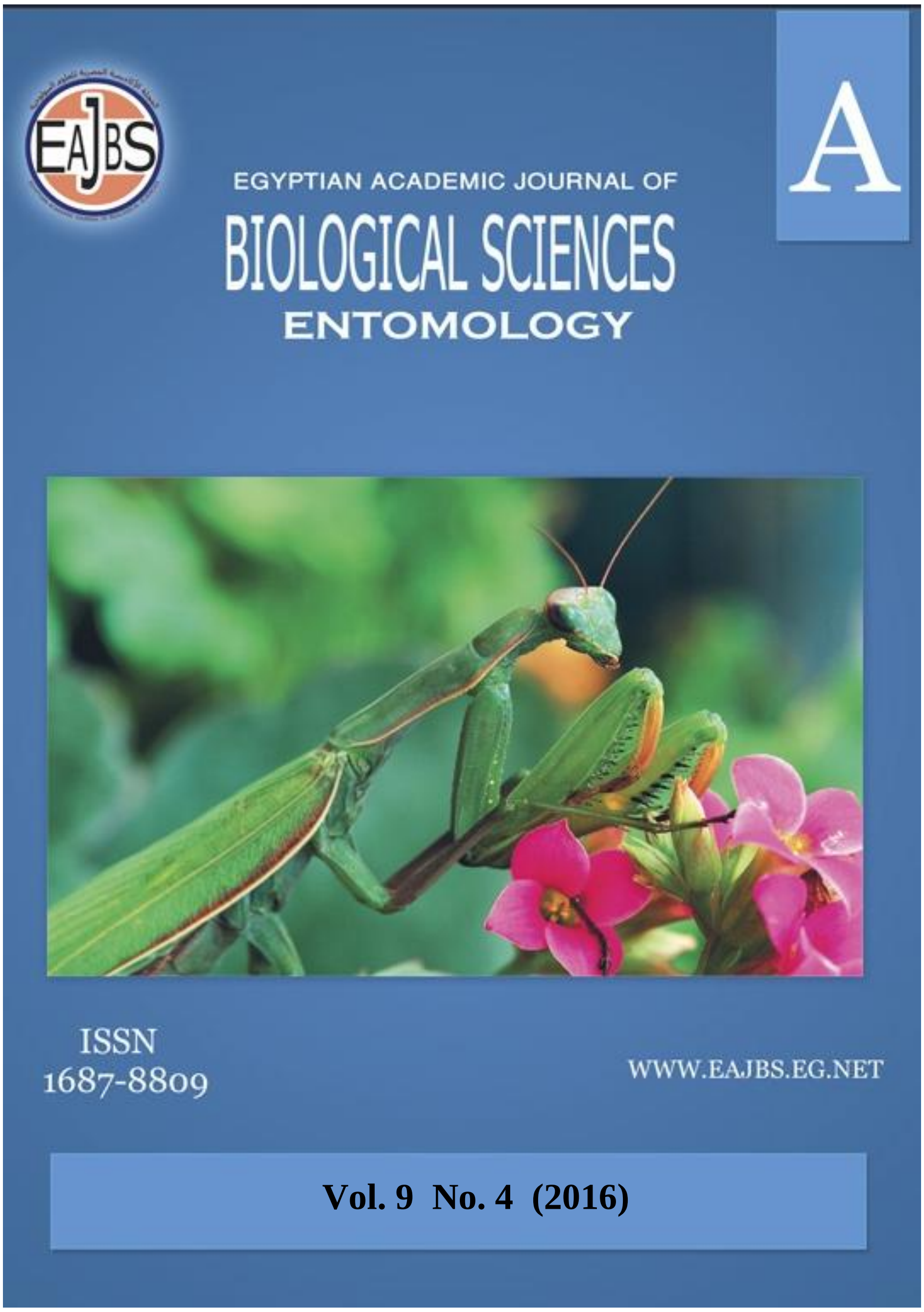

Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences, Department of Entomology, Faculty of Sciences Ain Shams University.

