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Population fluctuation of cottonwhitefly, *Bemisiatabaci* (Gennadius) on certain tomato hybrids at Sohag region

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Abstract

The population trend of *B. tabaci* adults and nymphs on tomato crop in winter plantation in terms of weekly mean numbers/ 10 leaves during the study period (2018/2019 and 2019/2020 seasons), The adults of whitefly started to take place from the first week of inspection, then the population increased to form three peaks of activity in both seasons. However, for the nymphs, the population started to appear on tomato leaves in the second week of inspection in both seasons, then increased to form two and one peaks in the two seasons, respectively. Also, data showed that the susceptibility of seven tomato hybrids to infestation by *B. tabaci* adults and nymphs, respectively, during two successive seasons 2018/2019 and 2019/2020.For adults, Hybrid Lugen appeared as moderately resistant (MR) in both seasons, also, Hybrid Super red, Hybrid 102, Hybrid 449 showed Low resistance (LR) to *B. tabaci*, adults While, Hybrid 65010, Hybrid 83 and Hybrid 039 appeared as susceptible (S) in both seasons. Also, for nymphs, it is clear differences between the tested hybrids were significant during the two seasons. Hybrid Super red, Hybrid 102,HybridLugen and Hybrid 449 showed Low resistance (LR) to *B. tabaci* nymphs during the both seasons While, Hybrid 65010, and Hybrid 039 appeared as susceptible (S) in both seasons.

Keywords: Tomato hybrids, *B. tabaci*, infestation, Susceptibility, winter plantation.

INTRODUCTION

Tomato, Solanum *lycopersicum L.* (Solanaceae) is one of the most widely cultivated and important vegetable crops in the world (Zhao *et al.*, 2016). Tomatoes are produced locally by small- and medium-sized farmers for food and household use, as well as for business income (Ma, 2017). In Egypt, tomato is one of the main vegetable crops representing 46.2% of the total vegetable production value(Hassan and Ahmed, 2018). Annually, it produces about 9,204,097 tons of tomatoes from a cultivated area of 9,000ha. Tomato crop is one of the most important vegetable crops in Egypt and is considered as the fifth largest tomato producer in the world (https://www.Egypt.Cropscience.bayer.com/en/Crops).

One of the most important problems that facing the Egyptian tomato farmers is insect pests (Ahmed, 2016). Also, in Egypt, tomato is subjected to attack by a number of insect pests include, *Bemisiatabaci* (Gennadius) (Hemiptera: Aleyrodidae) *Liriomyzatrifolii* (Burgess) (Diptera: Agromyzidae) *Nesidicoristenuis* Reuter. (Hemiptera: Miridae) *Tutaabsoluta* (Meyrick) (Lepidoptera: Gelechiidae) *Heliocoverpaarmigera* (Hübner) (Lepidoptera: Noctuidae) and that reduce its quality and quantity (Ridray, 2008; Szwejda and Rogowska, 2011; Radonjic and Hrncic, 2012; Mahmoud *et al.*, 2020 and Mukwa*et al*, 2021). Also, *Bemisiatabaci* (Gennadius) is one of the most important pests in agricultural crops worldwide. This whitefly is responsible for large reductions in crop yield and quality (Abd El-Ghany 2011; Ibrahim *et al.* 2015). The whitefly *Bemisiatabaci* (Gennadius) (Homoptera: Aleyrodidae), a cosmopolitan insect pest, is one of the most destructive agricultural pests worldwide owing to its ability to feed on hundreds of plan species, many of which are important agricultural crops (Brown 2010; Dinsdale *et al.* 2010). Whiteflies are now globally distributed and are serious pests of cultivated crops in tropical and subtropical areas including Africa, Asia, Central America, South America, and the West Indies (Cock 1986; Chu *et al.* 2007). They are widespread throughout the Mediterranean region and have become increasingly important pests of cotton and vegetables in Egypt (De Barro *et al.* 2011). Th e whitefly is a polyphagous insect pest on more than 600 different plant species (Oliveira *et al.* 2001; Bayhan *et al.* 2006; Stansly and Natwick 2010). It causes economic losses in vegetable, fiber, and ornamental crops due to both direct damage through phloem feeding and injection of toxins and indirect damage to the host plant through its ability to transmit plant viruses (Pereira *et al.* 2004; Brown 2010). The direct damage elicited by *B. tabaci* has a vast impact on plant health and consequently yield. The indirect damage caused by the whitefly is even more destructive for agriculture (Lima *et al.* 2000). Indirect damage occurs through transmission of geminiviruses; whiteflies are vector of more than 300 plant viruses (Hogenhout *et al.* 2008). Moreover, an unfavorable side effect of whitefly infestation is the production of carbohydrate- -rich honeydew excretions, which make the leaves sticky, impair photosynthesis and support the growth of sooty mold fungi on the plant leaf and fruit surface (Stansly and Natwick 2010).

