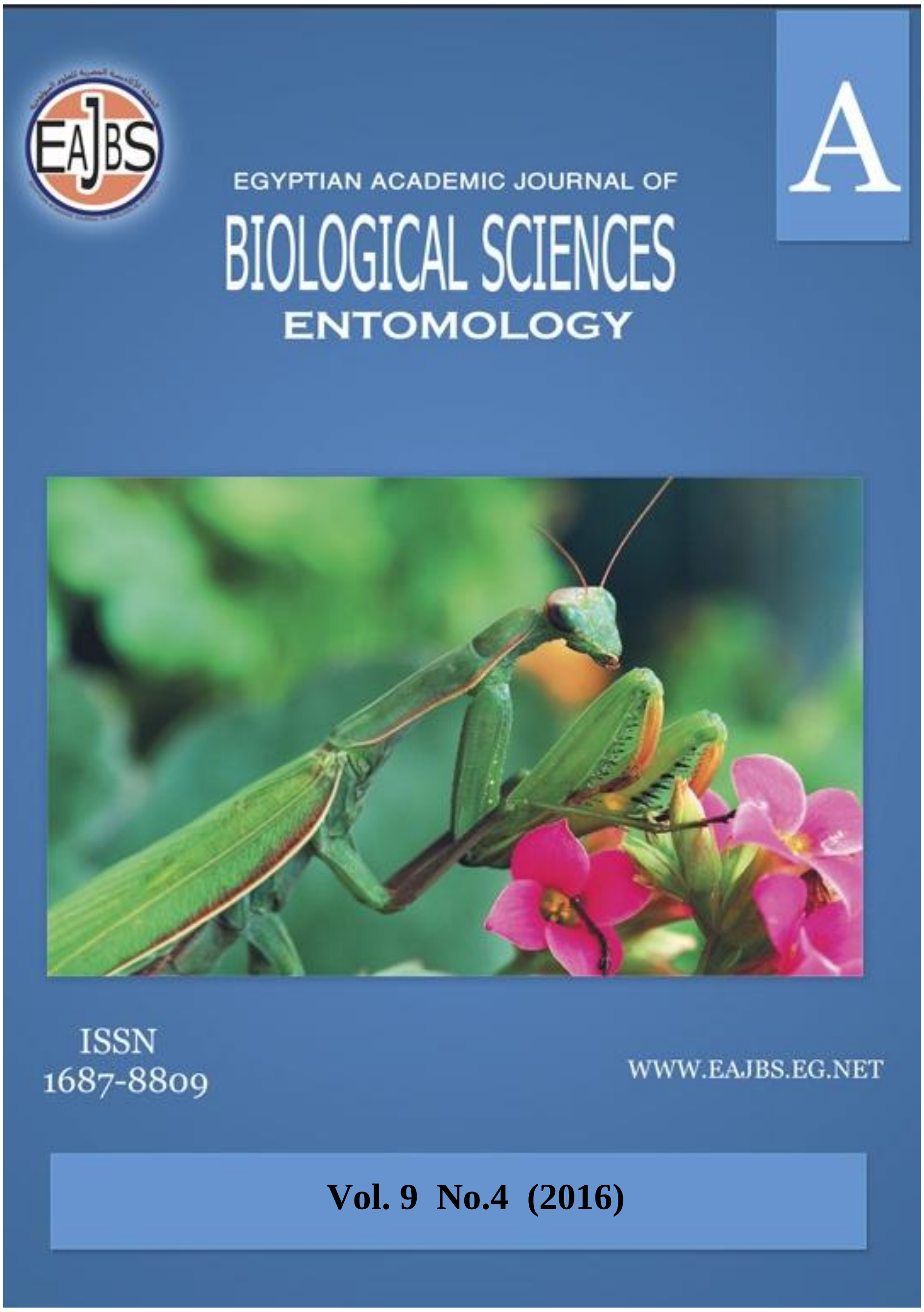

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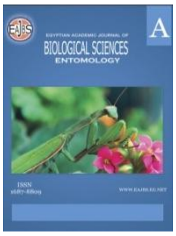

Population Dynamics of *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) on Common Potato Cultivars in Egypt.

