significantly lowest infestation was recorded on wheat plants in the third planting date (Dec., 15th) being 7.10 individuals /10 tillers. Statistical analysis of the obtained data in second season revealed that the significantly highest population of aphids was recorded on wheat plants in the first and third planting dates with mean number of 31.55 and 31.45 individuals/10 tillers, respectively. On the other hand, the intermediate planting date harbored low significant infestation of aphids (19.59 individuals / 10 tillers) (Table1). According to statistical analysis of the obtained data from two season's altogether, it was cleared that the two latest planting dates of wheat seeds in the Dec., 1st and Dec., 15th led to a slight infestation of aphids as the mean numbers were 15.52 and 19.28 individuals / 10 tillers, respectively. By contrast, the wheat plants in the early planting date (Nov., 15th) received the highest infestation of aphids being 23.73 individuals / 10 tillers (Table1).

Thrips: Results shown in Table (2) indicated that the population density of thrips on wheat plants was differed

significantly according to planting dates during two studied seasons. Wheat plants, cultivated in the latest planting date, were infested by thrips more than those cultivated in the other two planting dates showing 39.70 and 29.95 individuals /10 tillers during the two studied seasons, respectively. The lowest significant infestation of thrips was encountered in the second planting date (2.90 and 8.57 individuals /10 tillers in the two seasons, respectively). The first planting date occupied the second group of infestation, (12.23 and 15.82 individuals /10 tillers in the two seasons, respectively Table2). The overall mean number of thrips for two seasons indicated that wheat plants in the late planting date received the highest infestation rate of thrips (34.83 individuals /10 tillers), followed significantly by 14.03 individuals /10 tillers at the first planting date. While, the second date harbored the lowest mean infestation (5.74 individuals /10 tillers). Finally, it could be stated that planting date (Dec., 1st) mostly escaped from infestation by aphids and thrips (Table 2).

Table 1: Effect of planting dates on population density of aphids per ten tillers throughout three planting dates on wheat plants*.

Date of inspection	2012-2013			2013-2014			Mean no. of two seasons		
	Nov., 15th	Dec., 1st	Dec., 15th	Nov., 15th	Dec., 1st	Dec., 15th	Nov., 15th	Dec., 1st	Dec., 15th
Nov., 29th	4	-	-	2	-	-	3	-	-
Dec., 6th	3	-	-	1	-	-	2	-	-
13th	5	0	-	3	0	-	4	0	-
20th	4	0	-	5	0	-	5	0	-
27th	10	0	0	7	4	0	9	2	0
Jan., 3rd	2	0	0	5	4	0	4	2	0
10th	11	0	0	0	3	0	6	2	0
17th	18	0	0	2	2	0	10	1	0
24th	14	0	0	2	2	0	8	1	0
31st	7	0	0	7	2	0	7	1	0
Feb., 7th	2	2	0	4	4	2	3	3	1
14th	8	2	0	2	1	2	5	2	1
21st	63	6	11	2	3	4	33	5	8
28th	20	2	4	3	8	13	12	5	9
March, 7th	9	6	8	2	6	18	6	6	13
14th	0	11	11	2	7	32	1	9	22
21st	48	47	33	181	87	196	115	67	115
28th	33	55	17	150	103	95	92	79	56
April, 4th	17	81	4	76	153	20	47	117	12
11th	56	13	7	198	21	22	127	17	15
18th	16	8	18	40	9	74	28	9	46
25th	0	0	29	0	0	151	0	0	90
May, 2nd	-	0	0	-	0	0	-	0	0
09th	-	-	0	-	-	0	-	-	0
Total	350	233	142	694	419	629	545.73	341.52	385.5
Mean	15.91 a	11.10 b	7.10 c	31.55 a	19.95 b	31.45 a	23.73 a	15.52 b	19.28 ab
F Value	6.14			3.39			5.10		
LSD	3.15			5.54			7.02		

* Numbers of aphids /10 tillers

Table 2: Effect of planting dates on population density of thrips throughout three planting dates on wheat plants*.

