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Role of Free and Bound Phenols with Certain Field Factors in the Population Density of Aphid Species and Onion Thrips Attacking Bread Wheat Cultivars under Drought Conditions

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ABSTRACT

The experiment of five of bread wheat cultivars (Sahel 1, Seds 4, Gemaza 9, Giza 168, and Misr 2) were investigated during (2015- 2016 and 2016- 2017) at the farm of Faculty of Agriculture, Assiut University, Assiut, Egypt. The considered field factors were represented in the climatic factors of daily maximum and minimum temperatures (°C), soil temperatures at 5 cm depth (°C), and the prevailed natural enemies with an estimation of phenolic contents (free and bound phenols) in the selected wheat cultivars. To investigate the efficiency of all considered factors together and each factor separately on the population fluctuation of onion thrips, *Thrips tabaci* Lindeman and aphid species (*Mayzus persicae* Sulz., *Brivecoryne brassicae* Linnaeus, and *Rhopalosiphum padi* Linnaeus) on the selected wheat cultivars under drought and field conditions in relation to the yields of cultivars. The mean numbers of thrips were higher than aphid species on most of the selected cultivars during the two studies seasons. The individuals of both insect pests were observed in the 15th of February, 2015 for the 1st season, while in the second season the infestations started in the 15th of January, 2016 on all of cultivars. The 1st season peaks by aphids were showed from the 15th of March to the 30th of April, 2016 on all cultivars, while two peaks of thrips population were observed on Sahel 1 and Seds 4, and three outbreaks on the rest of cultivars. The number of the peaks during the 2nd season by aphids and thrips were reached to two peaks for each pest during the 28th of April and the 15th of March, 2016. The efficiency (R^2 x100) of all experimental considered factors were (72.98, 64.07, and 80.03%; respectively for aphids, thrips, and pests total grand). The considered factors were regulated the populations of pests during the studied seasons according to their efficiency in the following order for aphids: the natural enemies, the min. temperatures, the soil minimum temperatures were mainly participated with (20.847, 15.003, and 11.265 out of 72.98%; respectively for on all the cultivars), while The bound phenols were the least efficient factor (0.994 out of 72.98%). For thrips and the pests grand totals, the soil minimum temperature, the maximum temperature, and the minimum temperature were affected the population density by (22.099, 27.757; 12.914, 20.473; and 9.053, 11.377 out of 64.07 and 77.76%; respectively for thrips and the grand totals of pests) and the least efficient factor for thrips was free phenol contents (0.655 out of 77.76%, r= -1.082), and for the grand totals of pests were the natural enemies (0.169 out of 77.76%, r= 0.633). In both seasons, the greatest yield were obtained from from Giza 186 (178.33 and162.39 GY/10 plants; respectively in the 1st and the 2nd season). Meanwhile, the lowest one was recorded from Gemaza 9 (81.66 and 95.13 GY/10 plants; respectively in the 1st and the 2nd season).

Keywords: Drought condition, Free and bound phenols, Wheat aphids, Onion thrips, cultivar susceptibility

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a daily consumed cereal crops in all the world and contribute with 20% of world food calories and 13% of protein for 40% of the population around the world (Ahmad and Shaikh, 2003 & Istvan, 2006).

The major problems facing wheat plants are the insect pests which target its growth stages such as aphids species and onion thrips, causing an obvious reduction in the cereal yield presented as a direct loss reached up to 35 - 40%, and the indirect loss arranger between 20- 80% (Rossing *et al.*, 1994). Additionally, thrips is considered a difficult pest to control according to its behaviour during escaping from high temperatures by hiding in flowers and folded leaves where insecticides could not be reachable in such parts (Palumbo, 2000). In the regard of wheat problems, is the wide spread use of insecticides to control such insect pests, which finally affect the safety levels for consumers and the insecticides residuals in wheat (FAO, 2011).

Naturally, plants are exposed to grow under certain environmental stress factors such as insect pests infestations, unexpected changeable in the weather and soil maximum & minimum temperature degrees, and drought condition. The chemical defence system during lifetime such as phenolic contents and tannins which play an important role against the invasion of insects and herbivores attacks is still poorly understood (Marta and Sarah, 2011; Harborne, 1991; Appel, 1993). In this regard, many researchers have been described phenolics as antifeedant (Wrubel and Bernays, 1990) digestibility decreases (Martin *et al*., 1987), and toxins (Steinly and Berenbaum, 1985). These phenolic compounds delivery and provide an excellent plant protection defence system against insects (Ashok and Upadhyaya, 2012).

The aim of the study is to investigate the impacts of phenolic contents (free and bound phenols), plant age, the climatic and soil (at 5 cm depth from soil surface) maximum and minimum temperatures in Celsius degrees, and the natural enemies on the population abundance of various aphid species (*Mayzus persicae* Sulz., *Brivecoryne brassicae* Linnaeus, and *Rhopalosiphum padi* Linnaeus) and onion thrips, *T. tabaci* Lindeman on five of the most planted bread wheat cultivars in upper Egypt: Sahel 1, Seds 4, Gemaza 9, Giza 168, and Misr 2 under drought conditions in relation to their grain yields (GY/10 plants).

MATERIALS AND METHODS

1. The experimental design:

Five of bread wheat cultivars: Sahel 1, Seds 4, Gemaza 9, Giza 168, and Misr 2 were exposed to water stress and shortage of irrigation times during two seasons (2015- 2016 and 2016- 2017) at The farm of Faculty of Agriculture, Assiut University, Assiut, Egypt. Each cultivar was planted in three plots (replicates). The plot size was 3m x 4m and included ten rows (40 plants in each row), with 30 cm spacing the rows, and 30 cm within plants. The totals of 15 replicates under water stress (drought conditions) were kept free from spreading weedicides or pesticides.

