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SUSCEPTIBILITY OF CERTAIN POTATO VARIETIES TO THE INFESTATION WITH APHIDS AND WHITEFLY *Bemisia tabaci* Genn. IN NEWLY RECLAIMED SANDY AREAS AT EL-KHATTARA DISTRICT, SHARKIA GOVERNORATE, EGYPT

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ABSTRACT

Studies were carried out at El-Khattara district, Sharkia Governorate during two successive years 2016 and 2017 to study susceptibility of three potato cultivars (Spunta, Cara and Galactica) to infestation with aphids and whitefly.

The results showed that the infestation differs from variety to another, whereas Galactica cultivar was less susceptible followed by Cara cultivar, while Spunta cultivar showed the most susceptibility to infestation by aphids and Bemisia tabaci and associated with the greatest number of insect predators (Coccinella septempunctata L., C. undecimpunctata L, C. 9 puncata , Chrysoperla carnea Steph. and Metasyrphus corollae F.) followed by Cara and Galactica cultivars. The statistical analysis showed that this difference was highly significant among the different cultivars by aphids and whitefly infestation. As regards the effect of mean temperature and atmospheric relative humidity as well as their total combined effect on the numbers of certain investigated insect species and their predators, it is obvious that the effect was clear. The effect of the chemical contents of potato plants on the population density of aphids and whitefly that infest certain potato cultivars, indicated that a negative correlation appeared between population density of (aphids and whitefly), and protein, carbohydrate, phenols, pH, Nitrogen (N) %, Phosphorus (P)% and potassium (K) % percentage in the three potato cultivars.

***Conclusively,** the obtained results in developing the IPM programs against these pests on potato plants through activation the effect of both temperature and relative humidity on insect numbers and the need to conduct more of these studies.*

Key words: Potato Varieties, Infestation, Aphids, Whitefly *bemisia tabaci* genn., Newly Reclaimed Sandy Areas, El-Khattara District, Sharkia Governorate.

INTRODUCTION

Potato, *Solanum taberosum* L. is an important solanaceous crop in many parts of the world. During the last two decades, the potato cultivated area has steadily increased in Egypt. Rendering potatoes, it is consider the second most important vegetable crop after tomatoes. In field, potato plants are attacked by homopterous pests, that have great economic importance to the crops. They cause serious damage directly by sucking plant sap or indirectly by transmission of virus and mycoplasma diseases (El-Gindy, 2002 and El-Fatih *et al.,* 2016). Seasonal abundance of aphids was studied in Egypt by Abd El -Fattah *et al.,* (2000) and El-Gindy *et al.,* (2009). Natural enemies of aphids and whitefly especially parasitoids and insect predators are considered one of the most important factors that regulate the populations of aphids and whitefly and may be the best solution to such problems (Saleh *et al.,* 2006 ; El-Baz 2007 ; El-Maghraby *et al.,* 2008; Saljoqi, 2009; Khan *et al.,* 2012 and Ali 2014).

Therefore, the present study focused on susceptibility of certain potato varieties cultivated in newly reclaimed sandy areas to the infestation with aphids and whitefly.

MATERIALS AND METHODS

Field experiments were conducted during two summer seasons of 2016 and 2017 in El-Khattara district, east northern Sharkia Governorate. An area of about three feddans was cultivated with potato, under drip irrigation system. In all cases the field of each experimental host plant was left without pesticide application enhancing the natural enemies, to play its role in competing different insect pests. The tested potato cultivars were Spunta, Cara and Galactica.

