Acta
Entomology and Zoology

E-ISSN: 2708-0021
P-ISSN: 2708-0013
www.actajournal.com
AEZ 2025; 6(1): 30-35
Received: 27-11-2024
Accepted: 30-12-2024

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Factors affecting aphids infestation to certain wheat entries

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DOI: https://doi.org/10.33545/27080013.2025.v6.i1a.187

Abstract
Wheat, *Triticum aestivum* L. is a vital cereal crop in Egypt and allover the world. This crop is subjects to infestation by several insect pests, cereal aphids are major biotic constraints of crop production. Experiments were conducted at the experimental farm of Sakha Agricultural Research Station during 2021/2022 and 2022/2023 wheat seasons. The objectives were to determine the susceptibility of wheat entries to infestations by several aphid species. Also, the aphid infestation levels were correlated with weather factors prevailing in the location. Four aphid species were found attacking wheat plantations. These aphid species are: *Rhopalosiphum padi* L., *Rhopalosiphum maids* (Fitch), *Schizaphis gramium* (Rondani) and *Sitobion avenae* (Fabricius). *R. padi* was the most dominant species, followed by *Sitobion avenae, S. graminam* and *R. maids.* As for the entries susceptibility to aphids, the highest susceptible entries were Misr-1, Sakha-94, Gemmeiza-12, Shandaweel-1 and Sids12. The highest resistant genotypes were Giza-168, Sakha-95, Sids-14, and Sakha-1001. Sowing wheat dates significantly affected the degree of aphid infestation. In the first season (2021/2022), the wheat sown on November 5th suffered the highest aphid infestation (15.46±0.10) nymphs and adults/10 tillers, followed by that sown on December 5th (13.93±1.17), and by that sown on January 4th (13.73±0.73), while wheat sown on February 3th had the lost infestation (7.70±0.41 nymphs and adults/10 tillers). In the second season (2022/2023), the trend of infestation, due to sowing date, was relatively different. The highest infestation (5.31±0.32) was recorded in wheat sown later (February 3rd), followed by that sown-on January 4th (4.07±0.46), December 5th (3.24±0.47), and then the earliest sown wheat (November 5th), with 2.01±0.24 nymphs and adults/10 tillers.
The results of the current study could be included in IPM program on wheat fields.

Keywords: Wheat, aphide, weather, susceptibility and sown

Introduction
Wheat, *Triticum aestivum* L. occupies a highly distinguishable rank, as a food cereal crop, besides rice and maize. It is a crucial nutritional crop in Egypt and all over the world. Due to overpopulation and limited resources in Egypt, there is a big gap between wheat production and consumption, the situation that nominates Egypt as one of the biggest wheat importers (FAO 2014) [10].
One of the abiotic stresses, that challenge the increase in wheat production, is the infestation by insect pests, from which are aphid species. Aphids effect negatively the wheat production quantitatively and qualitatively by direct feeding on wheat plants, and by vectoring viral diseases (Aradottir *et al* 2017, Li *et al* 2020) [3, 12]. The wheat plants are subject to aphid infestation beginning from seedling up to milk-ripening stage (Naeem *et al* 2018) [13].
Due to rapid reproduction of aphid, because of parthenogenesis phenomenon, small scattered aphid colonies may turn into hot spots within few days, which should require insecticidal control. However, the chemical control is seen, by pest management programs, as a dangerous technique, which encourages the development of acquired resistance in pest species against widely applied pesticides (Bakry *et al* 2021) [5].
Furthermore; the climatic changes directly affect aphid colonies behavior, abundance, phenology, biology and their natural enemies (Eigenbrode and Adhikari, 2023) [6]. Warming can mitigate aphid behavior, typifies high temperature was lethal for bird cherry-oat aphid, *Rhopalosiphum padi* Linnaeus, which survives better in winter. Weather factors may limit and suppress some insects, and encourage some other miner insects to turn into major ones (Alfond *et al.*, 2014) [18] compared to the two cereal aphis, English grain aphid, *Sitobion avenae* and rose grain aphid, *Metopolophium dirhodum* Walker.