2. Determination of seasonal abundance of aphids and thrips:

The random sampling method was weekly conducted in the following consequence to three samples (plants) / replicate /cultivar. The total number of 45 samples/ week were transferred in polyethylene bags and kept in refrigerator at The Lab. of Econom. Entomol. / Plant Protec. Res. centre at the farm of Fac. of Agric., Assiut Univ., Assiut, Egypt to examine the stems, leaves upper, lower surface, and the heads of by binocular. The numbers of mature and immature stages of aphid species and thrips individuals were weekly recorded. The unknown samples of aphid species were maintained on glass slides and identification by Dr. Amal Hamed Ahmed Atta, at Plant Protection Department, Faculty of Agriculture, Assiut University, Assiut, Egypt (Atta, 1989).

3. The climatic and soil temperatures data:

The daily climatic and soil temperatures data were obtained from the meteorological station at the farm of Faculty of Agriculture, Assiut University, Assiut, Egypt.

The daily maximum and minimum temperatures ((DMxT and DMnT) of weather were in (°C degrees) and the maximum and minimum soil temperatures (SMxT and SMnT) in 5 cm depth from the soil surface were in (°C degrees).

4. Estimation of free and bound phenolic levels in wheat cultivars:

The free and cell wall-bound phenols were determined according to Kofalvi and Nassuth (1995). The reagents which used for this purpose were Folin-Ciocalteu's, 50% methanol, 2 N HCL, 0.5 N NaOH and 20% Na_2Co_3.

-The procedure of determination:

The weight of (0.3 g) from the collected fresh leaves was extracted in (10 ml) of methanol (50%) for 90 min. at 80 °C. The centrifuge was adjusted at at 14,000 rpm for 15 min to centrifuge the extraction. For free phenolics determination the supernatant of the Folin-Ciocalteu's phenol reagent was used. The pellet was sponified at room temperature with 2 ml of 0.5 N NaOH for 24 h to extract the bound phenolics, neutralized with 0.5 ml 2 N HCL and centrifuged at 14,000 rpm for 15 min. The assay of the Folin-Ciocalteu supernatant was used for the case of bound phenolics determination. An amount of (100 microliters) of the extracts of methanol and NaOH were diluted to (1 ml) with water and mixed with (0.5 ml) 2 N Folin-Ciocalteu's reagent and 2.5 ml of 20% Na2 Co3. After 20 min. under room temperature, the absorbance of samples was measured at (725 nm) with a unico UV-2100 spectrophotometer. The standard curve prepared with gallic acid was used in determining the phenolic concentration from the extract.

5. Statistical analysis:

The program of ASAP (Advanced Statistical Analysis Package) was used to conduct the multi-regression analyses for both seasons (2016 and 2017) together and not separately between the numbers of aphid species, thrips, the total numbers of pests (sums of aphid species and thrips) with free and bound phenols, climatic factors of daily maximum and minimum temperature (°C), soil temperature in 5 cm depth (°C) and the natural enemies.

RESULTS AND DISCUSSION

1. The population density of Aphids and thrips during (2015/ 2016 and 2016/ 2017):

Data presented in (Table 1; Fig. 1 and 2) showed that the mean numbers of thrips were higher than aphid species on almost of wheat cultivars during the two seasons of the study. The population density of aphid species and onion thrips were (0.0 individuals/ 9 plants/ 3 replicates) on all wheat cultivars during the 17th of December and January, because the plants were not targeted for insect pests attack due to its small sizes in the previous mentioned months. These results are partially in the same line of Hussein (1993) who found that aphid's dynamics were lower during January and February in wheat crop and then increased in March.

The population abundance of aphids and thrips during the first season (2015/ 2016):

The population of both insect pests (Table 1; Fig. 1 and 2) increased slightly and reached to moderate levels of abundance during the 15th and the 29th of February on all of wheat cultivars. These data of our findings are similar to Rustamani *et al*., (1998) who noticed that aphid's infestations appeared during the 3rd week of February on all of studied wheat verities. Afterwards, the peaks of both pests were occurred in the middle and the end of March (15th and 31th) and April (15th and 30th).

Respect to aphid species, three peaks (Table 1; Fig. 1 and 2) were recorded and the highest peaks in numbers of individuals were occurred in the 30th of April (averages 166.7, 201.3, 286.3, and 80.0 individuals/ 9 plants/ 3 replicates; respectively for Sahel 1, Seds 4, Gemaza 9 under free and bound phenol contents 1.3, 0.5; 1.1, 0.7; 0.8, and 0.5 mg/g fresh weight for the same sequences of the mentioned cultivars), while temperatures recorded (Max. temp. 37.2°C, Min temp. 15.4 °C, Soil max. temp. 44.6 °C, and Soil min. temp. 28.6 °C), and for Misr 2 was occurred in 31th of March (84.0 individuals/ 9 plants/ 3 replicates, when phenol content were 0.8 and 0.4; respectively for free and bound phenol), under temperature degrees (Max. temp. 31.6 °C, Min temp. 11 °C, Soil max. temp. 38.6 °C, and Soil min. temp. 18.4 °C). A partial agreement of the obtained results with Ahmad *et al*., (2001) in the role of minimum temperatures, where it offered a favorable and suitable conditions for building up the population of aphids when the minimum temperature reached to 13.7°C. Additionally, these findings of aphids populations results were in the same line of Ajmal *et al*. (2017) who recorded that aphid's peaks were occurred during the 1st week of March (39.97 aphids/tiller) on wheat plantations. In the same regard, there are matched results with ours which emphasized that the numbers of aphid's individuals began to rise in the 16th of March and the population was in highly increased till the 31th of March (Ahmad *et al*., 2016). The obtained results were in the same line of the findings which stated that aphid species populations reached to their outbreak (peak) during the stage of wheat flowering in the middle of March where the population of aphids rapidly built up by Hussein (1993).

