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The Cotton Mealybug, *Phenacoccus Solenopsis* Tinsley (Homoptera : Pseudococcidae) as a New Insect on Soybean Plants in Egypt and its Population Dynamic

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ABSTRACT

The cotton mealybug, *Phenacoccus solenopsis* Tinsley (Homoptera :Pseudococcidae) is an important insect pest worldwide causing economic damage to several crops. The insect was noticed for the first time on soybean, *Glycine max* L. plants (var. Giza 111) in late August using visual count during season of 2015 at Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt. The mealybug was collected from the infested soybean plants during season of 2016 at Kafr El-Sheikh Governorate, Egypt and identified as *P. solenopsis* at Insect Identification Unit, Plant Protection Research Institute, Agricultural Research Center, Egypt. The population density of mealybug started with a few numbers at the end of August during seasons 2015, while in season 2016, the infestation began to appear nearly in mid-August, then it increased gradually till the end of the season. Generally, the population of this insect was significantly higher in the second season than the first one. Both temperature and relative humidity had a negative and insignificant effect on the population in the two seasons with exception of effect of temperature in the second season, as it was negative and highly significant. The combined effect of the two considered weather factors was more pronounced on the population in the second season than in first one. Generally, this study represents the first published record of *P. solenopsis* on soybean in Egypt. However, the obtained results are very important in integrated soybean management programs to avoid damage of this insect in the future.

Keywords: Population dynamic,soybean,*Glycine max* L.,mealybug,*Phenacoccus solenopsis*,visual count,piercing-sucking,weather factors.

INTRODUCTION

The cotton mealybug, *Phenacoccus solenopsis* Tinsley (Homoptera: Pseudococcidae) is an important insect pest worldwide with a wide geographical and host range (Williams ,1985; Williams and Granara de Willink, 1992; Miller *et al.*,2005; Hodgson *et al*.,2008 and Khuhro *et al.*,2012). Mealybug ,*P.solenopsis* is a polyphagous and sap sucking insect, as it attacks more than 183 plant species in 52 families (Ben-Dov *et al*.,2009). The genus *phenacoccus* is one of the largest genera in the Pseudococcidae, as it currently contains about 180 species (Ben-Dov, 1994). The cotton mealybug has a wide geographical distribution with its origin in Central America (Fuchs *et al*., 1991) and later spread to several countries such as Ecuador (Ben–Dov, 1994); Chile (Larrian, 2002); Argentina (Granara de Willink, 2003); Brazil (Culik and Gullan, 2005); Pakistan and India (Hodgson *et al*., 2008); Nigeria (Akintola and Ande, 2008) and China (Wang *et al.,* 2009). In Egypt, *P.solenopsis* was first recorded on weeds (Abd–Rabou *et al*., 2010), subsequently as a new insect pest on tomato plants (Ibrahim *et al*., 2015) and on cotton plants (El-Zahi *et al.*, 2016). Cotton mealybug not only causes direct damage to the host plant by sucking plant sap, but also excretes large quantities of honeydew which encourages the black sooty mold growth and hinders photosynthesis (Arif *et al*., 2012). Furthermore, the insect is suspected as vector of plant diseases (Culik and Gullan, 2005). *P.solenopsis* has a high reproductive potential in a wide range of temperature (Prasad *et al*., 2012) and relative humidity (Hameed *et al.,* 2012). The population of *P.solenopsis* was significantly and positively correlated with the maximum and minimum temperature, while the correlation between the relative humidity and the population was positive and insignificantly (El–Zahi and Farag, 2017). Thus, the present study was planned to record *P.solenopsis* for the first time on soybean plants in Egypt and its population dynamic.