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ABSTRACT

The field experiments were carried out at El-Berka village, Abu-Hommus, El-Beheira Governorate, Egypt during three Nile successive seasons, 2013, 2014 and 2015 to evaluate the susceptibility of potato cultivars to *Polyphagotarsonemus latus* and to throw light on population build up in relation to weather factors distribution within the potato plants. Present data showed that the high infestation of *P. latus* was recorded in October and November on the tested potato plants.

The highest susceptible cultivars were represented by Spunta with mean number of 6.10 ±1.02 individuals /leaflet. The Moderate susceptible cultivar was represented by Sanura (3.66 ±0.59 individuals /leaflet). The lowest susceptible cultivar was represented by Pampa (3.60 ±0.34 individuals /leaflet).

The results reflected that maximum, minimum and mean temperatures had negative effect on mite population. However, maximum, minimum and mean relative humidity and plant age had positive effect with the mite population on all potato varieties. The temperature, relative humidity and plant age were common factors affecting the development rate of various stages of mites.

INTRODUCTION

Potato, *Solanum tuberosum* L. is one of the most important vegetable crops in Egypt. Potatoes suffered chiefly from a characteristic leaf curl complex attributed to the attack of *P. latus* (Grinberg *et al*., 2005). The broad mite, *Polyphagotarsonemus latus* (Banks), is an important, pest of diverse crops in tropical and subtropical regions (Palevsky *et al*., 2001). The broad mite, *P. latus* was first described by Banks (1904) as *Tarsonemus latus* from the terminal buds of Mango in a green house in Washington D.C., USA (Denmark, 1980). It is a minute herbivorous mite that attacks numerous plant crops from diverse families at least 60 plant families including Solanaceae, Cucurbitaceae, Fabaceae and Malvaceae causing severe symptoms as distorted and discoloured flowers sudden curling and wrinkling of leaves followed by discoloration or blistering. Plant growth may stop and survival of the plant may be threatened when severely injured and yield loss (Goff, 1987; Lei *et al*., 1992; Cho *et al*., 1996; Zhang, 2003). *P. latus* attacks plants such as pepper, tomato, cucumber, potato, eggplant, tea, jute, citrus, African violet, begonia, dahlia, fuchsia, and hibiscus plants (Gerson, 1992; Zhang, 2003). The potato plant (*Solanum tuberosum* L.) was considered as one of the most important vegetable crops. *P. latus* infestation caused stunting and twisting of the leaves and flowers, and blackening and death of new growth. The mites prefer a high humidity and low temperature (Hassan, 2011).

Several studies have been conducted for resistance, population fluctuations, biology and damages of broad mite, *P. latus* (Raj *et al*., 2004; Namvar and Arbabi, 2007). Broad mite, *P. latus* (Banks) is polyphagous. It feeds on variety of host plants including agricultural crops. It has been found damaging the potato crops in several governorates of Egypt. This species multiplies rapidly so only 4 to 5 days are enough to complete a generation in summer and 7-10 days in winter. The reproduction takes place throughout the year but it slows down during winter (Mostafa, 2007; Azouz and El-Sanady, 2013).

Therefore, the present study aimed to evaluate the susceptibility of potato cultivars to broad mite, *Polyphagotarsonemus latus* (Acari: Tarsonemidae), and to throw light on population in relation to weather factors distribution within the potato plants at El-Beheira governorate during the Nile seasons, 2013, 2014, and 2015.

MATERIALS AND METHODS

The field experiments were carried out at Berka village, Abu-Hommus, El-Beheira governorate, Egypt during three Nile successive seasons, 2013, 2014, and 2015. The experimental area was about one feddan (4200 m^2), chosen and divided into three equal plots, each plot contained three replicates. The replicate area was 466.7 m^2, each replicate was rowed into 50 rows with 0.7m width. Three potatoes varieties (Spunta, Sanura and Pampa) were sown in 10th August. All agricultural practices were manipulated as recommended without using any pesticide.