So, the present study was conducted to investigate the population fluctuation of *B. tabaci* and the susceptibility of certain tomato hybrids at Sohag Governorate during two successive seasons of 2018/2019 and 2019/2020.

MATERIALS AND METHODS

Population density

An area of about400 m^2 was divided into four plots (each 100 m^2) as replicates and arranged in a randomized complete block design. tomato plants (hybrid 65010) were transplanted on 1st September in both seasons.The normally recommended agricultural practices i.e. irrigation, fertilization and weeding were followed, except for the chemical control of pests, which was completely avoided.

Sampling methods

In situ count

Between 6 – 8 am., direct count method was adopted to determine the adults of whitefly, about 10 leaves were examined randomly for each plot and the numbers of adults were recorded. Sampling started after 15 days from transplanting (15th September) and continued at weekly intervals until the end of two seasons (23rd February).

For the nymphs of whitefly the picking method was adopted. Samples of 10 leaves were chosen at random from three levels, i.e., lower, middle and top of tomato. Samples were kept in polyethylene bags and transferred to the laboratory for examination by using stereoscopic microscope on both lower and upper surfaces of all the leaves collected for the immature stages of the previous mentioned pests. Collecting samples started after 15 days of transplanting date and continued until harvest at weekly intervals (from 15th September to 23rd February).

The susceptibility of certain tomato hybrid to whitefly, *Bebisiatabaci*.

Area and experimental design

An area of about 2800 m^2, divided into 28 blocks (about 100 m^2/plot) was cultivated with the 7 hybrids of tomato (65010, super red, 102, 449, 83, 039 and Lugen). Seedlings were transplanted in the field on 1st September in 2018/2019 and 2019/2020 seasons as winter plantation. Each hybrid was cultivated in four replicates and evaluated in complete randomized design. All normal and recommended agricultural practices were followed, however, no pesticide treatments during the whole period of the experiment.

Sampling methods

To determine the numbers of whitefly the *insitu* count method was used. About 10 leaves were chosen randomly for each plot and the numbers of previous pests were recorded (6 – 8 am.). The sampling period started after 15 days from transplanting (15th September) and continued at weekly intervals until the end of two seasons (23rd February). And to determine the immature stages of whitefly (nymphs), the picking method was adopted. About 10 leaves were chosen at random from three levels, i.e., lower, middle and top of tomato, then kept in polyethylene bags and transferred to the laboratory for examination by using stereoscopic microscope on both lower and upper surfaces of all the leaves collected for the immature stages of the previous mentioned pests. Sampling started after 15 days of transplanting date and continued until harvest at weekly intervals (from 15th September to 23rd February).

Data analysis

For the purpose of statistical analysis, data obtained were statistically analyzed using one – way analysis of variance and further tomato hybrids means were distinguished using the Duncan's Multiple Range Test (Snedecor and Cochran, 1967).

The pest's mean numbers were used to determine the relative susceptibility degree of the tested hybrids as described by Chiang and Talekar (1980) equation. Relative susceptibility degree was dependent on the general mean number of the pest ($\bar{x}$) and the standard deviation (SD). Hybrids that had mean numbers more than $\bar{x}$+2SD, were considered highly susceptible (HS), between $\bar{x}$ and $\bar{x}$+2SD, susceptible (S), between $\bar{x}$ and $\bar{x}$ -1SD, low resistant (LR), between $\bar{x}$-1SD and $\bar{x}$-2SD, moderately resistant (MR) and less than $\bar{x}$-2SD, were considered highly resistant (HR).