The insect predators and insect pests associated with the tested cultivars were counted and recorded. In each season, samples of 30 leaves per cultivar were taken random weekly from different levels of plant height and sites (one leaf per plant) after six weeks of sowing from the third week of February to first week of May in the first season, while in the second season to the second week of May. Sampling was continued till harvest. These leaves were kept in tightly closed paper bags and the included insects were counted in the laboratory with the aid of a stereoscopic binocular microscope. The total number of immature stages of *B. tabaci* Genn. and aphids were counted on each surface of the leaf. Insect predators were also counted as immature or adult stages on each leaf per sample. All the obtained results were statistically analyzed according to completely randomized design. For clearing the effect

of certain weather factors such as temperature and atmospheric relative humidity on the population density of the studied insect pests and their predators, the daily means of the two factors were provided by the Meteorological Central Laboratory for Agricultural Climate, Agricultural Research Center during the whole period of the potato plants growing seasons (2016 and 2017) to show the effect of each factor as well as their total effect on insects population density, the values of simple correlation coefficient (r), partial regression coefficient (p) and total explained variance (E.V.%) were calculated using Costat Software Microcomputer Program (Costat, 1995).

Effect of the chemical contents of potato plants on the population density of aphids and whitefly insects infesting certain potato varieties.

Plant leaves were taken at random from each replicate of Spunta, Cara and Galactica cultivars plants during the season of 2016 and 017 to determine protein, carbohydrates, pH, phenol, phosphorus and Potassium percentages in the central laboratory, Fac. Agric., Zagazig University, Egypt.

***1-Determination of protein content*:**

Total Nitrogen in leaves was estimated according to Bremner and Mulvaney (1982). The crude protein content was obtained by multiplying the Nitrogen content by the factor 6.25.

2- ***Determination of carbohydrates content:***

The total carbohydrate content in plants was determined calorimetrically using the anthrone reagent and the color intensity. It was measured at 240 mu according to Dubois *et al.* (1956).

3- Determination of phenol:

Content of phenol was determined by flame photometrically according to Jackson (1970).

4- Determination of PH value:

It was estimated in the plant sap using PH meters.

5- Determination of K, P and N%:

Determination of K, P and N according to (Ibrahim *et al*., 2000).

Statistical analysis:-

Data were analyzed using commercial statistical software. One way analysis of variance (ANOVA) was used to test the significant differences between mean values (Costat program, 1995).

RESULTS

Ecological studies:

Survey of insect pests and their predators associated with potato varieties:

Potato varieties are subjected to be attacked by several major piercing sucking insect pests which cause severe damage directly or indirectly to the crop production. The most dangerous pests are the three aphid species *Myzus persicae* Sulzer, *Aphis gossypii* Glover and *Macrosiphum pisi* Harris; and whitefly *Bemisia tabaci* (Genn.).

Insect predators associated with the above mentioned potato insect pests had been surveyed during two successive seasons of 2016 and 2017 under non application of pesticides; the predators were recorded as follows:

Coccinellids: *Coccinella septempunctata* L., *C. undecimpunctata* L. and *C*. 9 *puncata* (Coleoptera, Coccinellidae).
Chrysopid : *Chrysoperla carnea* Steph. (Neuroptera, Chrysopidae).
Syrphids : *Metasyrphus corollae* F. (Diptera, Syrphidae).

Population density of insect pests infesting potato vegetable plants:

Results given in Table (1) show clearly that the infestation of aphids was the highest, which represented 77.14 and 74.50% of the total number of insect pests followed by whitefly *Bemisia tabaci* Genn. 22.86% and 25.50% from the total number of insect pests during 2016 and 2017 seasons, respectively.

Population density of insect predators associated with insect pests infesting potato vegetable plants .

Results given in Table (1) show that the number of *C. undecimpunctata* was the highest and represented by 25.12% followed by *Ch. carnea* (22.51%) then *C. septempunctata* (21.59%) and (18.99) for *M. corollae* and (11.79%) of *C*. 9 *punctata* from the total number of insect predators during the first season (2016). While in the second season (2017), the number of *Ch. carnea* was the highest (23.18%) followed by *C. septempunctata* (22.14%) then *C. undecimpunctata* (21.99%) where *M. corollae* and *C*. 9 *punctata* were represented by 20.65 and 12.04% from the total number of insect predators, respectively.

Table (1): Relative abundance of aphids & whitefly and the associated insect predators collected from potato plants during 2016 and 2017 seasons.