Sampling procedure started after 35 days from sowing date until the harvest. Weekly samples of potatoes leaves were chosen randomly from each replicate from these plants. These samples of three leaves were chosen from top of each plant. Sampling procedure was extended from 3rd September till 5th November. Each sample was transferred in paper bag to the laboratory for investigation in the same day of inspection by using a stereoscopic-microscope. Numbers of *P. latus* individuals were counted and recorded on lower surfaces of leaflet for each cultivar.

The maximum, minimum & mean temperature and maximum, minimum & mean relative humidity were obtained from the nearest meteorological station in Delengat district. The numbers of *P. latus* individuals on the tested varieties were subjected to statistical analysis by using SAS computer program (SAS institute, 2003), f-test analysis in complete randomized design were applying to study variance for population density on the tested varieties. In addition, simple correlation test analysis was used to study the effect of meteorological and plant age factors on population density of *P. latus*.

RESULTS AND DISCUSSION

The seasonal dynamics of *P. latus* and potato varieties susceptibility at Beheira governorate

The changes in the population activity of *P. latus* expressed as numbers of larvae, nymphs and adults/ potato leaflet at Beheira Governorate (ecosystem) were expressed in Tables (1, 2) and Fig. (1) on three tested potato varieties and along three successive seasons, 2013, 2014 and 2015. During the season of 2013, as shown in

Figure (1), *P. latus* was gradually increased toward the end of season in all potato varieties. The average number of *P. latus* individuals infesting Spunta cultivar of potato apparently increased from 0.04 individuals /leaflet at September, 3rd 2013 to 12.41 individuals /leaflet in November, 5th 2013 (Table 1 and Fig. 1). The highest values of mite abundance were observed at the end of experiment (12.41 individuals /leaflet). *P. latus* infesting Spunta cultivar of potato exhibited the same trend of the infestation during the other seasons, 2014 and 2015 (from 0.11 to 14.35 and 0.85 to 11.70 individuals /leaflet, respectively), overall abundance of *P. latus* individuals was 8.13 ±1.65 and 5.23 ±1.69 individuals /leaflet infesting Spunta cultivar, respectively; there were non-significant differences between them (Table 1, Fig. 1).

Broad mite infestation started on the second or third week of September, reached its peak within October, 29th2013 & 2014 and October, 22nd 2015 in Sanura cultivar. In which, the infestation increased gradually from 0.70, 0.26 and 0.11 to 11.81, 7.04 and 7.81 individuals /leaflet on Sanura cultivar during three successive seasons, respectively (Table 1, Fig. 1). The overall abundance of *P. latus* individuals infesting Sanura cultivar was 4.70 ±1.56, 3.61±0.85 and 2.67 ±1.01 individuals /leaflet during the above seasons without significant differences between them, respectively (Table 1). The average number of *P. latus* individuals infesting Pampa cultivar apparently highly increased at the end of the experiment. On weekly basis, the highest values of mite abundance were observed on November, 5th 2013 & 2014 (9.59, 10.33 individuals /leaflet) and October, 22nd 2015 (7.33 individuals /leaflet) (Table 1 and Fig. 1). The overall abundance of *P. latus* individuals was 3.39, 4.26 and 3.14 infesting Pampa cultivar, without significant differences between them (Table 1). Similarly, the high infestation of *P. latus* was recorded in October and November on chili plant (Dhooria and Bindra, 1977; Lingeri *et al.*, 1998; Srinivasulu *et al.*, 2002). Also, Jyotika and Bhullar (2003) found September-October as peak months for the arthropod pests infesting okra plant.

Table 1: The seasonal dynamics of *P. latus* and potato varieties susceptibility during three seasons.