Date of inspection	2012-2013			2013-2014			Mean no. of two seasons		
	Nov., 15th	Dec., 1st	Dec., 15th	Nov., 15th	Dec., 1st	Dec., 15th	Nov., 15th	Dec., 1st	Dec., 15th
Nov., 29th	4	-	-	3	-	-	4	-	-
Dec., 6th	8	-	-	3	-	-	6	-	-
13th	13	0	-	0	0	-	7	0	-
20th	12	0	-	3	3	-	8	2	-
27th	11	0	0	15	2	0	13	1	0
Jan., 3rd	15	2	0	5	2	0	10	2	0
10th	22	1	0	16	11	0	19	6	0
17th	30	2	0	13	3	0	22	3	0
24th	23	5	0	12	4	2	18	5	1
31st	23	8	0	40	29	3	32	19	2
Feb., 7th	47	7	3	72	35	10	60	21	7
14th	34	7	4	66	21	15	50	14	10
21st	20	14	5	70	32	0	45	23	3
28th	5	3	10	15	20	2	10	12	6
March, 7th	2	1	8	8	10	3	5	6	6
14th	0	3	11	5	5	2	3	4	7
21st	0	0	7	1	2	2	1	1	5
28th	0	0	49	1	1	14	1	1	32
April, 4th	0	0	100	0	0	28	0	0	64
11th	0	3	150	0	0	102	0	2	126
18th	0	1	190	0	0	171	0	1	181
25th	0	4	221	0	0	214	0	2	218
May, 2nd	-	0	36	-	0	31	-	0	34
09th	-	-	0	-	-	0	-	-	0
Total	269	61	794	348	180	599	309	121	697
Mean	12.23 b	2.90 c	39.70 a	15.82 b	8.57 c	29.95 a	14.03 b	5.74 c	34.83 a
F Value		62.33			46.07			42.94	
LSD		2.15			3.57			7.91	

* Numbers of thrips /10 tillers

Similar works of the effect of planting date on the population density of aphids and thrips infesting wheat plants had been done in different countries. Aslam et al. (2005) in Pakistan mentioned that the seasonal mean number of aphids was higher on late sowing date (Dec.,25th) as compared with early planting date (Oct.,5th and Nov.,25th). Hesler et al (2005) in USA detected that there are no significant difference between aphid population on wheat plants planted at (August and September). Royer et al (2005) in USA stated that the highest seasonal mean number of aphids was recorded in the early planting date (Sep.11th) while the lowest mean number recorded in the middle and late planting date Sep.,29th & Oct.,10th. Ahmed et al (2006) in Pakistan stated that earlier sowing date of wheat showed less aphid population per tiller. The highest infestation was recorded at latest planting date(Nov., 10th & 25th Dec.,10th & 25th and Jan.,10th). Wains et al (2010) in Pakistan stated that early sowing on Nov., 1st showed the least aphid infestation comparing with the latest date (Nov., 10th, 20th, 30th, Dec.,10th and Dec.,20th). In Bulgaria, Krusteva and

Karadjova (2011) recorded that the infestation by aphids was recorded only in the crops with earliest sowing date (Sep., 25th). On the contrary, sowing the crop in later planting date (Oct., 9th &26th) could therefore be recommended in order to prevent damages on triticale crops.

Population fluctuation of aphids and thrips at wheat planting dates

Aphids: Population fluctuation of aphids at the early planting date (Nov., 15th) were characterized by initial occurrence at the first inspection in both studied seasons by mean numbers 4 and 2 individuals /10 tillers, respectively (Table,1). On the other hand, the wheat plantation at the early of December (2nd date) associated with postponed the appearance of aphids for 8 and 2 weeks during the two studied seasons, respectively. While, the plantation at the last planting date (Dec., 15th) detected absence the appearance of aphids for firstly 8 and 6 weeks in two seasons, respectively (Table 1). In the first planting date, data in Tables (1 & 3) and Figure (1) indicated that the majority of aphid population was observed at the last period of wheat age (ear head formation stage). The mean numbers of aphids at the five last weeks(from March, 21st to April,18th) were 48.00, 33.00, 17.00, 56.00, and 16.00 individuals / 10 tillers during first season, and 181.00, 150.00, 76.00, 198.00 and 40.00 individuals / 10 tillers in the second season (Table 1) recording 48.57 and 92.94 % occurrence during the two seasons, respectively (Table 3). Five and four peaks of aphids were recorded at the first planting date during the two studied seasons, respectively (Fig. 1). In case of the first season , these peaks were recorded at Dec., 27th, Jan., 17th, Feb., 21st, March, 21st and April, 11th with mean number of 10.00, 18.00, 63.00, 48.00 and 56.00 individuals / 10 tillers. In the second season, four peaks were recorded at Dec. 27th, Jan. 31th, March, 21st and April, 11th by lower numbers in the two first peak, and the high numbers in the two last peaks showing 7.00, 7.00, 181.00 and 198.00 individual / 10 tillers, respectively. In the second planting date (Dec., 1st) the results took the same trend as in the first planting date, as the wheat plants infested by the heaviest number of aphids during the last 5 weeks (from March, 21st to April, 18th) in the two studied seasons by 47.00, 55.00, 81.00, 13.00 and 8.00 individuals /10 tillers at the first season, and 87.00, 103.00, 153.00, 21.00 and 9.00 individuals /10 tillers at the second season (Table1 & Fig.1). The infestation percent of aphids in the above- mentioned weeks were 87.55 and 89.02 % during two seasons, respectively (Table 3). Two and three peaks of aphids were recorded during the two studied seasons, respectively. In respect to the first season, the population of aphids had a weak peak and one clear peak with mean numbers of 6.00 and 81.00 individuals /10 tillers at Feb., 21st and April, 4th, respectively. In the second season, the three observed peaks were classified into two categories; the firstly two peaks characterized by little number of aphids and the other one peak had the highest number of aphids being 4.00, 8.00, and 153.00 individual / 10 tillers, respectively, at the date of Feb., 7th , Feb., 28th and April, 4th, respectively, (Table 1 & Fig. 1). Regarding to the third planting date (Dec., 15th), results