Insect pests and predators	2016		2017	
	Total	%	Total	%
A. Insect pests:				
Aphids	15317	77.14	13595	74.50
Whitefly	4540	22.86	4653	25.50
Total	19857	100	18248	100
B. Insect predators:				
C. septempunctata	141	21.59	149	22.14
C. undecimpunctata	164	25.12	148	21.99
C. 9 *punctata*	77	11.79	81	12.04
Ch. carnea	147	22.51	156	23.18
M. corolla	124	18.99	139	20.65
Total	**600**	**100**	**673**	**100**

Susceptibility of certain potato varieties to the infestation with aphids and whitefly and their insect predators.

1- Aphids (*Myzus persicae* and *Aphis gossypii*):

Data given in Table (2) revealed that the differences between average numbers of aphids / 30 leaves on the three tested potato cultivars "varieties" were statistically significant for the two seasons of the study.

Table (2): Total mean numbers of aphids and whitefly infested potato cultivars during 2016 and 2017 seasons.

Insect pests	Aphids		Whitefly	
Years / Cultivars	2016	2017	2016	2017
Spunta	286.43 ± 6.32	283.59 ± 5.48	79.4±1.23	88.54±1.07
Cara	209.21 ±5.29	113.62±1.61	60.5±0.78	50.71±0.70
Galactica	14.93±0.28	22.62±0.34	11.43±0.16	15.88±0.18
F. value	**	**	**	**

The intensity of aphids infestation on different potato cultivars measured as average number of insects / leaf varied from sever to light infestation could be arranged in 2016 season, descending order as follows:

Spunta (286.43), Cara (209.21) and Galactica (14.93). In the second season 2017, Spunta (283.59), Cara (113.62) and Galactica (22.62 individuals/ leaf).

It was obvious that in the two seasons of study, cultivar Galactica proved to be the least susceptible host plant for aphid infestation followed by Cara variety, while the variety Spunta appeared to be the most susceptible potato variety. As clearly shown in Table (3), the initial infestation of potato leaves by aphids during the first season, all tested varieties was recorded in the third week of February, the infestation started slightly on all varieties (1.83, 1.57 and 0.1 individuals / leaf), and increased gradually to record two peaks of population activity , in the 4th week of March and April on Spunta variety by 36.43 and 78.5 individuals/ leaf at means (21 and 27.5˚C & 45 and 38 RH), while in Cara variety recorded also two peaks of population activity in the 4th week on both March and April by 27.83 and 66.33 individuals/ leaf at means (21 and 27.5˚C & 45 and 38 RH), respectively, while on Galactica variety was the least susceptible host plant for aphid infestation , and recorded two small peaks of population activity also in the 4th week of both March and April by 2.2 and 2.53 individuals / leaf at means (21 and 27.5 ˚C) & 45 and 38 RH), in the first season. In the 2017 season (Table 4) the infestation started slightly on all varieties (2.27, 1.23 and 0.3 individuals / leaf), and increased gradually to record two peaks of population activity, in the 4th week of both March and April on Spunta variety by 40.67 and 70.83 individuals / leaf at means (16.67 and 22.97C & 48.43 and 32.81, RH), while Cara variety recorded also two peaks of population activity in the 4th week of March and 3rd week of April by 20.0 and 16.5 individuals / leaf at means (16.67 and 19.07˚C & 48.43 and 52.11 RH). In case of Galactica variety, the least susceptible host plant for aphid infestation showed two peaks in the 4th week of March and April by 2.13 and 4.67 individuals / leaf) at means (16.67 and 19.07˚C & 48.43 and 52.11 RH), respectively.

2-Whitefly (*Bemesia tabaci*):

Data given in Table (2) revealed that the differences between average numbers of whitefly / 30 leaves on the three tested potato cultivars were statistically significant for the two seasons of study.

The intensity of whitefly infestation on different potato cultivars measured as average number of insects /leaf varied from severe to light infestation could be arranged in 2016 season, descending order as follows : Spunta (79.4), Cara (60.5) and Galactica (11.43). In the second season 2017, Spunta recorded (88.54), Cara (50.71) and Galactica (15.88 individuals/ leaf), as shown in Table (2).