To achieve a sustainable control against aphid in wheat fields, there is a crucial need to encourage the collaboration between wheat breeders and entomologists. These efforts should result in improving wheat genotypes that resist dominant species of aphids. Thus, wheat cultivars resistant to aphis could represent an alternative control technique, which minimizes inputs of chemical control (Xu *et* al 2021) [17].

The objective of the current research was to evaluate the effect of wheat sowing dates on susceptibility of wheat entries to infestation by cereal aphids.

Materials and Methods

The current investigation was carried out at the experimental farm of Wheat Program, Sakha Agricultural Research Station, Kafr El-Sheik Governorate, Egypt, to evaluate the susceptibility of 15 wheat entries (Table 2) under four sowing dates as related to climate changes during 2021/2022 and 2022/2023 wheat seasons.

Land preparation and fertilization

The experimental area was prepared ass recommended, and provided with phosphorous and potassium elements at the recommended doses. Nitrogen fertilizer was applied as 75 N units in three equal splits; the first at wheat sowing, the second one month later, and the third dose was applied one month later.

Experimental design

The experiment was conducted in a spilt-plot design, with three replicates. The experimental field was divided into four major plots (main plots) to act as four dates of sowing; November 5th, December 5th, January 4th, and February 3rd, and the 15 entries were allocated in the sup plots, with 10.5 m^2 plot area.

Aphid species considered

Wheat infestation by four aphid species was monitored from seedling up to maturity. The considered aphid species were English grain aphid, *Sitobion avenae* (Fabricius), bird cherry-oat aphid, *Rhopalosiphum padi* Linnaeus, green cereal- bug aphid, *Schizaphis graminum* (Rondani) and corn leaf aphid, *Rhopalosiphum maidis* (Fitch)

Aphid infestation assessment

One month after sowing, aphid infestations in the 15 wheat entries were assessed. Form each plot, weekly samples (10 tillers each) were examined visually and number of occurring aphid nymphs and adults were counted in field.

Statistical analysis

All experimental data were statistically analyzed by the "SPSS Statistics" program. Duncan Multiple Range Test (Duncan, 1959) [19] was adopted to compare the different significant means of aphid infestation. Also, correlations were computed between weather factors and aphid infestation

Results

1. Correlations between aphid populations and whether factors

Aphid populations positively correlated with highly significant values with each of maximum and minimum temperature in both seasons of study. Aphid populations correlated significant negatively with maximum humidity in the first season (2021/2022), but these correlations were insignificant negative in the second season (2022/2023). Aphid population had insignificant correlation with wind velocity in the first season, but this correlation was significant positive in the second season. Lastly, the aphid population had insignificant negative correlations with rain in the both seasons.

Table 1: Correlation coefficient values between aphid population and weather factors at wheat fields, Sakha Agricultural Research Station

Item	″r″ value/significance	
	2020/2021 season	2021/2022 season
Aphid population*max. Temp.	1.000**	1.000**
Aphid population*min. Temp.	0.903**	0.955**
Aphid population*max. RH%	-0.533*	-0.211 ns
Aphid population* min. RH%	-0.661*	-0.687*
Aphid population*wind velocity	0.314ns	0.679*
Aphid population*Rain	-0.336 ns	-0.096 ns

**, Correlation is significant at 0.01 probability level
*, Correlation is significant at 0.05 probability level
Ns, non-significant correlation at 0.05 probability level

2. Susceptibility of wheat entries to aphid species infestation

2.1 In 2021/2022 season

Wheat entries exhibited variable reactions to infestation by different aphid species (Table 2).

2.1.1 English grain aphid, *Sitobion avenae* (Fabricius)

The infestation of wheat entries by *S. avenae* ranged between 3.10 and 6.08 nymphs and adults/10 wheat tillers, with a seasonal average of 4.82±0.31 nymphs and adults/10 tillers. Statistical analysis revealed insignificant differences among the 15 wheat entries listed in Table (2). The highest infested entries were Shandaweel1, Sids-12 and Misr-1 that harbored 6.08, 6.07 and 5.92 nymphs and adults/10 tillers, respectively. On the other hand, the lowest infested entries were Giza 168, Sakha 1001 and Sids-14 with 3.10, 3.28 and 3.57 nymphs and adults/10 tillers respectively.