took the same trends as that occurred in the previously mentioned first and second dates, as the highest infestation rate of aphids on wheat plant were recorded at the last period of growth (six last inspection), ranged between 4.00 to 33.00 and 20.00 to 196.00 individuals / 10 tillers during two successive seasons, respectively. The occurrence % of aphid infestation throughout the last six weeks recorded 76.06 and 88.71 % in both two seasons, respectively (Table 3). Population of aphids had three and two peaks in two seasons, respectively (Table 1 & Fig. 1). The three peaks of aphids during the first season were noticed at Feb., 21st , March, 21st and April, 25th with number of 11.00, 33.00 and 29.00 individuals / 10 tillers, respectively. The second season had two peaks with mean number 196.00 and 151.00 individuals /10 tillers at March, 21st and April, 25th, respectively (Table 1 & Fig. 1).

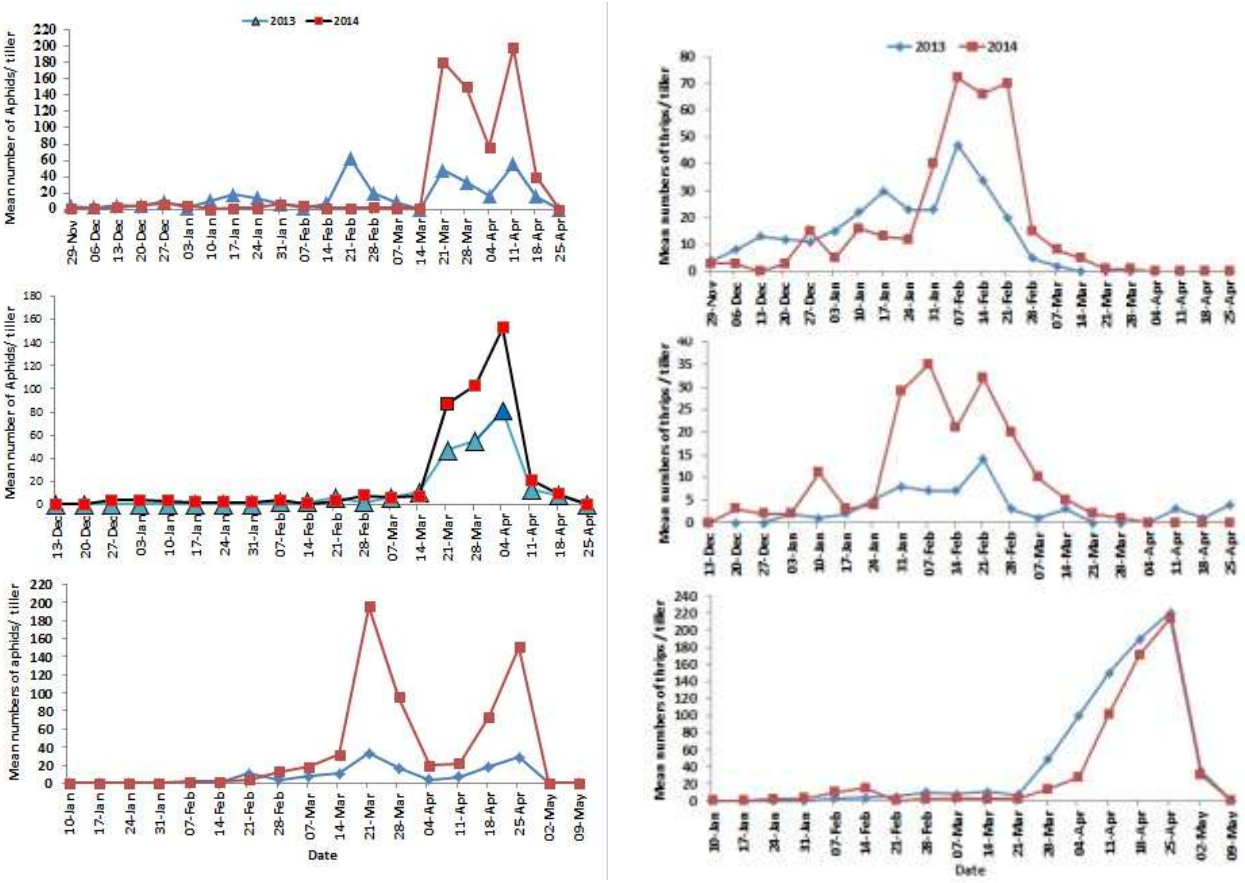

Figure 1: Population fluctuation of aphids and thrips throughout three planting dates during two successive seasons 2012/2013 and2013/2014.

Table 3: Occurrence percent of aphid individuals throughout three periods of plant age at different planting dates during two successive seasons*.