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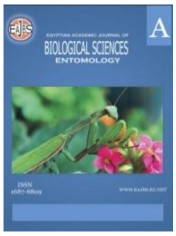
www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (A. Entomology) Vol.9 (4)pp. 129- 140(2016)*

Egypt. Acad. J. Biolog. Sci., 9(4): 129–140 (2016)

Egyptian Academic Journal of Biological Sciences
A. Entomology

ISSN 1687- 8809
www.eajbs.eg.net



Seasonal Abundance of *Brevipalpus phoenicis* (Acari: Tenuipalpidae) and Its Predators and Their Effects on *Gerbera jamesonii* Morphology

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ARTICLE INFO
Article History
Received:15/9/2016
Accepted:30/10/2016

Keywords:
Brevipalpus phoenicis
Abundance
Abiotic factors
Gerbera jamesonii
Photosynthetic pigments

ABSTRACT

The objective of this research was to study the abundance and prevalence of *Brevipalpus phoenicis* and its predators on *Gerbera jamesonii* Bolus and its relation with different weather variables during a one-year study 2015 at Ismailia Governorate, Egypt. The abundance of *B. phoenicis* life stages was monitored monthly. The effects of mite's infestation on *G. jamesonii* morphology represented in leaf, flower, bud and flower deformity numbers during spring was considered, in addition to the photosynthetic pigments. Our results revealed great variations in mite population throughout the year. The highest density of *B. phoenicis* adults, eggs, larvae, nymphs were recorded in January (50.25±6.08), May (71.85±8.57), January (31.40±4.71), July (74.43±8.73), respectively while the minimum density were recorded in October (4.10±0.83), September (10.30±2.09), August (1.95±0.46) and (16.10±2.50), respectively. Three predacious mites: *Amblyseius cucumeris*, *Hemicheyletia wellsina*, *Tydeus* sp. and one predacious insect *Scolothrips longicornis* were recorded. Negative correlations was recorded between *B. phoenicis* eggs or larvae with *S. longicornis* (-0.122, -0.168), respectively. Significant negative correlations were observed between different *B. phoenicis* life stages, *Tydeus* sp. and *S. longicornis* with temperature and relative humidity. There were significant negative or positive correlations between life stages of *B. phoenicis* and the morphological characteristics of the plant. Highly significant negative correlation was recorded between mite infestation and photosynthetic pigments. In conclusion, *G. jamesonii* is recorded as a new host for *B. phoenicis* with a marked deformation in the plant morphology. In addition environmental factors had a great effect on its abundance.

INTRODUCTION

Ornamental plants are grown widely to enrich the beauty of home gardens and parks but nowadays it represents a threat to the environment after being attacked by several insects and mites. Such mites mainly belong to families Tetranychidae, Tenuipalpidae, Eriophidae, Acaridae and Tarsonemidae (Ripka, 1998; Zhang, 2003).

Gerbera jamesonii Bolus is an ornamental member of the sunflower Asteraceae (Compositae) of great commercial value. Because of its colour, long vase life and ability to rehydrate after long transportation, it became in demand from floral industry as cut flower as well as potted plant (Lorenzi & Souza, 2000; Kanwar & Kumar, 2008). It is one of the ten most popular commercial cut flowers in the world ranked the fifth after rose, carnation, chrysanthemum, and tulip (Solgi *et al*., 2009). Besides its great commercial value it was recorded as the best air-filtering houseplants that absorbs the indoor gases and increased the quality of indoor air, according to NASA (Wolverton *et al*., 1989; Richard, 2012). It was also used as a control strategy in many crops, either as a trapping/banking plant or as a trapping/killing plant (Blumthal *et al*., 2005).

Brevipalpus phoenicis, the false spider mite or flat mite is the most important and economic pest within the family Tenuipalpidae (Childers & Rodrigues, 2011; Vásquez *et al*., 2012). It is the major pest of citrus (Teodoro & Reis, 2006), coffee (Chagas *et al.*, 2001), Indian tea (Kennedy *et al*., 1996) in addition to over 50 genera of ornamental plants (Smith-Meyer, 1979; Childers *et al*., 2003b).

Nowadays, *B. phoenicis* has been registered on *G. jamesonii* which is famous being attacked by *Tetranychus urticae* worldwide and it is as one of its main pests (Burdajewicz & Pelczynska, 1978; Nucifora & Calabretta, 1986; Bolland *et al*., 1998; Krips *et al*., 2001; Silva *et al*., 2009; Sulzbach *et al*., 2015). *B. phoenicis* feeds on the lower surface of leaf, in particular on the sap then inject toxic saliva into fruits, leaves, stems, and bud tissues of their host plant. Severe infestations lead to yellowing and drought in the plants affecting its growth thus their product quality reduced and lacking its marketability (Lazarova, 1975; Childers & Rodrigues, 2011).