RESULTS AND DISCUSSION

Population fluctuation of Bemisiatabaci infesting tomato plants

The adults of whitefly started to take place from the first week of inspection, and then the population increased to form three peaks of activity in both seasons (Fig. 1). The mean numbers of 16.8, 23.5 and 22.8adults/ 10 leaves, were recorded as peaks in 29thSeptember, 20th October and 10th November, respectively, in the first season. However, the mean numbers of 13.5, 16.5 and 14.5 adults/10 leaves were recorded as peaks in 6th October, 20th October, and10th November, respectively, in the second season. After that, the numbers decreased gradually and disappeared completely in 2nd February in both of seasons. However, for the nymphs, the population started to appear on tomato leaves in the second week of inspection in both seasons, and then increased to form two and one peaks in the two seasons, respectively (Fig. 2). The means numbers of 11.5and 9.8 nymphs/10 leaves were recorded as peaks on 20th October and 17th November, respectively, in the first season. However, in the second season, the peak was observed in 3rd November with mean number of 14.3nymphs/10 leaves. After that, the numbers decreased gradually and disappeared completely in 12th January in both of seasons. The previous findings were in

harmony with results of Khalid et al. (2009), Khuhroet al. (2014), Subbaet al. (2017) and Harshita et al. (2019)

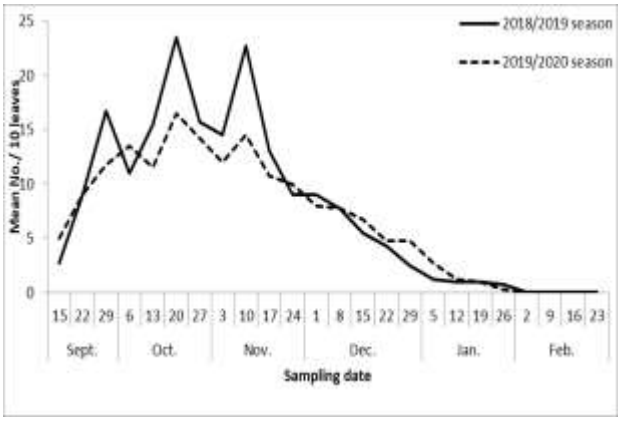

Figure (1) Population fluctuation of *Bemisia tabaci* adults infesting tomato crop at Sohag Governorate during two successive seasons of 2018/2019 and 2019/2020.

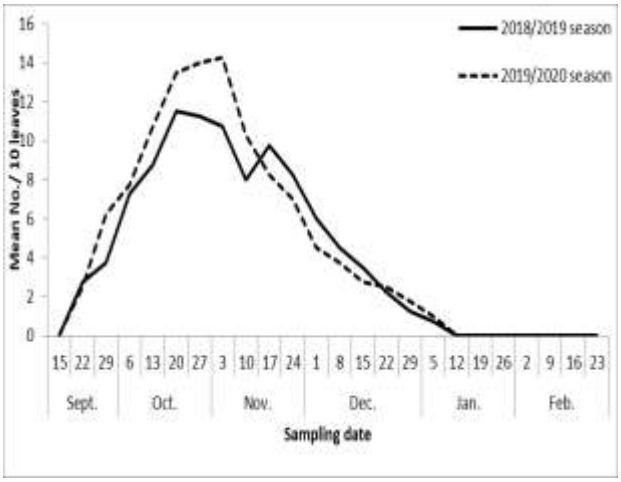

Figure (2) Population fluctuation of *Bemisiatabaci* nymphs infesting tomato crop atSohag Governorate during two successive seasons of 2018/2019 and 2019/2020.

The susceptibility of certain tomato hybrids to infestation by *Bemisiatabaci*

Adults

Data in Tables (1) and (2) present the susceptibility of seven tomato hybrids to infestation by *B. tabaci* adults during two successive seasons of 2018/2019 and 2019/2020, respectively. It is clear that the differences between the tested hybrids were significant during the two seasons. Data showed that the highest population of *B. tabaci* adults was in October for Hybrid Super red, Hybrid 83, Hybrid 102, Hybrid Lugen and Hybrid 039 during both seasons. While, it was in November for the Hybrid 65010 and Hybrid449 during the first season only but it was in October during the second season.

The lowest infestation was recorded on hybrid Lugen with 0.97 and 1.13 adults/ 10 leaves during the two seasons, respectively, by insignificant differences with hybrid 102, hybrid 449and Super red in both seasons. However, the highest infestation was recorded on Hybrid 65010 with 3.28 and 3.56adults/ 10 leaves during the two seasons, respectively, by insignificant differences with Hybrid 039 in both seasons of the study. Hybrid Lugen appeared as moderately resistant (MR) in both seasons, also, hybrid Super red, hybrid 102, hybrid 449 showed Low resistance (LR) to *B. tabaci*, adults While, hybrid 65010, hybrid 83 and hybrid 039 appeared as susceptible (S) in both seasons.