2.1.2 Bird cherry-oat aphid, *Rhopalosiphum padi* Linnaeus

The seasonal mean infestation in wheat entries by *R. padi* was the highest (7.25±0.33 nymphs and adults), with a range of 4.29-11.53 nymphs and adults/10 tillers, compared to the other aphid species.

Table 2: Susceptibility of wheat entries to aphid species, at the experimental farm of Sakha Agricultural Research Station, 2021/2022 season

Entry	No. nymphs and adults/10 tillers				Total/40 tillers
	Sitobion avenae	***Rhopalosiphum padi***	***Shizaphis graminum***	***Rhopalosiphum maidis***	
Misr-1	5.92±2.50 a	11.53±1.64 b	0.18±0.13 a	0.25±0.14 b	17.83±3.76 c
Misr-2	5.01±1.20 a	7.62±1.45 abc	0.41±0.24 a	0.10±0.01 a	13.14±1.43abc
Misr-3	5.24±0.99 a	6.34±0.82 ab	0.36±0.18 a	0.00±0.00 a	11.94±1.03 abc
Sakha-94	5.91±1.58 a	8.06±1.14 abc	0.82±0.45 a	0.02± 0.01 a	14.81±2.61 bc
Sakha-95	5.15±1.17 a	4.55± 0.71 a	0.64±0.34 a	0.28±0.14 b	10.62±1.60 ab
Sakha-1001	3.28±0.86 a	5.61±1.06 ab	0.28±0.17 a	0.00±0.00 a	9.17±1.42 ab
AEM/18#6	3.82±0.96 a	8.85±1.32 bc	0.47±0.30 a	0.00±0.00 a	13.14±1.89abc
FsDiv#42	4.81±0.80 a	7.83±1.59 abc	0.06±0.04 a	0.01±0.01 a	12.71±1.77abc
Giza-168	3.10±0.71 a	4.29±0.75 a	0.74±0.44 a	0.27± 0.16 b	8.40±1.26 a
Giza-171	4.78±1.31 a	7.37±1.32 ab	0.33±0.18 a	0.00±0.00 a	12.48±1.65abc
Gemmeiza-9	4.10±0.77 a	6.54±1.25 ab	0.38±0.20 a	0.04±0.03 a	11.05±1.35 ab
Gemmeiza-12	5.46±1.01 a	9.20±1.45 bc	0.40±0.20 a	0.01± 0.01 a	15.07±1.73 bc
Sids-12	6.07±1.03 a	7.33±1.30 ab	0.69±0.37 a	0.03±0.02 a	14.12±1.23abc
Sids-14	3.57± 0.74 a	5.89±0.97 ab	0.32±0.20 a	0.01±0.01 a	9.79±1.10ab
Shadaweel-1	6.08±1.33 a	7.81±1.31 abc	0.68±0.35 a	0.04±0.02 a	14.61±1.55 bc
Mean ± Std. Error	4.82±0.31 b	7.25± 0.33 b	0.45±0.07 a	0.06±0.09 a	12.59±0.49

There are no significant differences between means with the same letters in the same column, According to Duncan's Multiple Range Test at 0.05 probability level.

The highest susceptible entries to *R. padi* were Misr-1, Gemmeiza-12, AEM/18#6 and Sakha-94, having 11.53, 9.20, 8.85 and 8.06 nymphs and adults/10 wheat tillers, respectively. In contrast, the least infested entries were Giza 168, Sakha-95, Sakha-1001 and Sids-14, harbouring 4.29, 4.55, 5.61 and 5.89 nymphs and adults/10 tillers, respectively.

Statistical analysis proved that the differences in aphid infestation among the 15 entries are highly significant.

2.1.3 Green cereal-bug aphid, *Schizaphis graminum* Rondani

All tested entries were infested with very low numbers of *S. graminum*, as the seasonal average was 0.45±0.07 nymphs and adults/10 wheat tillers

2.1.4 Corn leaf aphid, *Rhopalosiphum maidis* Fitch

This aphid species was rarely infested the wheat cultivars as the seasonal average was only 0.06±0.09/10 tillers.