MATERIALS AND METHODS

During growing season of 2015, mealybugs were noticed in a few numbers in late of August on soybean plants (*Glycine max* L.var. Giza 111) at Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt. In season of 2016, the infestation with this insect increased on soybean plants. The specimens were collected from various parts of soybean plants on 12th August 2016, and identified at Insect Identification Unit, Plant Protection Research Institute, Agricultural Research Center, Egypt. Mealybug specimens were slide mounted for identification using the method outlined in Williams and Granara de Willink (1992). Identification of the genus was done using the key of the Pseudococcidae family (Hemiptera: Cocccidae) according to Mohammad and Moharum (2012). To study the population dynamics of mealybug, an experimental area of about one Feddan was divided into 4 equal plots at Sakha Agricultural Research Station Farm .The soybean var. Giza 111 was sown in the first week of May during the two study seasons. All plants received the usual recommended agricultural practices without any insecticidal application throughout the two seasons. To determine population of mealybug, 25 soybean branches were selected at random from each plot. The number of adults and nymphs on top 20 cm of the branch terminal portion were counted directly in the field. The weather factors: temperature and relative humidity were obtained from Meteorological Station of Sakha, Egypt and statistical analysis with SPSS version 16 was used to determine the partial correlation and regression coefficient between the prevailing weather factors and mean population of *P.solenopsis*.