Nymphs

Data in Tables (3) and (4) present the susceptibility of seven tomato hybrids to infestation by *B. tabaci* nymphs during two successive seasons of 2018/2019 and 2019/2020, respectively.

It is clear differences between the tested hybrids were significant during the two seasons. Data showed that the highest population of *B. tabaci* nymphs was in October for Hybrid 65010, Hybrid 83, Hybrid 102, and Hybrid 039 during both seasons (Table 3). While it was in November for Hybrid Lugen during both seasons. Whereas, it was in November for Hybrid Super red, and Hybrid 449 during the first season only but it was in October during the second season (Fig.2).

The lowest infestation was recorded on Hybrid Lugen and Hybrid Super red with 1.23 and 1.37 nymphs/ 10 leaves during the two seasons, respectively, by insignificant differences with Hybrid 102, Hybrid 449 and Hybrid Super red during the first season and with Hybrid 102 and Hybrid Lugen during the second season. However, the highest infestation was recorded on Hybrid 65010 with 4.49 and 4.55 nymphs/ 10 leaves during the two seasons, respectively, by insignificant differences with Hybrid 039 in both seasons of the study.

Hybrid Super red, Hybrid 102, Hybrid Lugen and Hybrid 449 showed Low resistance (LR) to *B. tabaci* nymphs during the both seasons While, Hybrid 65010, and Hybrid 039 appeared as susceptible (S) in both seasons. The present results are in the same way with Fekri *et al.* (2013), Ghulam (2016) and Shahrin *et al.* (2021).

Table (1) Susceptibility of certain tomato hybrids to infestation by *Bemisia tabaci* adults at Sohag Governorate during 2018/2019 season.

Mean number of adults/ 10 leaves								
Month	**Tomato hybrid**							**F. value**
	Hybrid 65010	**Super red**	**Hybrid 83**	**Hybrid 102**	**Logen**	**Hybrid 449**	**Hybrid 039**	
Sept.	3.08	1.67	3.42	1.75	1.00	1.75	3.42	-------
Oct.	6.88	3.13	5.19	3.44	2.31	2.94	6.94	-------
Nov.	7.00	2.25	3.88	2.69	1.63	3.38	5.75	-------
Dec.	2.30	0.90	1.15	1.20	0.75	1.10	1.70	-------
Jan.	0.44	0.19	0.50	0.19	0.13	0.31	0.13	-------
Feb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-------
Mean	**3.28 a (S)**	**1.35 c (LR)**	**2.35 b (S)**	**1.54 c (LR)**	**0.97 c (MR)**	**1.58 c (LR)**	**2.99 ab (S)**	**13.35***
Mean ± SD	**2.01 ± 0.88**							

(*): The F value is significant at P ≤ 0.05.Means followed by different subscript letters within row are significantly different from each other (P < 0.05). S=Susceptible LR= Low Resistant MR= Moderately Resistant

Table (2) Susceptibility of certain tomato hybrids to infestation by *Bemisiatabaci* adults at Sohag Governorate during 2019/2020 season.

Mean number of adults/ 10 leaves								
Month	**Tomato hybrid**							**F. value**
	Hybrid 65010	**Super red**	**Hybrid 83**	**Hybrid 102**	**Logen**	**Hybrid 449**	**Hybrid 039**	
Sept.	2.75	0.75	3.08	1.67	0.83	1.92	3.33	-------
Oct.	7.81	3.44	5.56	4.00	2.75	3.06	7.25	-------
Nov.	7.50	2.75	4.31	3.06	2.00	3.00	6.69	-------
Dec.	3.05	0.90	1.65	1.55	0.90	1.45	2.20	-------
Jan.	0.25	0.19	0.31	0.63	0.31	0.44	0.75	-------
Feb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-------
Mean	**3.56 a (S)**	**1.34 c (LR)**	**2.49 b (S)**	**1.82 bc (LR)**	**1.13 c (MR)**	**1.64 c (LR)**	**3.37 a (S)**	**17.45***
Mean ± SD	**2.19 ± 0.97**							

(*): The F value is significant at P ≤ 0.05.

Means followed by different subscript letters within row are significantly different from each other (P < 0.05). S=Susceptible LR= Low Resistant MR= Moderately Resistant

Table (3) Susceptibility of certain tomato hybrids to infestation by *Bemisia tabaci* nymphs at Sohag Governorate during 2018/2019 season.