From the abovementioned results, it could be concluded that *Sitobion avenae* and *Rhopalosiphum padi* had considerable aphid infestation, while *Shizaphis graminum* and *Rhopalosiphum maidis* rarely infested wheat plants.

2.1.5 Total aphid infestation

Total aphid infestations were calculated, regardless of aphid species, to find out the general trend of entry susceptibility. The highest infested entries were Misr-1, Gemmeiza-12, Sakha-94 and Sidis12 which had a total of 17.83, 15.07, 14.81 and 14.12 nymphs and adults/40 wheat tillers, respectively. As for the least infested entries; Giza 168, Sakha-1001, Sidis14 and Sakha-95 harboured only 8.40, 9.17, 9.79 and 10.62 nymphs and adults/40 tillers, respectively.

2.2 In 2021/2022 season

2.2.1 *Sitobion avenae, Shizaphis graminum* and *Rhopalosiphum maids*

These three aphid species induced very low infestation whatever the evaluated entry (Table 2). Seasonal averages of infestation were 0.58±0.07, 0.11±0.02 and 0.13±0.03 individuals for the abovementioned species, respectively.

2.2.2 *Rhopalospium padi*

Relatively higher infestation, in tested entries by this aphid species, was found compared to the abovementioned aphid species. The highest infested entries were FsDIV#42 (3.64 nymphs and adults/10 tillers) followed by Sids-14 (3.63), Giza 171 (3.55) and then, Sakha-1001 (3.20 individuals/10 wheat tillers). The least infested entries were Sakha 95 and Misr-2 that had 1.55 and 1.98 nymphs and adults/10 tillers. The seasonal average was 2.74±0.18 individuals/10 wheat tillers.

2.2.3 Total aphid infestation

Regardless of aphid species, the differences among entries were few ranging between 2.40 (Sakha-95) and 5.52 individuals/40 tillers (Sakha-94)

3. Effect of wheat sowing date on aphid infestation

3.1 First season (2020/2021)

Sowing date of wheat entries affected significantly the infestation by aphids (Table 3).

Regardless of entries, the first plantation (sown on Nov. 5th) had the highest average infestation (15.64 nymphs and adults/10 tillers) followed by the Dec. 5th plantation (13.93) and Jan. 4th (13.26), while Feb. 3rd plantation was least infested (7.70 nymphs and adults/10 tillers). Infestations of entries, as affected by the sowing dates were considered (Table 3).

Table 2: Susceptibility of wheat entries to aphid species, at the experimental farm of Sakha Agricultural Research Station, 2021/2022 season

Entry	No. nymphs and adults/10 tillers				Total/40 tillers
	Sitobion avenae	*Rhopalosiphum padi*	*Shizaphis graminum*	*Rhopalosiphum maidis*	
Misr-1	0.49±0.29 a	2.71±0.79 ab	0.07±0.06 a	0.08±0.5 a	3.46±0.91 a
Misr-2	0.40±0.17 a	1.98±0.52 ab	0.05±0.02 a	0.06±0.03 a	3.99±0.61 a
Misr-3	1.11±0.53 a	2.41±0.43 ab	0.19±0.14 a	0.09±0.08 a	4.47±0.67 a
Sakha-94	0.56±0.28 a	3.01±0.95 ab	0.30±0.14 a	0.11±0.09 a	5.52±1.25 a
Sakha-95	0.50±0.19 a	1.55±0.46 a	0.04±0.04 a	0.18±0.09 a	2.40±0.51 a
Sakha-1001	0.39±0.14 a	3.20±0.73 ab	0.25±0.19 a	0.11±0.06 a	4.19±0.81 a
AEM/18#6	0.62±0.16 a	2.94±0.83 ab	0.09±0.05 a	0.60±0.36 b	4.25±1.02 a
FsDiv#42	0.71±0.24 a	3.64±0.73 ab	0.11±0.11 a	0.07±0.04 a	4.58±0.86 a
Giza-168	0.47±0.23 a	2.25±0.83 ab	0.03±0.03 a	0.09±0.05 a	3.32±0.84 a
Giza-171	0.27±0.08 a	3.55±0.90 ab	0.01±0.01 a	0.04±0.02 a	4.56±0.94 a
Gemmeiza-9	0.46±0.20 a	2.61±0.67 ab	0.10±0.10 a	0.23±0.12 a	3.93±0.69 a
Gemmeiza-12	0.19±0.07 a	3.37±0.59 ab	0.13±0.12 a	0.02±0.02 a	4.58±0.60 a
Sids-12	1.03±0.55 a	2.17±0.52 ab	0.07±0.05 a	0.14±0.08 a	4.07±0.68 a
Sids-14	0.48±0.16 a	3.63±0.77 b	0.11±0.11 a	0.08±0.05 a	5.75±0.72 a
Shadaweel-1	0.95±0.29 a	2.01±0.48 ab	0.06±0.03 a	0.12±0.07 a	4.54±0.57 a
Mean ± Std. Error	0.58±0.07 a	2.74±0.18 b	0.11±0.02 a	0.13±0.03 a	4.24±0.21 a