It was known that *Brevipalpus* sp. was not important as spider mites according to Baker (1949) who first described *Brevipalpus* species but after various studies, it was evident that the genus *Brevipalpus* can be serious plant pests (Childers *et al.*, 2001; Parrella *et al*., 2014) as they are vectors of one or more cytoplasmic or nuclear plant viruses (Childers & Rodrigues, 2011; Alberti & Kitajima, 2014). So that because of its potential threat of introduction of one or more serious viral diseases into other crops, it is essential to shed light on this dangerous family as they are known to be long-lived and maintain their abilities to move from their main host (citrus or coffee) to other host plants (Childers *et al*., 2003 a, b).

The goal of this study is to obtain a more complete picture of the monthly variations on abundance and prevalence of *B. phoenicis* life stages, its predators and other pests infesting *G. jamesonii* under the influence of temperature, humidity, wind speed, rainfall, and sunshine hours. Additionally, the effects of mite's infestation on morphology and photosynthetic pigments of *G. jamesonii* were studied.

MATERIAL AND METHODS

Study site

The field experiments were conducted in a nursery of Faculty of Agriculture, Suez Canal University, Ismailia, located in Ismailia-Cairo desert road north-eastern Egypt.

Experiment (1): Seasonal abundance & prevalence of *B. phoenicis* life stages and its associated predators on *G. jamesonii*

The effect of monthly variations in temperature, relative humidity, sunshine hours, wind speed and rain on abundance and prevalence of *B. phoenicis* life stages and its associated predators on *G. jamesonii* were conducted for one year 2015.

Twenty leaves were collected monthly from the studied plants. Five leaves were selected from 4 plants, collected randomly and carried to the laboratory using separate polythene bags. Every plant served as a replicate. They were examined under stereo-binocular microscope in the laboratory. Different stages of flat mite viz. eggs, larvae, nymphs and adults, were counted. Field temperature (in degree Celsius), relative humidity (in percent), sunshine hours (in hrs.), wind speed (in Kilometers/hour) and rain (in millimeters) were obtained from the Central Laboratory for Agricultural Climate (CLAC), Agriculture Research Center, Egypt.

Experiment (2): Effects of *B. phoenicis* infestation density on morphological characteristics and photosynthetic pigments of *G. jamesonii*

For studying the possible effects of mite infestation density on some morphological characteristics of *G. jamesonii*, the leaf, flower, and bud numbers were counted in addition to the deformation in the flowers and length of main stem. *G. jamesonii* plants were divided into four groups: heavy, moderate, and mild infestations beside the control groups within a complete randomized block design consisting of five replicates per treatment at the same selected nursery. At each sampling date, ten leaves per plant were examined under a stereomicroscope and the egg, nymph, and adult stages of *B. phoenicis* per leaf were counted. The experiment was conducted during spring.

Estimation of photosynthetic pigments

At the end of experiment (last week of sampling), plant leaves were collected for photosynthetic pigments test. The level of chlorophyll a (Chl. a), chlorophyll b (Chl. b), total chlorophylls (Chl.) and carotenoids (Car.) in leaves were determined from acetone extract after Wettstein (1957) and expressed as mg g^{-1} leaf fresh mass. Each sample was consisted of 5 leaves per repetition. The absorbance was recorded at 645 and 663 nm for chlorophyll assay and 480 nm for carotenoids assay by spectrophotometer (Unico UV/VIS 2100, USA).

Statistical analysis

The percentage of infested leaves to non-infested one was calculated. Abundance, the number of individuals found per sample, was calculated and represented as Mean (±SE). To satisfy the assumption of statistical analysis used, all the data were normalized by log (x+1) transformation to achieve linearity. Analysis of variance was used for studying the significant differences between groups regarding the effects of monthly and site variations. All the statistical tests were performed by using the software packages SPSS 15.0.0 (USA).

RESULTS AND DISCUSSION

Unfortunately, *Gerbera* sp. make excellent host for different insect pests to the extent of being used as a trap plant for different pests especially western flower thrips, *Frankliniella occidentalis* which is its main pest with spider mites (Blumthal *et al*., 2005; Spiers *et al*., 2006).