Mean number of nymphs/ 10 leaves								
Month	**Tomato hybrid**							**F. value**
	Hybrid 65010	**Super red**	**Hybrid 83**	**Hybrid 102**	**Logen**	**Hybrid 449**	**Hybrid 039**	
Sept.	2.25	0.50	1.83	0.83	0.00	0.42	1.75	-------
Oct.	9.75	3.13	6.19	4.50	2.50	3.56	7.94	-------
Nov.	8.88	3.25	4.06	3.44	3.13	4.00	7.63	-------
Dec.	4.55	1.40	2.25	2.20	1.65	2.15	3.75	-------
Jan.	1.50	0.13	0.63	0.19	0.13	0.44	0.88	-------
Feb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-------
Mean	**4.49 a (S)**	**1.40 c (LR)**	**2.49 b (S)**	**1.86 bc (LR)**	**1.23 c (LR)**	**1.76 bc (LR)**	**3.66 a (S)**	**13.047***
Mean ± SD	**2.41 ± 1.23**							

(*): The F value is significant at $P \leq 0.05$.
Means followed by different subscript letters within row are significantly different from each other ($P < 0.05$). S=Susceptible LR= Low Resistant MR= Moderately Resistant

Table (4) Susceptibility of certain tomato hybrids to infestation by *Bemisiatabaci* nymphs at Sohag Governorate during 2019/2020 season.

Mean number of nymphs/ 10 leaves								
Month	**Tomato hybrid**							**F. value**
	Hybrid 65010	**Super red**	**Hybrid 83**	**Hybrid 102**	**Logen**	**Hybrid 449**	**Hybrid 039**	
Sept.	2.08	0.67	1.25	1.00	0.25	0.67	2.08	-------
Oct.	9.69	3.06	6.19	4.69	2.75	4.69	8.44	-------
Nov.	9.19	2.81	4.25	3.69	3.06	4.50	8.13	-------
Dec.	4.60	1.40	2.40	2.50	2.00	2.65	4.50	-------
Jan.	1.75	0.25	0.81	0.38	0.44	0.88	1.06	-------
Feb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-------
Mean	**4.55 a (S)**	**1.37 d (LR)**	**2.48 b (LR)**	**2.04 bcd (LR)**	**1.42 cd (LR)**	**2.23 bc (LR)**	**4.03 a (S)**	**21.791***
Mean ± SD	**2.59 ± 1.24**							

(*): The F value is significant at $P \leq 0.05$.
Means followed by different subscript letters within row are significantly different from each other ($P < 0.05$). S=Susceptible LR= Low Resistant MR= Moderately Resistant

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تذبذب المجموع لذبابة القطن البيضاء علي بعض هجن الطماطم في منطقة سوهاج

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تذبذب المجموع لذبابة القطن البيضاءB. tabaciالحشرات الكاملة والحوريات على محصول الطماطم في العروة الشتوية من حيث متوسط الأعداد الأسبوعية / 10 أوراق خلال فترة الدراسة (موسمي 2019/2018 و 2020/2019) ، وقد بدأت الحشرات الكاملة للذبابة البيضاء في الظهور بداية من الأسبوع الأول من الفحص ثم ازداد عدد السكان ليشكل ثلاث قمم للنشاط في الموسمين. أما بالنسبة للحوريات، فقد بدأت أعدادها بالظهور على أوراق الطماطم في الأسبوع الثاني من الفحص في كلا الموسمين، ثم ازدادت لتشكل قمتين في الموسم الأول وقمة واحدة في الموسم الثاني.كما أظهرت البيانات قابلية سبع هجن طماطم للإصابة بذبابة القطن البيضاء .B tabaci(الحشرات الكاملة والحوريات) خلال موسمين متتاليين 2019/2018 و2020/2019.فبالنسبة للحشرات الكاملة،اظهر هجين Lugenمقاومة متوسطة (MR) في كلا الموسمين، أيضًا أظهر هجين Super redوهجين102 وهجين449 مقاومة منخفضة (LR) لذبابة القطن البيضاء B. tabaci، بينما أظهرت الهجن 65010 و 83 و 039حساسية للإصابة بالحشرة (S) في كلا الموسمين. أيضا ، بالنسبة للحوريات ، كما أوضح التحليل الاحصائي أن الفروق بين هجن الطماطم السبعة كانت معنوية خلال الموسمين. حيث أظهرت الهجنSuper redو 102 و Lugen و 449 مقاومة منخفضة (LR) لحوريات الذبابة البيضاء .B tabaciخلال الموسمين بينما أظهرهجيني65010 و 039 حساسية(S) للاصابة في كلا الموسمين.