There are no significant differences between means with the same letters in the same column, According to Duncan's Multiple Range Test at 0.05 probability level.

Table 3: Infestation of wheat entries by aphid species as influenced by sowing date, at the experimental farm of Sakha Agricultural Research Station, 2020/2021 season

Entry	No. nymphs and adults/10 tillers			
	Nov. 5th	Dec. 5th	Jan. 4th	Feb. 3rd
Misr-1	19.94±5.89 ab	30.81±10.70 b	13.31±2.67 abcd	7.28±1.28 abc
Misr-2	14.42±4.90 ab	11.36±0.70 a	17.28±0.85 cd	9.11±0.96 bc
Misr-3	14.37±2.33 ab	10.94±1.97 a	13.83±1.70 abcd	8.61±0.47 abc
Sakha-94	25.00±6.10 b	14.83±3.17 a	13.14±0.95 abcd	6.31±0.24 abc
Sakha-95	18.30±0.66 ab	11.25±2.20 a	8.30±0.51 ab	4.64±0.69 a
Sakha-1001	12.27±4.26 a	10.36±3.61 a	6.80±1.14 a	7.25±1.39 bc
AEM/18#6	14.02±3.20 ab	20.22±3.85 ab	10.11±3.19 abc	8.25±1.25 abc
FsDiv#42	9.28±2.27 a	13.58±1.18 a	18.81±5.23 d	9.14±1.84 bc
Giza-168	12.89±2.39 a	8.33±2.22 a	8.18±1.95 ab	4.18±1.14 a
Giza-171	18.28±0.29 ab	12.72±4.40 a	13.14±1.11 abcd	5.81±0.16 ab
Gemmeiza-9	9.60±1.80 a	12.03±.41 a	12.83±1.72 abcd	9.75±0.87 bc
Gemmeiza-12	20.12±4.99 ab	15.11±0.57 a	15.53±2.91 bcd	9.53±1.93 bc
Sids-12	16.27±2.78 ab	12.81±2.17 a	16.87±2.13 cd	10.57±1.68 c
Sids-14	10.29±0.42 a	10.53±1.18 a	12.72±1.94 abcd	5.58±2.77 ab
Shadaweel-1	16.85±1.53 ab	14.08±5.04 a	18.06±1.72 d	9.45±0.29 bc
Mean ± Std. Error	15.46±0.10 b	13.93±1.17 b	13.26±0.73 b	7.70±0.41 a

There are no significant differences between the means with the same litters in the same column, According to Duncan's Multiple Range Test at 0.05 probability level.

In the first plantation, Sakha 94 and Gemmeiza-12 had the highest aphid infestations; 25.00 and 20.12 individuals/10 tillers, respectively. In the second plantation, the highest infested entries were Misr-1 and AEM/18#; 30.81and 20.22 nymphs and adults, respectively, while the least infested entries were Giza 168 and Sakha 1001 (8.33 and 10.36 individuals/10 tillers, respectively.