For thrips, there were two peaks had been occurred (Table 1; Fig. 1 and 2) on Sahel 1 and Seds 4 during the 31th of March and 15th of April. For Sahel 1, the grandest peak in population density was recorded in the 15th of April for Sahel 1 with mean numbers (222.0 individuals/ 9 plants/ 3 replicates under phenolic contents: 1.4 and 0.5 mg/g fresh weight; respectively for free and bound phenols) (Max. temp. 33.4°C, Min temp. 12.4 °C, Soil max. temp. 45.8 °C, and Soil min. temp. 23.6 °C). However, for Seds 4 the highest peak was registered in the 31th of March with averages (210.0 individuals/ 9 plants/ 3 replicates; respectively, with phenol contents 0.8 and 0.6; respectively for free and bound phenols), when the temperatures were (Max.

temp. 31.6 °C, Min temp. 11 °C, Soil max. temp. 38.6 °C, and Soil min. temp. 18.4 °C). For the rest of the cultivars, three peaks were observed on Gemaza 9, Giza 186, and Misr 2. For Gemaza 9, the highest peak was occurred on in the 31th of March with averages (214.0 individuals/ 9 plants/ 3 replicates; respectively, and the phenol contents were 0.7 and 0.4; respectively for free and bound phenols), when the temperatures were (Max. temp. 31.6 °C, Min temp. 11 °C, Soil max. temp. 38.6 °C, and Soil min. temp. 18.4 °C). For Misr 2, the largest peak was occurred in the 30th of April (averages 264.7 individuals/ 9 plants/ 3 replicates and the phenol contents were 1.0 and 0.4 mg/g fresh weight; respectively for free and bound phenols), (Max. temp. 37.2°C, Min temp. 15.4 °C, Soil max. temp. 44.6 °C, and Soil min. temp. 28.6 °C). These results of thrips are in a partial accordance with Ahmed *et al*. (2015) who stated that *T. tabaci* populations increased and reached to their peaks in April on four different cultivars of *Leucaena leucocephala*, in Merida, Yucatan, Mexico (the same latitude on the sphere).

In the end of the season, both insect pests were gradually decreased in the abundance during 15th of May, 2016 and reached to mean numbers (74.0, 87.0, 195.0, 27.3, and 38.0 individuals/ 9 plants/ 3 replicates for aphids); and for thrips (44.0, 32.3, 44.3, 25.3, and 139.7 individuals/ 9 plants/ 3 replicates, when the temperatures were (Max. temp. 45 °C, Min temp. 24 °C, Soil max. temp. 53.2 °C, and Soil min. temp. 34 °C) where the phenol contents were 1.5, 0.6; 1.0, 0.8; 0.9, 0.5; 4.4, 1.0; 1.0, and 0.4 mg/g fresh weight for free and bound phenole; respective for Sahel 1, Seds 4, Gemaza 9, Giza 186, and Misr 2).

Respect to grand totals of wheat cultivars, the highest grand total of means for aphid species was showed on Gemaza 9 (1246.3 individuals/ season); and the lowest attacked cultivar was Misr 2 with grand total of means (374.7 individuals/ season) (Table: 1). Meanwhile, in the case of thrips the highest fluctuated numbers was occurred on Misr 2 cultivar with grand total number (1148.3 individuals/ season); and the low infested cultivar was Giza 186 with grand total (649.3 individuals/ season).

The highest yield was obtained from Giza 186 (178.33 GY/10 plants), and the lowest one was recorded from Gemaza 9 (81.66 GY/10 plants).