It was obvious that in the two seasons of study, cultivar, Galactica proved to be the least susceptible host plant for whitefly infestation followed by Cara variety, while the variety Spunta appeared to be the most susceptible potato variety.

As clearly shown in Table (3), the initial infestation of potato leaves by whitefly during the first season all tested varieties were recorded in the third week of February, the infestation started slightly on all varieties (1.0, 0.6 and 0.07 individuals/ leaf), and increased gradually to record two peaks of population activity, in the 4th week of both March and April on Spunta variety by 12.0 and 13.93 individuals / leaf at means (21 and 27.5˚C & 45 and 38 R.H), while Cara variety recorded also two peaks of infestation , in the 3rd week of March 7.4 and in the 4th week of April 9.13 individuals at means (21.5 and 27.5˚C & 45 and 38 RH), respectively. On the Galactica variety, infestation recorded three peaks of activity in the first and third week of March and 2nd week of April by 1.23, 1.93 and 1.50 individuals / sample at means (22, 21.5 and 26 ˚C & 52, 45 and 45 RH), respectively.

Table (4), show the initial infestation of potato leaves by whitefly during the second season (2017), all tested varieties were recorded in the 3rd week of February, the infestation started slightly on all varieties (1.47, 0.83 and 0.17 individuals/ leaf), increased gradually to record three peaks of population activity, in the 4th week of March, 16.17, 3rd week of April 9.67 and first week of May, 9.47 individuals / leaf, respectively at means (16.67, 19.07 and 20.11 ˚C & 48.43, 52.11 and 38.20 RH) respectively, on Spunta variety. In the Cara variety, only two peaks of population activity were recorded in the 4th week of both March and April by 8.77 and 7.0 individuals / sample at means (16.67 and 22.97 ˚C & 48.43 and 32.81 RH), respectively. Also, two peaks were recorded on Galaction variety, in the 2nd week of March and in the 4th week of April by (1.5 and 2.23 individuals/ leaf) at means (16.83 and 22.97 ˚C & 47.04 and 32.81 RH), respectively.

3- *Chrysoperla carnea*:

The population mean number of *Ch. carnea* throughout first season were 5.64, 5.55 and 2.18 individuals /sample on Spunta, Cara and Galactica varieties, respectively (Table 5). The mean number of *Ch. carnea* on different potato varieties during second season gave highest population number on potato (Spunta variety) (6.42 individuals/sample), while the lowest population was recorded on Galactica variety with mean number 1.92 individuals/sample, the mean number on Cara variety was 4.67 individuals/ sample as shown in Table (6).

4. ***Coccinella septempunctata :***

Data in Table 5, shows that the mean number of *C. septempunctata* during first season recorded 6.18 , 4.55 and 2.09 individuals / sample on Spunta, Cara and Galatica potato variety, respectively. On other hand, the mean number of *C. septempunctata* during the second season (2017), Table 6. recorded , 5.42, 4.33 and 2.67 individuals/ sample on Spunta , Cara and Galactica, respectively.

5- ***Coccinella undecimpunctata***:

Data represented in Table (5), showed the differences in *C. undecimpunctata* population between three tested potato cultivars for the first season which recorded 6.91, 5.27 and 2.73 individuals/sample on Spunta, Cara and Galactica, respectively. In the second season (2017), Table 6. indicated that Spunta, Cara and Galactica potato varieties were associated with 4.92, 5.33 and 2.08 individuals/sample, respectively.

***6. Coccinella 9 punctat*:**

Data in Table (5) indicated that Spunta variety was associated with 4.45 individuals/sample, while Cara variety recorded 2.55 individuals /sample, No individuals were recorded on Galactica variety.

In the second season (2017), Table (6), showed that the mean number were 4.17 and 2.58 individuals/sample on Spunta and Cara varieties, respectively. Galactica variety was free of individuals.