Plant growth	Planting dates of 2012-2013 season						Planting dates of 2013-2014 seasons					
	1st		2nd		3rd		1st		2nd		3rd	
	No. of aphids	Occ.%	No. of aphids	Occ.%	No. of aphids	Occ.%	No. of aphids	Occ.%	No. of aphids	Occ.%	No. of aphids	Occ.%
Seedling	28.00	8.00	0.00	0.00	0.00	0.00	23.00	3.31	13.00	3.10	0.00	0.00
Tillering	152.00	43.43	29.00	12.45	34.00	23.94	26.00	3.75	33.00	7.88	71.00	11.29
Ear head formation	170.00	48.57	204.00	87.55	108.00	76.06	645.00	92.94	373.00	89.02	558.00	88.71
Total	350.00		233.00		142.00		694.00		419.00		629.00	

*Numbers of aphids /10 tillers

Table 4: Occurrence percent of thrips individuals throughout three plant age at different planting dates during two successive seasons*.

Plant growth	Planting dates of 2012-2013 season						Planting dates of 2013-2014 seasons					
	1st		2nd		3rd		1st		2nd		3rd	
	No. of thrips	Occ.%	No. of thrips	Occ.%	No. of thrips	Occ.%	No. of thrips	Occ.%	No. of thrips	Occ.%	No. of thrips	Occ.%
Seedling	63.00	23.42	5.00	8.20	0.00	0.00	29.00	8.33	21.00	11.67	30.00	5.01
Tillering	206.00	76.58	48.00	78.69	41.00	5.16	317.00	91.09	156.00	86.67	23.00	3.84
Ear head formation	0.00	0.00	8.00	13.11	753.00	94.84	2.00	0.57	3.00	1.67	546.00	91.15
Total	269.00		61.00		794.00		348.00		180.00		599.00	