Inspection dates	**Potato varieties**								
	Spunta			**Sanura**			**Pampa**		
	2013	**2014**	**2015**	**2013**	**2014**	**2015**	**2013**	**2014**	**2015**
Sept., 3rd	0.04	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10th	0.22	0.93	0.85	0.00	0.26	0.11	0.00	0.00	0.04
17th	0.89	2.41	2.78	0.70	1.00	0.63	0.22	0.00	0.26
24th	1.89	6.56	4.15	0.96	1.96	1.67	1.48	1.30	1.04
Oct., 1st	2.78	10.70	8.26	1.70	3.37	2.48	2.26	2.56	3.63
08th	4.85	11.74	11.33	3.56	4.81	5.67	2.67	4.52	7.44
15th	5.85	12.67	13.07	6.11	4.48	7.81	3.70	5.63	7.52
22nd	9.26	14.35	11.70	11.74	6.15	7.81	5.93	8.52	11.33
29th	11.26	10.67	0.15	11.81	7.04	0.52	8.00	9.74	0.15
Nov., 5th	12.41	11.19	0.00	10.44	7.00	0.04	9.59	10.33	0.00
Mean ±SE	**4.94 a ±1.46**	**8.13 a ±1.65**	**5.23 a ±1.69**	**4.70 a ±1.56**	**3.61 a ±0.85**	**2.67 a ±1.01**	**3.39 a ±1.08**	**4.26 a ±1.30**	**3.14 a ±1.32**
F value	**1.21**			**0.74**			**0.23**		
LSD	**4.6541**			**3.4312**			**3.592**		

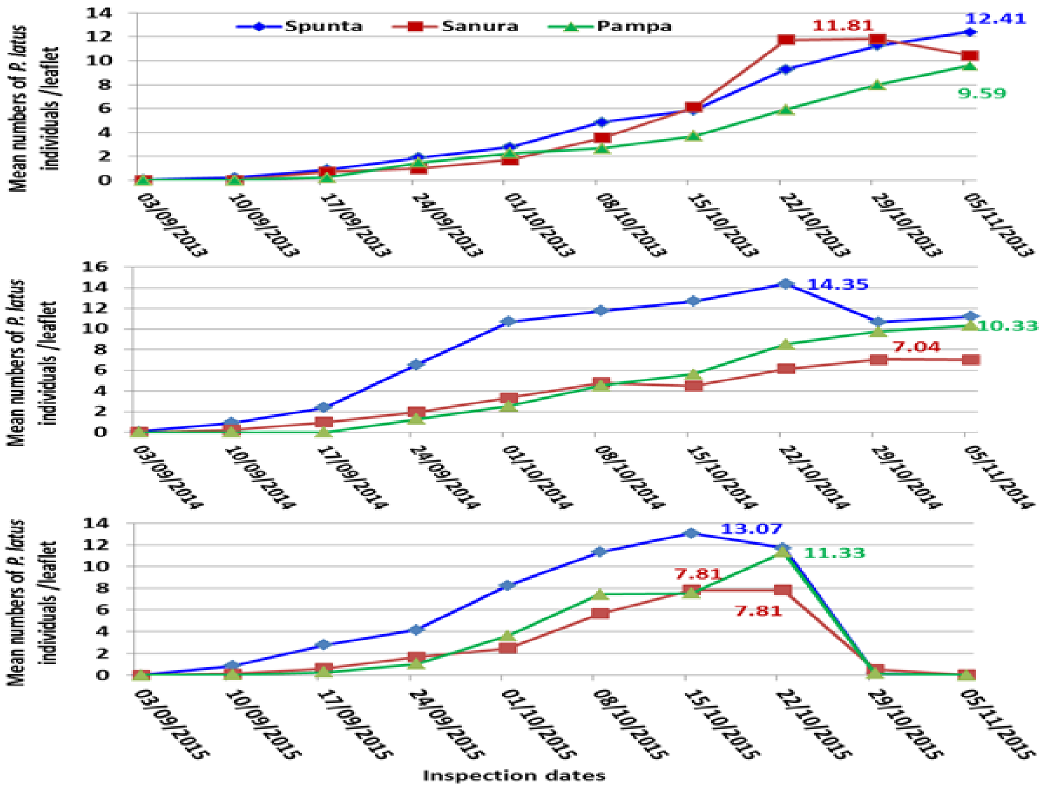

Fig. 1: Weekly mean numbers of *P. latus* individuals/ leaflet on potato plants during three growing seasons, 2013, 2014 and 2015.