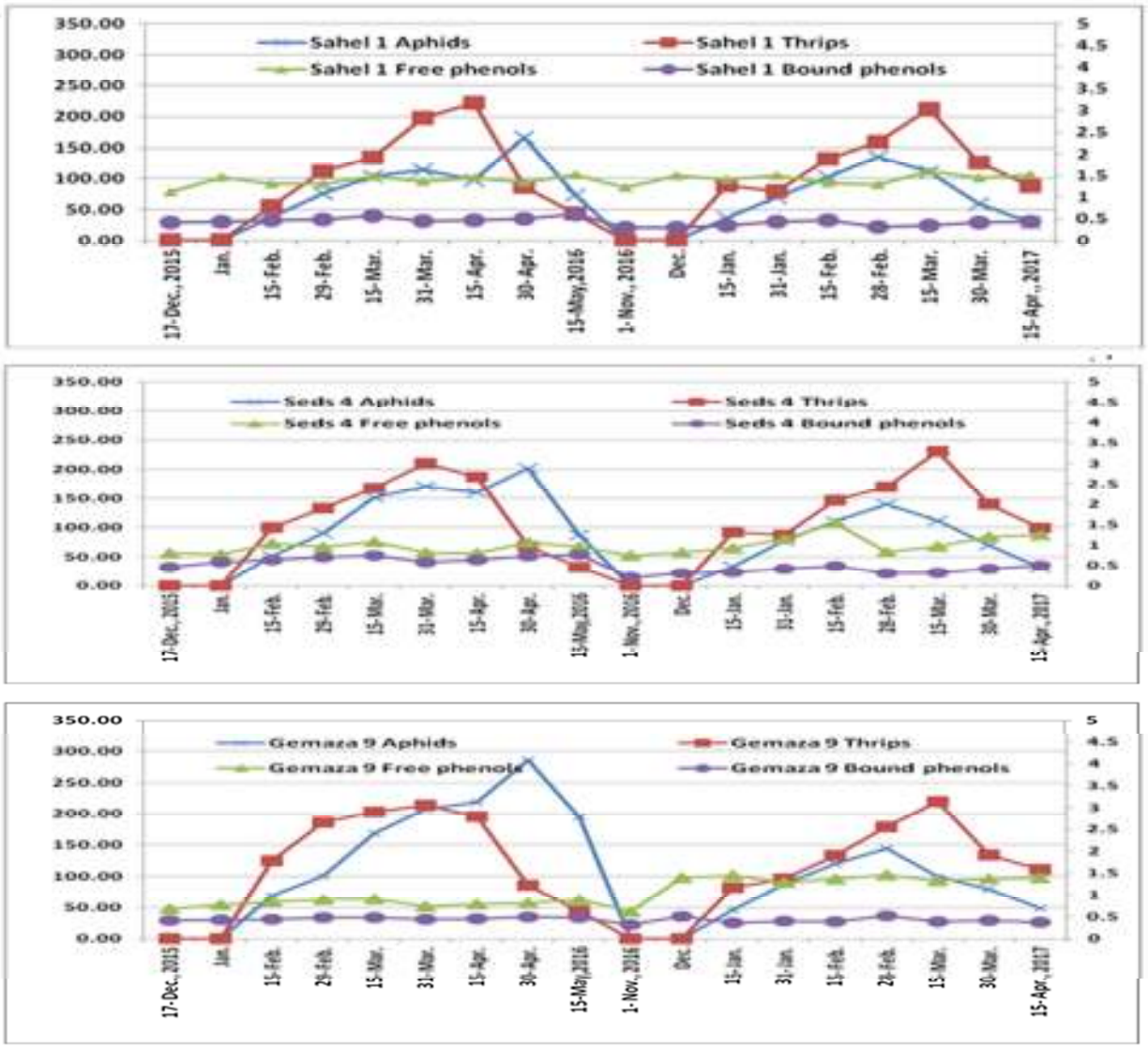

Fig. 1. The fluctuations of aphid species and thrips included free and bound phenols contents under the considered meteorological data in some wheat cultivars during (2015/ 2016 and 2016/ 2017) at the farm of Plant Protection Department, Faculty of Agriculture, Assiut University, Assiut, Egypt under drought condition.

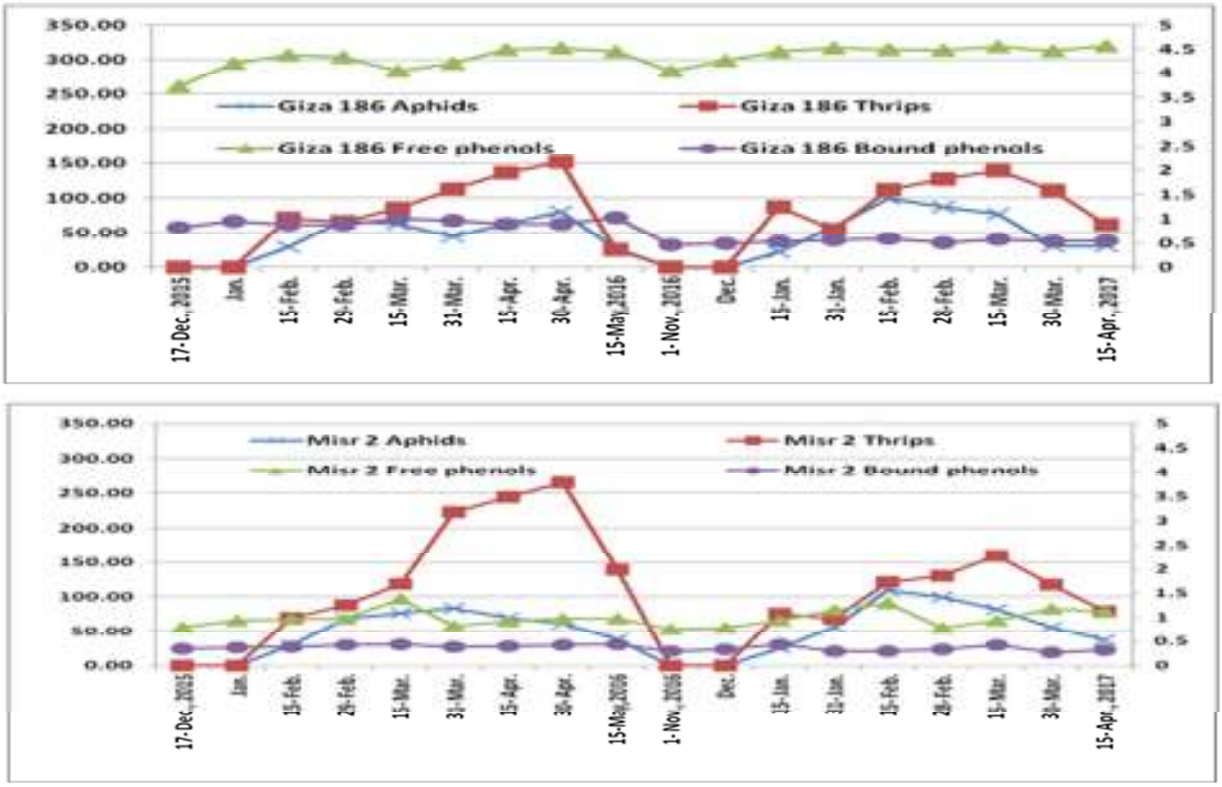

Fig. 2. The fluctuations of aphid species and thrips included free and bound phenols contents under the considered meteorological data in some wheat cultivars during (2015/ 2016 and 2016/ 2017) at the farm of Plant Protection Department, Faculty of Agriculture, Assiut University, Assiut, Egypt under drought condition.

Table 1. Mean numbers of [#]aphid species and onion^ thrips on certain bread *wheat cultivars with reference to their yields (GY/10 plants) under drought and irrigation conditions during (2015/ 2016 and 2016/ 2017) at the farm of Plant Protection Department, Faculty of Agriculture, Assiut University, Assiut, Egypt.