*Numbers of thrips /10 tillers

Thrips: Data in Tables (2&4) and Figure (1) showed that wheat plants cultivated in the first planting date (Nov.,15th), were liable to the infestation with thrips throughout seedling and tillering growth period of this plant which extended from the last week of November (Nov., 29th) until the first week of March (March, 7th) in the first season, and the last week of march (March, 28th) in the second season, respectively. After that, the population density of thrips gradually decreased during ear head formation stage till non-existence of thrips for 7 and 4 last weeks for first and second seasons, respectively (Table 2). From data tabulated in Table (4) it was cleared that the highest thrips infestation was obtained at second stage of wheat plant (tillering stage) with 206.00 and 317.00 individuals / 10 tillers in the two studied seasons, respectively, recording occurrence percent of 76.58 and 91.09 %, respectively, followed by wheat plants in the first growth stage (seedling) which infested by 63.00 and 29.00 individuals / 10 tillers and represented by 23.42 and 8.33 %, during the two studied seasons, respectively. On the contrary, wheat plants, at the third plant growth (ear head formation stage), was not infested by thrips during the first season, but, it infested by the lowest number in the second season being 2.00 individuals / 10 tillers recording 0.57 % occurrence from grand total (Table 4). During 1st planting date, the population fluctuation of thrips showed three peaks for the first season in Dec., 13th, Jan.,17th and Feb.,7th with mean numbers 13.00, 30.00, and 47.00 individuals / 10 tillers, respectively and four peaks in the second season during Dec., 27th, Jan., 10th, Feb.,7st and Feb., 21st with mean numbers of 15.00,16.00, 72.00 and 70.00 individuals /10 tillers, respectively (Table 2). In the second planting date, the infestation of thrips began to appear in the first week of January (Jan., 3rd) in the first season and the end of third week of December (20th) in the second season,

where the mean numbers were 2.00 and 3.00 individuals / 10 tillers in the two seasons, respectively, with postpone infestation for 3 and 1 week at the two seasons, respectively (Table 2). In the first season, data in Table (4) showed that the highest infestation rate of thrips occurred during tillering growth with mean number 48.00 individuals / 10 tillers followed by ear head formation stage (8.00 individuals/10 tillers), as the occurrence percent were 78.69 and 13.11 %, respectively. The lowest infestation rate was recorded during seedling stage, with mean number 5.00 individuals/ 10 tillers and occurrence percent 8.20% (Table 2). During the second season, the lowest mean number of thrips was recorded on wheat plants during ear head formation stage with mean number of 3.00 individuals / 10 tillers and their occurrence percent was 1.67 %, followed by seedling stage (21.00 individuals / 10 tillers and 11.67 % occurrence). As occurred in the first season, the wheat plants suffered from the highest infestation during the tillering growth (156.00 individuals / 10 tillers and 86.67 % occurrence percent) (Table 4). In the two studied seasons, 4 peaks were detected in the 2nd planting date with low mean numbers of thrips in the first seasons, as (2.00, 8.00, 14.00 and 3.00 individuals / 10 tillers at the dates of Jan., 3rd, Jan., 31st , Feb., 21st and March, 14th , respectively). The 4 peaks in the second season were recorded in Dec., 20th , Jan., 10st, Feb., 7th , and Feb., 21st, with mean numbers of 3.00, 11.00, 35.00 and 32.00 individuals / 10 tillers , respectively. Generally, the population density of thrips infesting wheat plants in the second planting date was higher in the second season than the first one, the seasonal mean numbers were 180.00 and 61.00 individuals / 10 tillers in the two studied seasons, respectively. In the last planting date, the wheat plants were free from any infestation in firstly 6 and 4 weeks in the two seasons, respectively (Table 2). In this planting date, the obtained results took different trend as in the first and second planting date, as the highest infestation rates were recorded during ear head formation stage in the two studied seasons showing mean numbers 753.00 and 546.00 individuals /10 tillers and recorded occurrence percent 94.84 and 91.15 % in the two studied seasons, respectively. The remaining two other plant stages was infested by low numbers of thrips and gave the lowest occurrence percent from grand total (Table 4). Data in Table (3) and Figure (1) indicated that there were three and two peaks in the two studied seasons, respectively. Peaks in the first season had mean numbers of 10.00, 11.00 and 221.00 individuals / 10 tillers at the date of Feb., 28th, March, 14th and April, 25th, respectively. In case of the second season, the peaks were 115.00 and 214.00 individuals / 10 tillers at Feb., 14th and April, 25th, respectively (Table 2). Finally, the obtained results indicated that the population density of aphids increased during ear head formation stages and decreased during the two earliest stages (seedling and tillering stages) on the three studied planting dates, indicating that wheat plants is less vulnerable to aphid in the early stages and susceptible at latter growth stage or it may be attributed to low temperature during early growth stage. On the other hand, the infestation rate of thrips increased during tillering stage in the 1st planting date (Nov., 15th)