During 10 weeks of inspections, the susceptibility of potato varieties, Spunta, Sanura and Pampa against *P. latus* individuals during three seasons was studied. According to statistical analyses and L.S.D. value, the tested cultivars can be categorized according to the order of infestation levels to three groups: The highest susceptible cultivars were represented by Spunta with mean number of 6.10 ±1.02 individuals /leaflet. The Moderate susceptible cultivar was represented by Sanura (3.66 ±0.59 individuals /leaflet). The lowest susceptible cultivar was represented by Pampa (3.60 ±0.34 individuals /leaflet) (Table 2).

Table 2: The susceptibility of potato varieties against *P. latus* individuals during three seasons.

Inspection dates	Potato varieties		
	Spunta	**Sanura**	**Pampa**
2013	4.94±1.46	4.70±1.56	3.39±1.08
2014	8.13±1.65	3.61±0.85	4.26±1.30
2015	5.23±1.69	2.67±1.01	3.14±1.32
Mean ± SE	**6.10 ^{a} ±1.02**	**3.66 ^{ab} ±0.59**	**3.60 ^{b} ±0.34**
F value	**4.08**		
LSD	**2.444**		

The susceptibility to mite damage has been studied also in other crops. Most of the investigations concluded that different cultivars were susceptible to the mite *P. latus*, however at varying levels viz. in potato (Kamlesh and Luthra, 2007), Jute (Yadav and Adbhut, 2010), mulberry trees (Zhang *et al*. 1990), sesame (Ahuja and Kalyan, 2001), cotton (*Gossypium hirsutum*) (Vieira *et al.*, 2002), eggplant (Gui *et al.*, 2001), cucumber (Grinberg *et al*., 2005) and sweet orange plants (Umeh *et al.*, 2007). The difference in the susceptibility of different potato cultivars observed in the present study to infestation by *P. latus* may be due to change of phytochemical components in the leaves, physical and anatomical characters and genetic variability to pest resistance.

Impact of some climatic factors on *P. latus* population dynamic in potato cultivars

The results of applying simple correlation reflected that maximum temperature had significantly negative effect on mite population during seasons of 2013 and 2014 (r = -0.752 and -0.710, respectively) on Spunta variety except in season 2015 which it showed a slight positive correlation but insignificant (r = 0.029). Also, the relation with maximum temperature was negative (r = -0.648, -0.883 & -0.082 and -0.758, -0.862 & -0.092 during 2013, 2014 & 2015 on Sanura and Pampa varieties, respectively). Similarly, the relationship was high significant and negative effect in case of average temperature except during 2015 which it was insignificant effect on all the tested varieties. However, the correlation was negative but non-significant effect minimum temperature on all varieties. This means that the population of *P. latus* increased with the decrease of these factors (Table 3).

Table 3: The relationship between some climatic factors, plant age, and seasonal dynamics of *P. latus* on potato varieties during three seasons.

Factors		**Potato varieties**								
		Spunta			**Sanura**			**Pampa**		
		2013	**2014**	**2015**	**2013**	**2014**	**2015**	**2013**	**2014**	**2015**
Mean of population		4.94	8.13	5.23	4.70	3.61	2.67	3.39	4.26	3.14
Correlation values (r) with some climatic and plant age factors	**Max. T°C**	-0.752	-0.710	0.029	-0.648	-0.883	-0.082	-0.758	-0.862	-0.092
	Prob.	0.012	0.022	0.936	0.043	0.001	0.821	0.011	0.001	0.801
	Mini. T°C	-0.481	-0.277	-0.276	-0.553	-0.483	-0.415	-0.392	-0.473	-0.394
	Prob.	0.159	0.439	0.440	0.097	0.157	0.234	0.262	0.168	0.260
	Avg. T°C	-0.841	-0.646	-0.089	-0.772	-0.845	-0.213	-0.812	-0.825	-0.211
	Prob.	0.002	0.044	0.807	0.009	0.002	0.554	0.004	0	0.558
	Max. RH %	0.782	0.567	0.438	0.719	0.711	0.571	0.742	0.692	0.698
	Prob.	0.008	0.088	0.205	0.019	0.021	0.085	0.014	0.027	0.025
	Mini. RH %	-0.663	0.388	-0.256	-0.720	0.399	-0.183	-0.646	0.357	-0.161
	Prob.	0.037	0.268	0.475	0.019	0.253	0.612	0.044	0.311	0.656
	RH avg.%	0.634	0.532	0.392	0.556	0.636	0.542	0.596	0.607	0.676
	Prob.	0.049	0.113	0.263	0.095	0.048	0.106	0.069	0.063	0.032
	Age	0.971	0.867	0.239	0.926	0.986	0.348	0.957	0.973	0.350
	Prob.	0.0001	0.001	0.506	0.0001	0.0001	0.324	0.0001	0.0001	0.322
E.V.%		97.41	96.47	75.88	98.02	98.60	84.27	96.38	97.62	81.10