Season	Months	Mean numbers of individuals/ 3 plants/ replicate										Free and bound phenols contents										Temp. in °C			
		Sahel 1		Seds 4		Gemaza 9		Giza 186		Misr 2		Sahel 1		Seds 4		Gemaza 9		Giza 186		Misr 2		Weather °C		Soil T (5 cm)	
		Aph.	*Th.*	*Aph.*	*Th.*	*Aph.*	*Th.*	*Aph.*	*Th.*	*Aph.*	*Th.*	Mx.T	Min.T	Mx.T	Min.T	*F*	*B*	*F*	*B*	*F*	*B*	Mx.T	Min.T	Mx.T	Min.T
First season (2015/ 2016)	17- Dec., 2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.8	0.5	0.7	0.4	3.7	0.8	0.8	0.3	0	0	0	0
	Jan.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.4	0.8	0.6	0.8	0.4	4.2	1.0	0.9	0.4	0	0	0	0
	15- Feb.	38.0	55.3	51.7	99.7	69.0	124.7	29.0	71.0	29.7	69.3	1.3	0.5	1.0	0.6	0.8	0.4	4.4	0.9	1.0	0.4	23.8	8	34	12.2
	29- Feb.	76.0	111.3	90.0	132.7	101.0	186.7	67.7	66.0	68.7	88.0	1.3	0.5	1.0	0.7	0.9	0.5	4.3	0.9	1.0	0.4	32.4	12.2	37.8	16.2
	15- Mar.	103.7	134.0	151.3	168.0	168.7	203.0	62.7	85.7	76.3	119.0	1.5	0.6	1.1	0.7	0.9	0.5	4.0	1.0	1.4	0.4	26.2	13.4	36	19
	31- Mar.	114.0	198.3	171.0	210.0	207.3	214.0	45.0	112.7	84.0	223.0	1.4	0.5	0.8	0.6	0.7	0.4	4.2	1.0	0.8	0.4	31.6	11	38.6	18.4
	15- Apr.	97.7	222.0	160.0	187.3	219.0	196.0	63.0	136.7	69.3	244.7	1.4	0.5	0.8	0.6	0.8	0.5	4.5	0.9	0.9	0.4	33.4	12.4	45.8	23.6
	30- Apr.	166.7	86.3	201.3	67.7	286.3	85.7	80.0	152.0	61.7	264.7	1.3	0.5	1.1	0.7	0.8	0.5	4.5	0.9	1.0	0.4	37.2	15.4	44.6	28.6
	15-May, 2016	74.0	44.0	87.0	32.3	195.0	44.3	27.3	25.3	38.0	139.7	1.5	0.6	1.0	0.8	0.9	0.5	4.4	1.0	1.0	0.4	45	24	53.2	34
	Grand total	670.0	851.3	912.3	897.7	1246.3	1054.3	374.7	649.3	427.7	1148.3	12.3	4.5	8.4	5.8	7.3	4.1	38.2	8.4	8.8	3.5	-----	-----	-----	-----
	Grand mean	74.4	94.6	101.4	99.7	138.5	117.2	41.6	72.2	47.5	127.6	1.4	0.5	0.9	0.6	0.8	0.5	4.2	0.9	1.0	0.4	-----	-----	-----	-----
	The yield	129.66		123.33		81.66		178.33		171.66		-----		-----		-----		-----		-----		-----	-----	-----	-----
Second season (2016/ 2017)	1- Nov., 2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.3	0.7	0.2	0.6	0.3	4.1	0.5	0.8	0.3	0	0	0	0
	Dec.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.3	0.8	0.3	1.4	0.5	4.3	0.5	0.8	0.3	0	0	0	0
	15- Jan.	36.4	88.6	33.5	92.0	45.5	82.0	21.9	87.0	25.7	75.4	1.4	0.3	0.9	0.3	1.5	0.4	4.5	0.5	0.9	0.4	22.6	7.8	28.2	12
	31- Jan.	69.4	79.3	77.9	87.6	87.9	95.9	59.0	55.0	55.9	68.4	1.5	0.4	1.2	0.4	1.3	0.4	4.5	0.6	1.2	0.3	20	3	28.4	8.8
	15- Feb.	102.0	132.7	110.4	146.5	120.2	133.5	100.0	112.0	110.0	121.0	1.3	0.5	1.5	0.5	1.4	0.4	4.5	0.6	1.3	0.3	19.2	4.6	34	12.2
	28- Feb.	135.6	159.5	139.8	169.7	144.3	178.5	87.9	127.0	99.8	130.0	1.3	0.3	0.8	0.3	1.5	0.5	4.5	0.5	0.8	0.3	28.8	7.6	36.6	16
	15- Mar.	110.3	212.7	111.5	230.7	99.5	219.5	77.8	139.0	82.3	160.3	1.6	0.3	1.0	0.3	1.3	0.4	4.6	0.6	0.9	0.4	26.4	9.8	36	19
	30- Mar.	59.6	125.9	69.8	140.0	79.0	134.4	30.7	111.0	55.5	118.0	1.4	0.4	1.2	0.4	1.4	0.4	4.5	0.5	1.2	0.3	31	14.8	37.6	17.8
	15- Apr., 2017	29.4	87.4	31.5	99.5	49.0	111.2	30.0	62.4	36.8	79.5	1.5	0.4	1.3	0.5	1.4	0.4	4.6	0.6	1.1	0.3	28.6	10	45.8	23.6
	Grand total	542.7	885.9	574.3	965.8	625.4	955.0	407.3	693.4	466.0	752.6	12.8	3.4	9.4	3.2	11.8	3.7	40.1	4.9	9	2.9	-----	-----	-----	-----
	Grand mean	60.3	98.4	63.8	107.3	69.5	106.1	45.3	77.0	51.8	83.6	1.4	0.4	1.0	0.4	1.3	0.4	4.5	0.5	1.0	0.3	-----	-----	-----	-----
	The yield	138.25		128.7		95.13		162.39		160.29		-----		-----		-----		-----		-----		-----	-----	-----	-----