***7. Metasyrphis corollae* :**

Table 5, shows that the mean number of this predator during the first season 2016 recoded 5.55, 4.82 and 0.92 individuals/sample on Spunta , Cara and Galactica variety.

In the second season (2017), Table 6 showed the mean number were 5.25, 5.0 and 1.33 individuals/sample on Spunta, Cara and Galactica varieties, respectively.

Effect of temperature and relative humidity on the population densities of aphids and whitefly infesting potato plants and their predators.

a) Aphids :

Table (7) indicated that the correlation between number of aphid and temperature was positive significant during 2016 and 2017 seasons (r = 0.6447* and 0.6476*), respectively. The partial regression between number of aphids and mean temperature was significant during 2016 and 2017 seasons (p = 0.0322 and 0.0228), respectively.

The correlation between number of aphids and mean relative humidity was negative significant (r = -0.6808* and 0.6397*) during 2016 and 2017 seasons, respectively. The partial regression between number of aphids and mean relative humidity was significant (p = 0.0211 and 0.0251) during 2016 and 2017 seasons, respectively.

b) *Bemisia tabaci*

The obtained results Table (7) appear that the correlation coefficients between *B. tabaci* and mean temperature was positive significant (r_1= -0.5477*, -0.5093*) in the two seasons, respectively. While, The partial regression between number of *B. tabaci* and mean temperature was significant during 2016 and 2017 seasons (p = 0.0811 and 0.0228), respectively.

The correlation coefficients between number of *B. tabaci* and mean relative humidity was negative significant during two seasons of study (r_1= -0. 5744*, -0.5276*), respectively. While, The partial regression between number of *B. tabaci* and mean relative humidity was significant during 2016 and 2017 seasons (p = 0.0646 and 0.0779), respectively.

c) *Insect predators:-*

In the first season 2016, Table (7) indicated that the correlation between number of *C. 9 punctata* and mean temperature was positive significant (r= 0.6626) and negative significant (r = 5798), with mean relative humidity. While the partial regression between number *C. 9 punctata* and mean temperature was significant effect (p = 0.0263)

In 2017 season the correlation between number of *M. corollae & C. 9 punctat* and mean temperature were positive significant (r= 0.5793 and 0.6500), respectively. While the correlation between number of (C. *septempunctata*, C. *undecimpunctata*, M. *corollae* and *C. 9punctat*) and mean relative humidity were negative significant (r= -0.6133, -0.6093, -0.6270 and -0.6441) respectively. While the partial regression between number *M. corollae* and *C, 9 punctata* and mean temperature was significant effects (p = 0.0483 and 0.0221), respectively. In case of (*C. septempunctata*, *C. undecimpunctata*, *M. corollae* and *C. 9punctat*) and mean R.H. were significant effects (p= 0.0339, 0.0291 and 0.0238) respectively.

E.V.% values obviously demonstrate that the population of both aphids in 2016 season and *C. 9 punctata* in 2016 more sensitive to changes in the considered weather factors (mean temperature and relative humidity) showing the highest values of 0.5317 and 0.4754 respectively. On the other hand, the least combined effects were detected with *C. undecimpunctata* and *C. carnae*

of predator insects indicating the lowest values of E.V. % were (0.1671 and 0.0851) in the two experimented seasons, successively, Table (7)

Similar results were obtained by Parh (1986) and Raupach *et al*., (2002) who explained that the temperature and relative humidity had effects on the insects population density under study on the cowpea plants.

Effect of chemical contents of potato cultivars on the population density of aphids and whitefly.

Data presented in Tabel (8), indicated that the differences between values of total protein, carbohydrate**,** phenols**,** pH, K, P, contents in three potato cultivars were highly significant during 2016 season.