Until very recently, little data dealing with interactions between *G. jamesonii* and false spider mites were available. All the studies dealt with the fact that *T. urticae* is key pest of *Gerbera* sp. In contrast to our findings, that the *B. phoenicis* is the main pest affecting *G. jamesonii*. This was in agreement with Silva *et al*. (2009) and Sulzbach *et al*. (2015) who evaluated in Brazil the abundance of *T. urticae* in three varieties of *G. jamesonii* Adlam. Also, in Iran and India the *T. urticae* was recorded on *Gerbera* sp. (Pal & Sarkar, 2009; Haghghadam & Arbabi, 2012).

Regarding the effect of monthly variations on abundance and percentage of infested leaves with different stages of *B. phoenicis* and other pests on *G. jamesonii*, results showed significant effects as shown in Tables (1 & 2). *B. phoenicis* adults density per leaf was found maximum in January (50.25±6.08) whereas it was minimum in October (4.10±0.83) (P <0.000).

Table 1: Monthly variations of *B. phoenicis* life stages (mean ± SE), its predators, and other pests infesting *G. jamesonii* during one year survey 2015.

Months	***Brevipalpus phoenicis***				**Predacious mites**			**Predacious insect**	**Insect Pests**			
	Adults	**Eggs**	**Larvae**	**Nymphs**	***Amblyseius cucumeris***	***Hemicheyletia wellsina***	***Tydeus* sp.**	***Scolothrips longicornis***	***Myzus persica***	***Bemissia tabaci***	**Scale insects**	**Mealy bugs**
January	50.25 ±6.08	33.95 ±5.61	31.40 ±4.71	26.10 ±3.38	0	0	0.10 ± 0.07	0	0	0	0	0
February	32.75 ±4.49	37.60 ±4.94	16.05 ±2.47	24.75 ±2.69	0.10 ±0.07	0	11.85 ± 4.33	0	0.05 ±0.05	0.10 ±0.10	0.25 ±0.18	0
March	25.30 ±4.88	19.70 ±2.51	20.30 ±2.524	19.25 ±2.88	0	0	6.15 ± 2.18	0	0	0	0	0
April	36.68 ±11.79	29.32 ±8.59	24.89 ±4.06	23.31 ±3.68	0	0.15 ± 0.08	2.47 ± 0.59	0.05 ±0.05	2.31 ±0.53	0	0	0
May	21.80 ±3.56	71.85 ±8.57	24.15 ±3.99	49.05 ±6.76	0.10 ±0.07	0	1.10 ± 0.28	0	0.85 ±0.55	0	0	0
June	22.60 ±2.87	66.10 ±7.41	24.30 ±2.89	74.43 ±8.73	0.05 ±0.05	0.05 ±0.05	0.60 ± 0.17	0	0	0.25 ±0.09	0	0
July	23.25 ±2.97	31.80 ±6.00	8.35 ±1.22	73.05 ±8.14	0	0.15 ± 0.08	0.25 ± 0.09	0.50 ±0.21	0	0.05 ±0.05	0	0
August	6.60 ±1.36	13.20 ±2.38	1.95 ± 0.46	16.10 ±2.50	0	0	0.50 ± 0.32	0	0	0.95 ±0.359	0	0
September	4.45 ±0.97	10.30 ±2.09	3.45 ± 0.70	23.10 ±3.26	0	0.25 ±0.12	0	0.50 ±0.18	0	2.15 ±0.79	0	0
October	4.10 ±0.83	18.15 ±2.32	12.30 ±1.89	23.15 ±4.97	0	1.20 ±0.54	0.05 ± 0.05	0.35 ±0.21	0	6.85 ±2.57	0	0.05 ±0.05
November	13.35 ±2.79	37.00 ±5.38	25.25 ±0.83	60.40 ±7.18	0.25 ±0.09	0	0.50 ± 0.31	0.05 ±0.05	0.05 ±0.05	1.35 ±0.55	0.05 ±0.05	0
December	28.69 ±4.90	21.26 ±2.59	16.08 ±2.41	22.10 ±2.20	0	0.04 ±0.03	1.02 ± 0.46	0.04 ±0.03	0	2.30 ±1.33	0.04 ±0.03	0

Table 2: Percentage of infested leaves with *B. phoenicis* (life stages), its predators, and other pests infesting *G. jamesonii* during one year survey 2015.