[#]= *Mayzus persicae*, *Brivecoryne brassicae*, and *Rhopalosiphum padi* ^= *Thrips tabaci* lindeman Aph.= Aphid Th.= Thrips

*= Sahel 1, Seds 4, Gemaza 9, Giza 168, and Misr 2 F= Free phenol B= Bound phenol

The population abundance of aphids and thrips during the second season (2016/ 2017):

In the beginning of the season, the fluctuations of aphids and thrips (Table: 1; Fig. 1 and 2) begins with slight fluctuations for both pests in the 15th of January, and the moderate levels of fluctuations were recorded in 31th of January on all of wheat cultivars. These results are similar to (Ibrahim, 2010) who stated that the population of *T. tabaci*, was in low numbers of individuals in onion plantations

For Aphids, two peaks were recorded on all wheat cultivars. On sahel 1 and Seds 4 the peaks were registered in the 28th of February and 15th of March with mean numbers (135.6, 110.3; 139.8, and 111.5 individuals/ 9 plants/ 3 replicates; respectively for Sahel 1 and Seds 4) under temperatures degrees (Max. temp. 28.8 °C, Min temp. 7.6 °C, Soil max. temp. 36.6 °C, Soil min. temp. 16 °C during the 28th of February, and in the 15th of March were temperatures reached (Max. temp. 26.4 °C, Min temp. 9.8 °C, Soil max. temp. 36 °C, Soil min. temp. 19 °C) under phenol contents 1.3, 0.3; 0.8, 0.3; 1.5, 0.5; 4.5, 0.5; 0.8, and 0.3 mg/g fresh weight; in the 28th of February; and in the 15th of March were 1.6, 0.3; 1.0, 0.3; 1.3, 0.4; 4.6, 0.6; 0.9, and 0.4 mg/g fresh weight; respective for free and bound phenole in Sahel 1and Seds 4). However, for the rest of cultivars Gemaza 9, Giza 186, and Misr 2 their two peaks were occurred in the 15th and 28th of February with averages (120.2, 144.3; 100.0, 87.9; 110.0, and 99.8 individuals/ 9 plants/ 3 replicates; respectively for Gemaza 9, Giza 186, Misr 2, when the temperatures of the considered factors were (Max. temp. 19.2 °C, Min temp. 4.6 °C, Soil max. temp. 34 °C, Soil min. temp. 12.2 °C, in 15th of February, and Max. temp. 28.8 °C, Min temp. 7.6 °C, Soil max. temp. 36.6 °C, Soil min. temp. 16 °C in the 28th of February) under the respect order of free and bound phenol contents as following (1.4, 0.4; 4.5, 0.6; 1.3, and 0.3 mg/g fresh weight in 15th of February, and 1.5, 0.5; 4.5, 0.5; 0.8, and 0.3 mg/g fresh weight in the 28th of February). The obtained results were confirmed by the findings of (Aslam *et al*., 2004), where the populations of aphids begin in appearance in the 3rd week of January. Likewise, the obtained results of the peaks in February are totally in agreement with the results of (Ahmad *et al*., 2015), where the maximum densities of aphids/ leaf on wheat were occurred in February. Respect to our observation of the peaks in March, the same results of were noticed in the 2nd week of March by Aslam *et al*., (2004) on different verities/ lines of wheat. Afterwards, the decline of aphids individuals in April on all wheat cultivars were confirmed by the findings of (Aslam *et al*., 2004).

On the other hand, the individuals of thrips recorded all of their peaks in 28th of February and 15th of March (with averages 159.5, 212.7; 169.7, 230.7; 178.5, 219.5; 127.0, 139.0; 130.0, and 160.3 individuals/ 9 plants/ 3 replicates; respectively for Sahel 1, Seds 4, Gemaza 9, Giza 186, and Misr 2). These results were confirmed by Ibrahim, (2010) as he recorded two peaks of the population of onion thrips, one in the 11th of February and the 2nd peak was registered in the 11th of March with averages 80 thrips/plant in the 1st season and 280 thrips/ plant for the 2nd season. In the end of the season, the populations of both pests were sharply decreased in the 30th of March and 15th of April, 2017. This reduction in the fluctuations of both pests in the end of the season could be occurred due to the changes in wheat cultivars where the color of the plants became yellow with hard appearance in the last growth stages of wheat to attract or shelter aphids or thrips, as both prefer green and juicy plants for feeding and complete life cycle.

The highest grand total of aphids, had been recorded on Gemaza 9 (625.4 individuals/season); and Giza 186 was the lowest (407.3 individuals/season). Meanwhile, thrips individuals recorded the highest grand total on Seds 4 cultivar and the grand total of number (965.8 individuals/season); and the lowest one was Misr 2 with grand total (752.6 individuals/season). The highest yield was resulted from Giza 186 (162.39 GY/10 plants), and the lowest cultivar was Gemaza 9 (95.13 GY/10 plants). The differences between the cultivars in the infestation degrees of both pest's individuals and their yield may be returned to ceratin variations of cultivar characteristics. These results were stated by Metcalf and William (1975).

The efficiencies of considered factors on pest's fluctuations during (2015/16 and 2016/17):

The results obtained in **(**Table: 2) showed that all selected factors of the experiment were responsible together (R^2) for regulating the populations as following: 72.98, 64.07, 77.76 %; respectively for aphids, thrips, and the grand totals of pests (The sums of aphid species and thrips). These results explained that aphids individuals were more sensitive to the selected factors than thrips individuals, because aphids populations were deterred by (72.98 %), while thrips populations affected with (64.07 %). This could be occurred because the individuals of thrips were obviously active and fast moving than aphid individuals, which enables thrips to escape from high temperatures to shelter in the folded leaves than the individuals of aphid species.