and prefer wheat plants during last growth stage in 2nd and 3rd planting date. The obtained results of the population fluctuation of aphid and thrips partially agree with those of Aslam et al. (2005) in Pakistan mentioned that aphid population increased exponentially from the end of Feb. to end of March and declined from end of March to the beginning of April on wheat planted of Oct., 25th , Nov.25th, and Dec.,25th. *Buriro* et al. (2006) in Pakistan revealed that aphid population was higher in the month of April (during ear head formation) and lowest in the month of March (tillering stage) indicated that wheat is less vulnerable to aphids in early stage. Population of thrips was observed on 3rd week of March and continued to increase up to 2nd week of April, the population was mostly observed on developing ear head and flowers. Saleem et al. (2009) found that aphid infestation started during the last week of Dec., remained low during January with a peak in the 1st week of March. Wains et al. (2010) revealed that a peak of aphids' population was recorded during the beginning of the third week of March. Khan et al. (2011) in Pakistan recorded that the 4th of February was found to be very favorable for aphids in wheat fields. Barbec et al. (2014) in Pakistan stated aphids' population grow quickly and increased at the last period wheat plants. Ullah et al. (2014) showed that aphids attack wheat plants started in the 1st week of January and increased with the vegetative growth of plants and reached at peak level in the 3rd week of March.

Table 5: Effect of certain climatic factors on the population fluctuation of aphids on wheat plants throughout three planting dates during two seasons.

Season	Factors	Planting dates											
		1st				2nd				3rd			
		Correlation coefficient (r)	P.	E.V. %	Overall E.V. %	Correlation coefficient (r)	P.	E.V. %	Overall E.V. %	Correlation coefficient (r)	P.	E.V. %	Overall E.V. %
2013	Max. temp.	0.227	0.23	7.10	20.440	0.603	0.01	36.35	37.530	0.227	0.36	5.16	30.120
	Min. temp.	0.120	0.59	1.44		0.560	0.01	35.37		0.123	0.63	1.50	
	Max.RH.	-0.167	0.46	2.79		-0.376	0.10	14.09		0.175	0.49	3.06	
	Min. RH.	-0.421	0.05	17.79		-0.449	0.05	20.18		-0.226	0.37	5.12	
2014	Max. temp.	0.483	0.02	23.32	27.390	0.496	0.03	24.56	25.650	0.350	0.15	12.29	25.810
	Min. temp.	0.403	0.06	16.26		0.485	0.03	23.53		0.267	0.28	7.14	
	Max.RH.	-0.174	0.44	3.02		-0.286	0.22	8.17		-0.125	0.62	1.57	
	Min. RH.	-0.339	0.12	11.51		-0.350	0.13	12.28		-0.164	0.52	2.68	

Table 6: Effect of certain climatic factors on the population fluctuation of thrips on wheat plants throughout three planting dates during two seasons.

Season	Factors	Planting dates											
		1st				2nd				3rd			
		Correlation coefficient (r)	P.	E.V. %	Overall E.V. %	Correlation coefficient (r)	P.	E.V. %	Overall E.V. %	Correlation coefficient (r)	P.	E.V. %	Overall E.V. %
2013	Max. temp.	-0.732	0.0001	53.70	90.52	-0.206	0.38	4.23	35.04	0.311	0.21	9.68	28.34
	Min. temp.	-0.718	0.0002	51.52		-0.221	0.35	4.89		0.268	0.28	7.16	
	Max.RH.	-0.143	0.53	2.04		-0.268	0.25	7.2		0.227	0.37	5.13	
	Min. RH.	0.392	0.07	15.37		-0.042	0.86	0.18		-0.179	0.48	3.20	
2014	Max. temp.	-0.451	0.04	20.37	54.68	-0.395	0.08	15.62	51.28	0.206	0.41	4.23	31.04
	Min. temp.	-0.444	0.04	19.73		-0.344	0.14	11.86		0.167	0.51	2.80	
	Max.RH.	-0.240	0.28	5.74		-0.233	0.32	5.45		0.312	0.21	9.76	
	Min. RH.	0.150	0.50	2.27		0.206	0.38	4.23		-0.072	0.78	0.52	

Effect of some climatic factors on the population density of aphids and thrips infesting wheat plants