Avg. = Average **Prob.** = Probability

Data tabulated in Table (3) show that maximum and average relative humidity had low to moderate positive significant effect with the mite population on all potato varieties. This means that the population of *P. latus* increased with the increase of these factors. On the other hand, the minimum relative humidity had negative significant effect on mite population on all tested potato varieties except during 2014 when it was noticed a positive but insignificant effect on all varieties. In case of plant age, the simple correlation illustrated a high significant and positive effect on the broad mite, *P. latus* infestation on Spunta, Sanura and Pampa varieties during 2013 and 2014. While, the effect was a slight positive but non-significant during season 2015 in all tested potato varieties, this means that the mite population increased with the increase of this factor (Table 3).

The relationship between these factors (maximum, minimum and mean temperatures, and relative humidity and plant age) and the population fluctuation of *P. latus* individuals is expressed by calculating the explained variance (E.V. %) between them in three potato cultivars (Table 3). The E.V. % value ranged between 75.88% and 98.60% (Table 3).

Population fluctuation of broad mite *P. latus* and their relation with various meteorological variables was extensively studied on potatoes as on a wide variety of crops viz. in pepper (Hassan, 2011), cucumber (Mostafa, 2007) and jute (Zaman and Karimullah, 1987). Temperature, relative humidity and plant age were common factors affecting the development rate of various stages of mites, followed by other factors such as rainfall, initial population and growth condition of food plants (Hassan, 2011), where the population density of *P. latus* is positively correlated with both temperature and relative humidity. The increase of population density was influenced by temperature, rainfall, initial population and the growth condition of food plants in China (Misra *et al.*, 1990). Also, Ahuja (2000) found that maximum temperature showed negative and significant correlation with mite population on sesame and the correlation between minimum temperature and the number of mites was negative and non-significant. Accordingly, we concluded that the temperature-humidity combination and the plant age are an important regulatory factor affecting mite development.

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ARABIC SUMMERY

التذبذب العددى للحلم *Polyphagotarsonemus latus* (Acari: Tarsonemidae) على أكثر أصناف البطاطس شيوعاً فى مصر

عبد الناصر حسن

معهد بحوث وقاية النباتات ، مركز البحوث الزراعية ، الدقى ، مصر

تم تنفيذ التجارب الحقلية بمحافظة البحيرة بمركز أبو حمص بقرية بركة غطاس خلال ثلاث عروات نيلية متتالية (٢٠١٣ ، ٢٠١٤ ، ٢٠١٥) لتقييم حساسية ثلاثة أصناف من البطاطس (سبونتا ، سنيورا ، بمبا) للحلم الترسونومي وكذلك درجات الحرارة وإلقاء الضوء على التعداد وعلاقته بالعوامل الجوية.

أوضحت الدراسة أن الصنف اسبونتا كان أكثر حساسية للحلم الترسونوموى بمتوسط ٦,١ ± ١,٠٢ فرد / وريقة يليه الصنف سنيورا بمتوسط ٣,٦٦ ± ٠,٥٩ بينما أظهر الصنف بمبا أنه أكثر تحملاً وأقل عدداً بمتوسط ٣,٦٠ ± ٠,٣٤.

وبينت التجارب أيضاً أن درجات الحرارة العظمى والصغرى والمتوسطة كان لها تأثير سالب بينما كان غير معلوم على تعداد الآفة. وأظهرت النتائج وجود تأثير موجب ومعنوى لكل من نسبة الرطوبة الصغرى والعظمى والمتوسطة وكذلك عمر النبات على تعداد هذه الآفة على الأصناف الثلاثة المختبرة.