The efficiencies of considered factors on aphids during (2015/16 and 2016/17):

The considered factors participated with an efficiency of 72.98% in arranging the population density (Table: 2). The populations density of aphids were consequently regulated by the following order of the selected factors according to their efficiency: the sums of the natural enemies, minimum temperature, and soil minimum temperatures. Meanwhile, the bound phenols content recorded the least efficient factor. The natural enemies was the main responsible factor and participated with (20.847 out of 72.98%) in regulating the populations. These results are in agreement with Burkman and Gardiner, (2014) whom stated that natural enemie's agents are vital for bio-control services in controlling aphids in greenspaces. In this regard, there was a study stated that natural enemies provide general reduction and fragmentation on aphid's population in greenspace (Rocha, 2017). Afterwards, the min.

temperatures ranked the second efficient factor in regulating the numbers by participating with 15.003 out of 72.98%. In the same regard, there were similar results stated that minimum temperatures showed significant and positive correlation (r= 0.646) on the density of aphid individuals with an increasing tendency (R^2 = 0.4176) by (Nasir and Ahmad 2001; Wains, 2010). Then, the soil minimum temperatures were the third efficient factor (11.265 out of 72.98%). The bound phenol amounts were the least efficient factor on the density of the population (0.994 out of 72.98%).

Table 2. Multiple correlation analysis between the considered independent variables and the changes in the population density of # aphids species and ^onion thrips on various » wheat cultivars under drought conditions during (2015/16- 2016/17) at the farm of Plant Protection Department,

Cv.	Treatment	*Drought Condition*								
	Variable removed	*Aphids*			*Thrips*			*Grand total (Aphids + Thrips)*		
		r	$R^2 \times 100$	*Efficiency*	*r*	$R^2 \times 100$	*Efficiency*	*r*	$R^2 \times 100$	*Efficiency*
*Sahel 1, Seds 4, Gemaza 9, Giza 168, and Misr 2	None	------	72.98	------	------	64.07	------	------	77.76	------
	Plant age	0.712	70.71	7.806	0.461	74.44	5.737	0.718	78.57	9.814
	Free phenols	- 0.114	72.69	1.958	- 1.082	75.03	0.655	-6.281	79.75	1.879
	Bound phenols	0.113	73.23	0.994	- 1.228	74.92	1.621	0.031	79.69	3.619
	N.E.	0.713	66.30	20.847	0.793	73.81	8.499	0.633	0.008	0.169
	Max. Temp.	0.7117	71.99	4.019	0.606	73.59	12.914	0.526	76.99	20.473
	Min. Temp.	0.602	68.28	15.003	0.379	74.05	9.053	0.635	78.34	11.377
	Soil Max. Tem	0.716	69.6	11.085	0.645	74.70	3.487	0.746	79.63	2.670
	Soil Min.Temp.	0.711	69.54	11.265	0.460	72.51	22.099	0.825	75.91	27.757

 # = *Mayzus persicae*, *Brivecoryne brassicae*, and *Rhopalosiphum padi* ^ = *Thrips tabaci* lindeman N.E= Natural enemies
Min.Temp. = Minimum Temperature; Max. Temp. = Maximum Temperatur » = Sahel 1, Seds 4, Gemaza 9, Giza 168, and Misr 2 Significant at > 0.001 level of probability r = Simple correlation coefficient R^2 = Coefficient of determination.

The efficiencies of considered factors on thrips and the grand total of pests during the seasons of the study (2015/16 and 2016/17):

There were some similarities in the efficient among the considered factors (Table: 2) affecting the populations of thrips and its sums with aphids (total numbers of all pests) on all wheat cultivars. The reason behind these similarities between the factors could be existed due to the obvious highly numbers of thrips compared with aphids individuals, the thing which makes the thrips and its sums with aphids the same. In this regard, the population density of both were highly under controlled with soil minimum temperatures, the minimum temperatures, and the maximum temperatures; respectively. However, the least efficient factor for thrips was bound phenols content, and for the sums of both pests were the natural enemies.

In case of thrips, all the factors had been participated with 64.07 and 77.76 % for the sums of thrips and aphids on all wheat cultivars.

Respect to thrips and the sums of the total pests, the soil minimum temperature ranked the first efficient factor (22.099 and 27.757 out of 64.07 and 77.76%; respectively for thrips and grand totals of pests). The second efficient factor was the maximum temperature (12.914 and 20.473; out of 64.07 and 77.76% respectively for thrips and grand totals of pests). Afterwards, the minimum temperature was ranked the third factor in arranging the population of thrips (9.053 out of 64.07%) and grand total of pests (11.377 out of 77.76%). These results of thrips were in the same trend of (Ahmed, 2016) as their results stated that the minimum and maximum temperatures ranked the first efficient factors in affecting the population abundance *of T. tabaci* on four different cultivars of the fodder crop, *Leucaena leucocephala*. The least efficient factor for thrips was free phenol contents (0.655 out of 64.07%, r= -1.082), and for the grand totals of pests was the natural enemies (0.169 out of 77.76%, r= 0.633). Matching results were similar to our findings confirmed that weather temperatures (minimum and maximum temperatures) showed a positive significant role in the density of wheat aphid's populations (Nasir and Ahmad, (2001); Aheer *et al*. (2007, 2008).