Aphids: During the first season, data indicated that a positive correlation was detected between the population density of aphids and both of maximum and minimum temperature in the three tested planting dates, Nov., 15th, Dec., 1st and Dec., 15th , as the calculated (r) values were 0.227 & 0.120 , 0.603 & 0.560 and 0.227 & 0.123 at the three planting dates, respectively. The correlation coefficient value (r) of maximum and minimum temperature showed its highest values (0.603 and 0.560) in the second planting date with probability 0.01 (Table,5). Regarding the effect of relative humidity, it is clear that the population density of aphids affected insignificantly negative in all the three studied planting date except for the effect of maximum R. H % in the 3rd planting date, as r value was 0.175 with probability 0.49. In the second season, the results took the same trend as in the first season, the population density of aphids correlated insignificantly positive with maximum & minimum temperature and insignificantly negative with maximum and minimum relative humidity in the all three tested planting dates. The combined effect of temperature relative humidity on the population density of aphids throughout the three tested planting dates of wheat plants could be also detected through the calculated explained variance shown in Table (5). E.V. % values were 20.44, 37.53 and 30.12 % for the three planting dates in the first season and 27.39, 25.65 and 25.81for the second season, respectively. This variance reflected that, there were other factors affecting the population of this pest.

Thrips: With regard to sensitivity of thrips infesting wheat plants during the three planting dates to the physical factors, the data in Table (6) revealed that the population density of thrips was affected by the changes of weather factors during the two studied seasons. In the first season, the population density of thrips was affected significantly negative by maximum and minimum temperature (r values = -0.732 and -0.718 with probability 0.0001 and 0.0002, respectively) during 1st planting date, but it was insignificantly negative at the 2nd planting date (r= -0.206 and -0.221, respectively). For the 3rd planting date, the relations with thrips population were insignificantly positive, (r 0.311 and 0.268, respectively). Concerning the effect of relative humidity, data indicated that the population density of thrips was affected insignificantly negative effect at the 2nd planting date (r= -0.268 and -0.042 with probability 0.25 and 0.86 with maximum & minimum temperature, respectively). The results were differed in the 1st and 3rd planting dates, the correlation was insignificantly negative with maximum R.H.% in the 1st planting date (r=-0.143) and insignificantly positive in the 3rd planting date (r=0.227). The effect of minimum R.H was positive in the 1st planting date (r=0.392) and negative in the 3rd planting date (r=-0.179). In the second season, the same relations were detected for both factors in the all studied planting dates except for the effect of minimum temperature in the 2nd planting date. In the 1st planting date, the population density of thrips was correlated

insignificantly negative with maximum & minimum temperature and maximum relative humidity, (r values were -0.451, -0.444 and -0.240, respectively). On the contrary, the effect of minimum R.H was insignificantly positive (r= 0.150). In the third planting date, population of thrips was affected insignificantly positive with maximum & minimum temperature and maximum relative humidity(r=0.206, 0.167 and 0.312, respectively) and insignificantly negative with minimum R.H (r=-0.072) in the 2nd planting date. These relations were insignificantly negative with maximum & minimum temperature and maximum relative humidity (r= -0.395, -0.344 and -0.233, respectively) and insignificantly positive with minimum R.H (r=0.206). The multiple regression analysis indicated that the combined effect (E.V.%) of these two factors together on the population density of thrips on wheat plants throughout three planting dates were 90.52, 35.04 and 28.34 % during the first season and 54.68, 51.28 and 31.04 % during the second season, respectively(Table 6). This means that these two factors had strong effect on the activity of thrips, especially in the first planting date. Finally, it could be stated that the combined effect of temperature and relative humidity on the population density of thrips decreased by delaying planting date of wheat seeds and there are unconsidered factors other than temperature and relative humidity affect on the building up of thrips population. The abovementioned results of the effect of climatic factors on the population density of aphid and thrips are partially agree with that obtained by several authors on different crops. Saleem et al. (2009) mentioned that major activities of aphid species were correlated with the rising temperature in the month of February, but as the crop mature, fewer aphids were found in wheat plants. Wains et al. (2010) reported that aphids density was positively associated with maximum and minimum temperature, while it showed negative correlation with relative humidity. Hussein et al. (2010) on garlic plants indicated that the population density of thrips nymphs and adults were negatively correlated with maximum and minimum temperatures, while, the mean of R.H affected positively. The combined effects of two weather factors altogether were 68.55 and 78.97 % in the two seasons, respectively. Hanafy et al. (2014) in Egypt stated that the incidences of the thrips on cucumber and kidney bean was significantly positive correlated with maximum temperature and maximum relative humidity, while, it was insignificantly positive correlated with minimum temperature. On the contrary, the minimum relative humidity had negative and non-significant effect on the two host plants. The combined effects of two weather factors altogether were 67.00 and 71% on cucumber and 71.00 and 69.00 % on kidney bean, respectively.

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