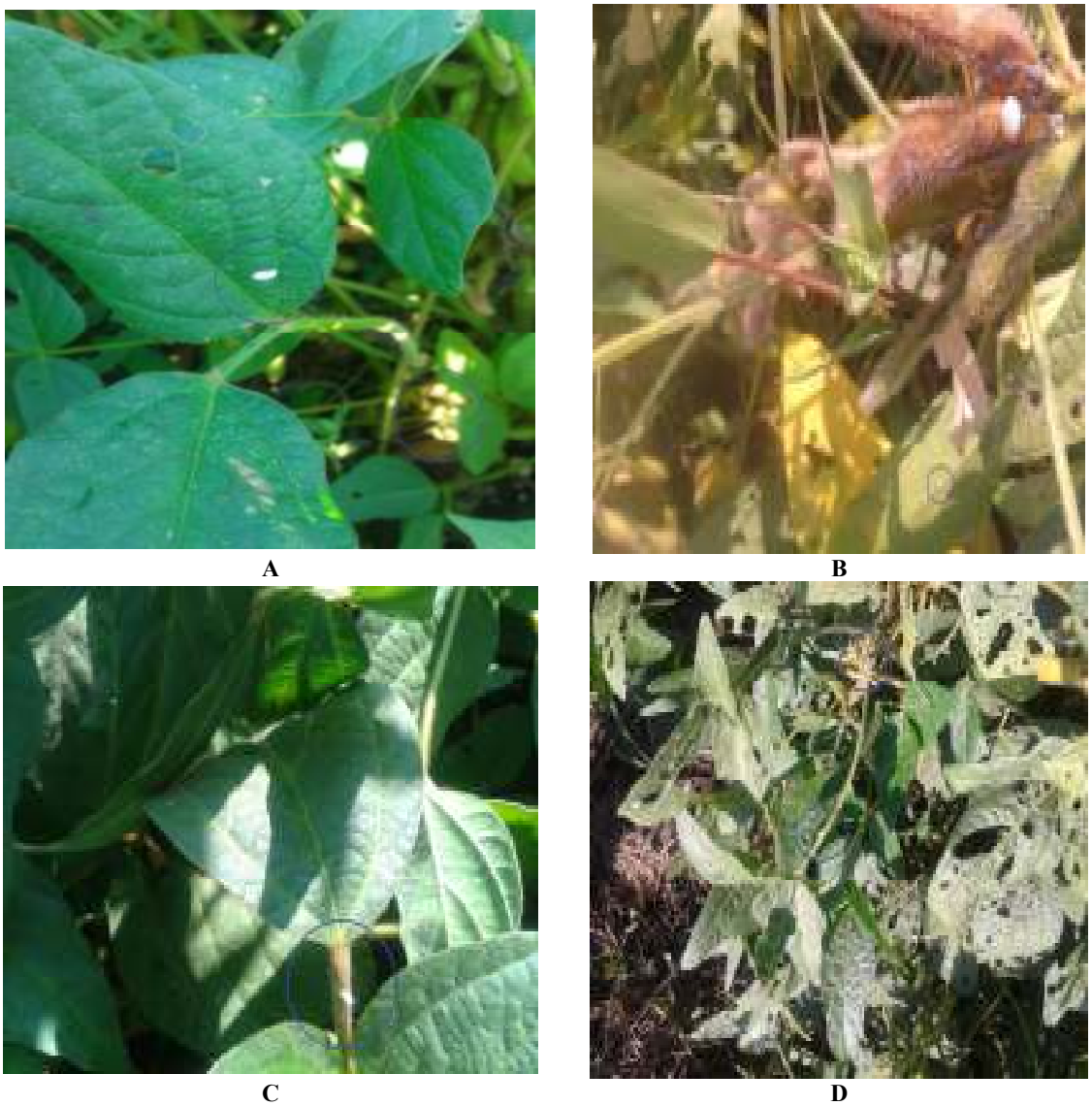
RESULTS AND DISCUSSION

The present study represents the first record of mealybug, *Phenacoccus solenopsis* Tinsley on soybean plant in Egypt during season of 2016 in Kafr El-Sheikh governorate. The insect appeared for the first time in a few numbers on soybean during growing season of 2015. In season of 2016, the infestation started in a few numbers on 12th August and increased gradually till the harvest. Photographs cleared the infestation of *P.solenopsis* on different parts of soybean plants are shown in Figure (1). Adults and nymphs of cotton mealybug were observed on

leaves, buds, stems, and pods (Fig. 1: A-D) and feed on the plant sap producing fewer pods of smaller size. The insect also, excretes large quantities of honeydew on the upper surfaces of leaves which encourages the black sooty mold growth and hinders photosynth esis process (Fig.1-B). These results are similar to previously recorded symptoms but on cotton plants (Culik and Gullan, 2005; Osborne, 2005 and Silva, 2012). However, cotton mealybugs in Egypt, was firstly recorded on weeds (Abd-Rabou *et al*., 2010); on tomato plants (Ibrahim *et al*. 2015) and on cotton plants (El-Zahi *et al*., 2016). This study is the first published record of soybean as a host for *P.solenopsis* in Egypt.

Data presented in Table (1) show th e population density of mealybug on soybean plants and the prevailing weath er factors (temperature and relative humidity) during 2015 and 2016 seasons. In the first season, infestation started on 30th August in a few numbers by 2.00 insects /25 branches of soybean, and then the population increased gradually till the end of season on 28th September with mean numbers of 10.00 insects/25 branches. During season of 2016, the population began to appear on 12th August (1.5 insect /25 branches) then, the infestation increased till the harvest on 26th September recording 11.5 insect /25 branches. Th ese results agreed with findings of El-Zahi and Farag (2017), they reported that the highest population of mealybug on cotton plants was noticed on 11th September.

In general, t- test analysis indicated that the seasonal mean of the insect was significantly higher in season of 2016 than season of 2015, as it was 7.57 and 6.25 insects, respectively. The results in Table (2) cleared that the population of *P.solenopsis* was negatively and highly significant correlated with temperature in the season of 2016, while temperature in season 2015 and relative humidity in both seasons affected insignificantly and negatively population of mealybug.



A **B** **C** **D**

Fig. 1. Infestation of *Phenacoccus solenopsis* Tinsley on different parts of soybean plants. A- nymphs and adults of *P.solenopsis* on leaves B- excreted honeydew on pods and leaves C – Infestation of buds and leaves D- *P.solenopsis* on tillers and leaves

Table 1. Mean number of *Phenacoccus solenopsis* Tinsley on soybean plants and the prevailing weath er factors during 2015 and 2016 season at Kafr El-Sheikh governorate, Egypt

Season of 2015				Season of 2016			
Sampling date	Mean number/25 branches	Temp C°	RH %	Sampling date	Mean number/ 25 branches	Temp. C°	RH %
Aug.15	-	-	-	Aug.12	1.5	29.62	73.43
22	0.0	30.57	65.57	19	4.75	29.54	67.07
30	2.00	28.89	65.63	28	5.50	29.71	67.14
Sept.7	7.50	28.48	73.65	Sept.5	8.75	28.77	69.38
14	8.25	29.68	67.64	12	10.25	28.49	68.38
21	9.73	28.68	65.93	19	10.75	29.05	67.07
28	10.00	29.53	60.93	26	11.5	27.62	66.5
Total	37.50	175.83	399.39	Total	53.00	202.8	448.97
Grand mean±SE	6.25± 0.13	29.31 ±0.78	66.56± 4.13	Grand mean±SE	7.57 ± 3.72	28.98± 0.74	68.42 ± 2.41