In the third plantation, the highest infested entries were FsDiv#42 and Shandweel1 with 18.81 and 18.06, respectively, while, the lowest were Sakha 1001 and Giza-168 with 6.80 and 8.18 nymphs and adults, respectively.

In the fourth plantation, the highest infested entries were Sids-12 and Gemmeiza-9 entries with 10.57 and 9.75 individuals/10 tillers, respectively. However, the least infested entries were Giza-168 and Sakha-95 with 4.18 and 4.64 individuals/10 tillers, respectively.

The abovementioned results show that the highest and lowest infested entries were not the same in each plantation which indicates that the evaluated wheat entries performed differently according to the date of sowing.

3.2 Second season (2021/2022)

The highest infested plantation was the latest one, sown on Feb.3th followed by Jan., Dec. and Nov. plantations, with seasonal averages of 5.31, 4.07, 3.24 and 2.01 individuals, respectively (Table 4)

The reactions of evaluated entries as influenced by sowing were considered.

In the first plantation, the highest infested entries were Gemmeiza-12 (4.72), while the lowest infested were Giza 168, Misr-1, Misr-2, Sakha-94, Sakha 95 and Sakha-1001 with 0.81, 0.81, 0.93, 1.33, 1.11 and 1.81 individuals/10 tillers.

In the second plantation, the highest infested entries were Misr-1 (30.81) and AEM/18#6 (20.22), while the lowest were Giza 168 and Sids-14 with 8.33 and 10.53 individuals/10 tillers, respectively. In the third plantation, the highest infested entries were Sakha 94 (8.03) and Misr-3 (6.63), while the lowest ones were Sakha-95 and Giza 171 (2.46 individuals/10 tillers).

Table 4: Infestation of wheat entries by aphid species as influenced by sowing date, at the experimental farm of Sakha Agricultural Research Station, 2022/2023 season

Entry	No. nymphs and adults/10 tillers			
	Nov. 5th	Dec. 5th	Jan. 4th	Feb. 3rd
Misr-1	0.81±0.24 a	30.81±10.70 b	3.51±1.99 a	6.76±1.69 a
Misr-2	0.93±0.26 a	11.36±0.70 a	2.48±0.67 a	5.24±1.33 a
Misr-3	1.99±0.28 ab	10.94±1.97 a	6.63±0.93 a	4.86±0.54 a
Sakha-94	1.33±0.45 a	14.83±3.17 a	8.03±4.10 a	5.28±0.87 a
Sakha-95	1.11±0.26 a	11.25±2.20 a	2.46±1.21 a	4.09±1.09 a
Sakha-1001	1.81±0.46 **a**	10.36±3.61 a	3.34±1.22 a	7.19±0.62 a
AEM/18#6	2.08±0.81 ab	20.22±3.85 ab	3.50±0.35 a	7.22±1.93 a
FsDiv#42	2.37±1.44 ab	13.58±1.18 a	5.70±2.27 a	6.29±1.74 a
Giza-168	0.81±0.24 a	8.33±2.22 a	4.27±3.20 a	4.34±0.73 a
Giza-171	2.29±1.07 ab	12.72±4.40 a	2.46±0.58 a	6.89±1.57 a
Gemmeiza-9	2.09±0.98 ab	12.03±5.41 a	3.73±1.26 a	4.19±1.42 a
Gemmeiza-12	4.72±0.84 b	15.11±.57 a	2.82±1.25 a	3.95±0.33 a
Sids-12	1.96±0.91 ab	12.81±2.17 a	4.94±2.16 a	4.27±0.75 a
Sids-14	3.44±1.87 ab	10.53±1.18 a	3.03±0.50 a	5.91±0.81 a
Shadaweel-1	2.36±0.69 ab	14.08±5.04 a	4.18±1.30 a	3.14±1.11 a
Mean ± Std. Error	2.01±0.24 a	3.24±0.47 b	4.07±0.46 b	5.31±0.32 c

There are no significant differences between the means with the same letters in the same column, According to Duncan's Multiple Range Test at 0.05 probability level.