CONCLUSION

Under drought conditions, thrips mean numbers were higher than aphids on almost of wheat cultivars. The infestation of both pests begins in February in the 1st season, and in January in the 2nd season. Aphids peaks, were occurred in the 1st season in three outbreaks during March and April, 2015; and two peaks were observed in the 2nd season during February and March, 2016. The factors were participated with (72.98, 64.07, 77.76 % in arranging the patterns of fluctuations; respectively for aphids, thrips, and the sums of both pests). The efficiencies of factors were arranged according to their effects as following: 1- for aphids, the sums of the natural enemies (20.847), minimum temperature (15.003), and soil minimum temperatures (11.265). Meanwhile, the bound phenols content recorded the least efficient factor (0.994) all out of 72.98 %. 2- for Thrips and the sums of both pests, were the soil minimum temperature (22.099 and 27.757 out of 64.07 and 77.76%; respectively for thrips and grand totals of pests). The 2nd efficient factor was the maximum temperature (12.914 and 20.473; out of 64.07 and 77.76% respectively for thrips and grand totals of pests). Afterwards, the minimum temperature was ranked the third factor in arranging the population of thrips (9.053 out of 64.07%) and grand total of pests (11.377 out of 77.76%). Respect to cultivars yields, In the 1st season the highest yield was obtained from Giza 186 (178.33 GY/10 plants), and the lowest one was

recorded from Gemaza 9 (81.66 GY/10 plants) and for the 2nd season, the highest yield was resulted from Giza 186 (162.39 GY/10 plants), and the lowest cultivar was Gemaza 9 (95.13 GY/10 plants).

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دور الفينولات الحرة والمرتبطة مع العديد من العوامل الحقلية علي الكثافة العددية لبعض انواع المن وتربس البصل التي تهاجم بعض اصناف اقماح الخبز تحت ظروف الجفاف

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تمت الدراسة علي خمسة أنواع من أصناف القمح (الساحل 1 ، سدس 4 ، الجميزة 9 ، الجيزة 168 ، مصر 2) خلال الموسمين (2015-2016 و 2016- 2017) في مزرعة كلية الزراعة ، جامعة أسيوط ، أسيوط ، مصر. تم تحديد العوامل الحقلية التي تم دراستها والمتمثلة في العوامل المناخية وهي درجات الحرارة العظمي والصغري اليومية (درجة مئوية) ودرجات حرارة التربة على عمق 5 سم (درجة مئوية) والأعداء الحيوية السائده مع تقدير المحتويات الفينولية (الفينولات الحرة والمرتبطة) علي أصناف القمح المختارة. وذلك لدراسة كفاءة جميع العوامل المنظورة معاً وكل عامل على حده على تذبذب تعداد تربس البصل، *Thrips tabaci* Lindeman وكذلك بعض أنواع المن: (*Mayzus persicae* Sulz., *Brivecoryne brassicae* Linnaeus, and *Rhopalosiphum padi* Linnaeus) على أصناف القمح المختارة تحت الجفاف و الظروف الحقلية مع الاخذ في الاعتبار الناتج المحصولي لتلك الاصناف. اوضحت النتائج أن متوسطات أعداد التربس أعلى من متوسطات المن على معظم الأصناف المختارة خلال المواسم الدراسية. تم ملاحظة الأفراد من كلتا الافتين في 15 فبراير 2015 للموسم الأول ، بينما بدأت الإصابة في الموسم الثاني في 15 يناير 2016 على جميع الأصناف. تم ملاحظه الاعداد في قمة الذروة (الفوران) في الموسم الأول من 15 مارس إلى 30 أبريل 2016 على جميع الأصناف ، في حين لوحظت ذروتان لتعداد التربس في ساحل 1 وسدس 4 ، وثلاث فورانات على بقية الأصناف. تم تسجيل عدد من الفورانات العددية خلال الموسم الثاني من المن والتربس إلى ذروتين لكل آفة خلال 28 أبريل و 15 مارس 2016. كانت الكفاءة (R^2 x100) من جميع العوامل العملية التجريبية (72.98 ، 64.07 ، و 80.03 ٪ ؛ على التوالي للمن ، التربس ، وعلي مجموعي الآفات). تم ترتيب العوامل التي أخذت بعين الاعتبار في تأثيرها علي أعداد الحشرات خلال المواسم التي تمت دراستها وفقًا لكفاءتها بالترتيب التالي: بالنسبة إلى المن: جاءت الأعداء الحيوية ، ثم درجات الحرارة الصغري ، درجات الحرارة الصغري في التربة حيث شاركت بشكل رئيسي بالنسب الأتية (20.847 ، 15.003 ، و 11.265 من 72.98٪ ، على التوالي لجميع الأصناف) ، في حين كانت الفينولات المرتبطة أقل عامل كفاءة (0.994 من 72.98٪). بالنسبة إلى التربس ومجموعي الآفات: فقد تأثروا بشكل رئيسي بدرجة الحرارة الصغري للتربة ، ودرجة الحرارة العظمي الجوية ، ودرجة الحرارة الصغري الجوية (22.099 ، 27.757 ، 12.914 ، 20.473 ، و 9.053 ، و 11.377 من 64.07 ، و 77.76٪ على التوالي بالنسبة للتربس والمجاميع الكلية للآفات) وأقل عامل في الكفاءة لمجاميع التربس هي محتويات الفينول الحرة (0.655 من 77.76٪ ، r = -1.082) ، وبالنسبة للمجموع الكلي للآفات كانت الأعداء الطبيعية (0.169 من 77.76٪ ، r = 0.633). اما بالنسبة للناتج المحصولي من الحبوب في كلا الموسمين ، تم الحصول على أكبر إنتاج من نباتات الجيزة 186 (178.33 و162.39 محصول الحبوب/ 10 نباتات على التوالي في الموسم الأول والثاني). وفي الوقت نفسه، تم تسجيل أدنى عائد محصولي من صنف جميزة 81.66 و 95.13 محصول الحبوب/ 10 نباتات وذلك على التوالي في الموسم الأول والثاني).