SE=standard error t..caculated =4.20 t.tabulated 5% =2.44 1% =3.71**

Table 2. Statistical parameters for mealybug, *Phenacoccus solenopsies* Tinsley population in relation to certain weather factors on soybean branches during 2015 and 2016 seasons

Season	Temperature.		RH %		EV%
	r	b	r	b	
2015	- 0.54	-3.27	- 0.29	- 0.30	29 .12%
2016	- 0.92 **	-3.31	- 0.66	- 0.63	80.23%

(r) = correlation coefficient (b) = regressions coefficient
**** High significantly EV=explained variance RH= relative humidity**
In season of 2015 t –tabulated at 5% = 0.76 1% = 0 .87
In season of 2016 t –tabulated at 5% = 0.71 1% = 0.84

Based on the regression coefficient, it revealed that decrease of temperature by 1 C° increased population of *P.solenopsis* by 3.27 and 3.31 insects per 25 branches in season of 2015 and 2016, respectively, while increase of relative humidity by 1% decreased population of mealybug by 0.29 and 0.63 insects per 25 branches in 2015 and 2016 season ,respectively. Th ese results agreed with Prasad *et al*., 2012, as they showed that the development duration of *P. solenopsis* decreased as temperature increased from 18 to 32 C°. In contrast, Hamead *et al*., (2014) and El-Zahi and Farag (2017) showed that relative humidity had positive effect on the population of *P.solenopsis*. The combined effect of temperature and relative humidly was responsible for changes in the population density of *P. solenopsis* by 29.12 and 80.23% during 2015 and 2016, respectively. This means that there are other unconsidered factors affecting on the population. This may be due to the differences in prevailing weather factors or/and its natural enemies.

Finally, it can be concluded that the cotton mealybug, *P. solenopsis* was noticed for the first time on soybean in Egypt and its population changed from season to oth er. Thus, the obtained results are of most importance in the integrated soybean management programs to avoid the spread and potential risk of this insect.

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بق القطن الدقيقى (Homoptera :Pseudococcidae) *Phenacoccus solenopsis* Tinsley حشرة جديدة على نباتات فول الصويا في مصر وديناميكية تعدادها

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يعتبر بق القطن الدقيقى من الآفات الحشرية الهامة في العالم والتي تسبب ضرراً اقتصاديا لعديد من المحاصيل. ولوحظت هذه الحشرة لأول مرة على نباتات فول الصويا (*Glycine max* L.) صنف جيزة ١١١ فى نهاية أغسطس موسم ٢٠١٥م فى المزرعة البحثية بسخا – كفر الشيخ – مصر. تم جمع هذه الحشرة من أجزاء مصابة مختلفة من نباتات فول الصويا المنزرعة فى المزرعة البحثية بسخا كفر الشيخ موسم ٢٠١٦م وتم تعريفها في وحدة تعريف الحشرات بمعهد بحوث وقاية النباتات، مركز البحوث الزراعية ، مصر. وظهرت الحشرة بأعداد قليلة فى نهاية شهر أغسطس موسم ٢٠١٥م ولكن في ٢٠١٦ م بدأت تظهر الإصابة في حوالي منتصف أغسطس وازداد التعداد تدريجياً حتى نهاية الموسم . وبصفة عامه كان التعداد في الموسم الثاني أعلى بدرجه معنوية عن الموسم الأول وكل من درجة الحرارة والرطوبة النسبية لهما تأثير سالب وغير معنوي في كلا الموسمين ما عدا درجة الحرارة حيث كان لها تأثير موجب وعالي المعنوية في الموسم الثاني وكان التأثير المشترك لكل من درجة الحرارة والرطوبة النسبية أكثر وضوحاً علي الحشرة في الموسم الثاني عن الأول. وعموماً تمثل هذه الدراسة أول تسجيل منشور لبق القطن الدقيقي علي فول الصويا في مصر وبذلك فإن النتائج المتحصل عليها لها أهمية كبيرة في برامج الإدارة المتكاملة لفول الصويا لتجنب ضرر هذه الحشرة في المستقبل.