In the fourth plantation, the highest infested entries were AEM/18#6 and Sakha 1001 (7.22 and 7.19 individuals/10 tillers), while the least infested were Shandaweel 1 and Gemmeiza-12 with values 3.14 and 3.95 nymphs and adults/10 tillers, respectively.

Discussion

In the current study**,** aphid population positively correlated with highly significant values with each of maximum and minimum temperature in both seasons of study. Aphid populations correlated negatively with relative humidity. Also, the aphid population had insignificant negative correlations with rain in the both seasons. This result does not agree with that of Williscotte (2019) [16] who reported that the life history of English grain aphid *S. avenae* correlated negatively with temperature raise and CO_2 concentration.

Cereal aphid biology, survival, development, behavior, beginning of infestation, reproduction, abundance, phenology, cultivars resistance and their natural enemies are affected by climatic factors like; temperature and relative humidity (Wang *et al.*, 2022) [15].

In the current study, four aphid species were found attacking wheat plantations at the experimental farm of Sakha Agricultural Research Station, Kafr El-sheikh Governorate. These aphid species are: *Rhopalosiphum padi, R. maids, Schizaphis gramium* and *Sitobion avenae. R. padi* was the dominant and species, followed by *Sitobion avenae, S.graminam* and *R. maids.* El-Henidy (1998) [8] recorded the same four species on wheat plantations at middle and upper -Egypt. Awadalla *et al* (2018) [4] surveyed the four abovementioned aphid species in addition to *Diuraphis noxia*

As for the variety susceptibility to aphids, the sitting results proved that the highest susceptible entries were Misr-1, Sakha-94, Gemmeiza-12, Shandaweel-1 and Sids12 (out of 15 wheat entries evaluated to four aphid infestation). The highest resistant genotypes were Giza-168, Sids-14, Sakha-1001 and Sakha-95. However, Studies of El-Rawy (2013) [9] revealed that Misr-3, Giza-168 and Gemmieza had high aphid infestation, while Giza-9 performed as resistant. El-Desouky *et al* (2022) [20] attributed the susceptibility of Misr-3 to the high wheat leaf contents of protein and phenols, and the resistance of Misr-1 was attributed to the low contents of both components. However, the variations in degrees of reactions of different genotypes to the aphid species may due to variable environmental conditions, severity of aphid infestation and to the dominant aphid species. Xu *et al* (2021) [17] explained the mechanism of wheat resistance to aphid, indicating that the resistant varieties had a higher capability to keep more enzyme activities and synthesizing greater amounts of phenols and tannins than wheat varieties susceptible to aphids.

In this investigation wheat sowing wheat date significantly affected the degree of aphid infestation. In the first season (2020/2021), the wheat sown on January 4th suffered the highest aphid infestation (16.27±2.13 nymphs and adults/10 tillers, followed by that sown on November 5th, (16.27±2.78), and by that sown on December 5th, (12.81±2.17), while wheat sown on February 3rd had the least infestation (10.57±1.68 nymphs and adults/10 tillers). In the second season (2021/2022), the trend of infestation, due to sowing date, was relatively different. The highest infestation (5.31±0.32) was recorded in the latest sown wheat (February 3rd), followed by that sown on January 4th (4.07±0.46), December 5th (3.24±0.47), and then the earliest sown wheat (November 5th), with 2.01±0.24 nymphs and adults/10 tillers.

Some authors studied the effect of wheat sowing date on the yield losses. Abdel-Rahman and Mohamed (2007) [21] assessed the wheat yield losses caused by aphids due to sowing dates. Wheat sown on November 1th had the least yield losses (15.07%), followed by that sown on mid-November, while wheat sown latest suffered the highest yield reduction (21.96%). Similar results were obtained by Helmi and Rashwan (2013) [11], as they estimated the highest aphid infestation in wheat sown latest, (December 1st) compared to that sown on October 1st, October 16th, October 31st or November 15th.

In general, aphid population densities greatly decreased in the last few years, from 2014 by Abdel-Aziz to 2018 by Awadalla *et al.*, [4] while the population densities in the current study revealed sharp reduction in aphid population densities on all wheat entries, that may be attributed to dramatic changes in weather parameters.

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