The intensity of aphid infestation in 2016 measured as total numbers of insects arranged in descending order as follows Spunta (781.18), Cara (567.27) and Galactica cultivars (40.75) insects, in the same trained Spunta recorded the most infestation with *B. tabaci* (216.55 insects) followed by

Cara (167.09) and Galactica (30.73) insects. Table (8) showed that Galactica cultivar recorded high level in total protein, Carbohydrate phenols. K% and P% followed by Cara and Spunta, the results recorded (19.458, 27.273, 375.713, 2.177 and 0.288) & (14.291, 21.66, 262.113, 1.91 and 0.261) and (12.875, 19.93, 221.75, 1.189 and 0.234), respectively.

This rustles are agreement with those of Hegab (2001), Abdel-Samad (2006) and Amer (2016).

DISCUSSION

There was a negative relationship between aphids, whitefly infestation and protein, carbohydrates contents, phenol and pH value, in there tested potato cultivars Spunta, Cara and Galactica, this results in agreement with Abd-Elsamad (2006) who found negative correlation between protein and carbohydrate content and insect infestation. Also, he observed a negative correlation between pH value and insect infestation. The present results revealed that potato cultivars were infested with aphids *M. persicae*, *A. gossypii* , *Macrosiphum pisi* and whitefly *B. tabaci*. These pests were recorded on potato plants and the present results are in same line with Hegab (2001), El-Gindy (2002, 2006) and El- Gindy *et al.,(*2006). They mentioned that the increase of potassium fertilization decreased the population density of the many homopterous pests.

Results concluded that the increase of potassium level increase the thickness of epidermal leaves. This consequently suppressed the ability of homopterous insect mouth parts to pierce leaves cells of potato cultivars to

feed. This results agree with those obtained by Hegab (2001), El-Gindy (2002, (2006) , El-Gindy *et al.*, (2006, 2009), they found that potassium fertilization increased the thickness of epidermal leaves and suppressed the infestation of several piercing and sucking insect pests on cereals, legumes and maize plants.

Conclusively, the obtained results in developing the IPM programs against these pests on potato plants through activation the effect of both temperature and relative humidity on insect numbers and the need to conduct more of these studies.

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حساسية بعض أصناف البطاطس للأصابة بالمن و الذبابة البيضاء *Bemisia tabaci* Genn. فى المناطق المستصلحة حديثاً بمنطقة الخطارة محافظة الشرقية، مصر

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أجريت هذه الدراسة فى منطقة الخطارة، محافظة الشرقية، خلال موسمى الدراسة ٢٠١٦، ٢٠١٧، لدراسة حساسية ثلاثة أصناف من البطاطس و هى سبونتا و كارا و جالكتيكا للإصابة بالمن و الذبابة البيضاء *Bemisia tabaci* Genn من صنف لأخر. حيث كان الصنف جالكتيكا أقلهم حساسية يليه الصنف كارا بينما الصنف سبونتا كان أكثرهم حساسية للإصابة بالمن و الذبابة البيضاء حيث كان مصحوبا بأكبر تعداد من المفترسات الحشرية (*Coccinella septempunctata* L., *C. undecimpunctata* L, *C.* 9 *puncata* , *Chrysoperla carnea* Steph. and *Metasyrphus corollae* F.) يليه الصنف كارا ثم الصنف جالكتيكا.

أوضح التحليل الإحصائى وجود إختلاف عالى المعنوية بين الأصناف الثلاثة للإصابة بالمن والذبابة البيضاء. ومن دراسة تأثير متوسط درجة الحرارة وكذلك الرطوبة النسبية على تعداد الحشرات و المفترسات المصاحبة لها اظهرت النتائج أن التأثير كان واضحا بالنسبة لعاملى الحرارة و الرطوبة النسبية. أما تأثير المحتوى الكيميائى للأصناف الثلاثة على الإصابة بالمن والذبابة البيضاء وجد أن هناك إرتباط سالب بين تعداد المن و الذبابة البيضاء و البروتين الكلى و الكربوهيدرات و الفينولات و pH و النسبه المئويه للنيتروجين والفسفور و البوتاسيوم فى أصناف البطاطس تحت الدراسة.

التوصية: يوصى هذا البحث الى استخدام النتائج المتحصل عليها و الاستفادة منها عند وضع برامج المكافحة المتكاملة.