Months	***Brevipalpus phoenicis***				**Predacious mites**			**Predacious insect**	**Insect Pests**			
	Adults	**Eggs**	**Larvae**	**Nymphs**	***Amblyseius cucumeris***	***Hemicheyletia wellsina***	***Tydeus* sp.**	***Scolothrips longicornis***	***Myzus persica***	***Bemissia tabaci***	**Scale insects**	**Mealy bugs**
January	100	100	100	100	0	0	5	0	0	0	0	0
February	100	100	100	100	10	0	85	0	5	5	10	0
March	100	100	100	100	0	0	55	0	0	0	0	0
April	100	100	100	100	0	15	80	5	65	0	0	0
May	100	100	100	100	10	0	60	0	30	0	0	0
June	100	100	100	100	5	5	45	0	0	25	0	0
July	100	100	100	100	0	15	25	25	0	5	0	0
August	100	100	75	100	0	0	15	0	0	45	0	0
September	95	100	85	100	0	20	0	35	0	45	0	0
October	85	100	100	100	0	40	5	20	0	70	0	5
November	100	100	100	100	25	0	15	5	5	55	5	0
December	100	100	100	100	0	5	25	5	0	35	5	0

The infestation rate of leaves with *B. phoenicis* adults was ranged from 85 to 100%. Eggs density per leaf was found maximum in May (71.85±8.57) whereas it was minimum in September (10.30±2.09) (P <0.000). The infestation rate of leaves with *B. phoenicis* eggs was 100%. The larval population density per leaf was maximum in January (31.40±4.71) and minimum during August (1.95±0.46) (P <0.000). The infestation rate of leaves with *B. phoenicis* larvae was ranged from 75 to 100%. The nymphal population density per leaf was maximum in July (74.43±8.73) and minimum in August (16.10±2.50) (P <0.000). The infestation rate of leaves with *B. phoenicis* nymphs was 100%.

These findings were in agreement with Rezk (2001) who recorded the *Brevipalpus obovatus* as a major pest of citrus trees in Egypt with a peak in February (21.23±0.8 mites/30 leaves) then decreased in September-November ranging between

(15.7±1.2 and 18.39±0.9 mites/30 leaves) then declined sharply in August. In accordance, the results also agree with the findings of Rizk *et al*. (1978), Raizer *et al*. (1988), and Sadana & Kumari (1991).

On the contrary, Karmakar & Saha (2005) found that *B. phoenicis* increased during October (15.l3 mites/leaf) and thereafter decreased with a minimum level in January (0.20 mites/leaf). Also, a peak of *B. phoenicis* population on guava was reported on November-December by Kumari & Sadana (1995). These observations were in similarity with the earlier findings of Patel & Karmakar (2005) who recorded that maximum population of *B. phoenicis* in pointed gourd was in September. Also, Pal & Sarkar (2009) recorded *T. urticae* on *Gerbera* sp. in June, July, August, and September. In addition, Shah & Shukla (2014) found that *T. urticae* on *Gerbera* sp. was maximum in July (12.86 mites/leaf).

In Egypt, tenuipalpidus are the most important fruit tree pests (Zaher & EL-Badry, 1964; Yousef, 1967; Wafa *et al*., 1969). The genus *Brevipalpus* was first recorded in Egypt by Attiah (1956) on pear, quince, vines and ornamental plants with no males of *B. inornatus*, *B. phoenicis* or *B. lewisi* have been observed in Lower and Upper Egypt. *B. phoenicis* has been registered lately on *Gerbera* sp. (Childers *et al*., 2003b) with no studies on its abundance and prevalence on ornamentals as they weren't preferred hosts. *B. phoenicis* population varied significantly on different months of the year on *G. jamesonii* as being a perennial herb host they persist on it throughout the year.

Regarding the predators, results showed the presence of three predacious mites: *Amblyseius cucumeris* (Acari: Mesostigmata: Phytoseiidae), *Hemicheyletia wellsina* (Acari: Prostigmata: Cheyletidae) and *Tydeus* sp. (Acari: Prostigmata: Tydeidae), and one predacious insect *Scolothrips longicornis* (Thysanoptera: Thripidae).

A. cucumeris was recorded in February, May, June, and November. Its density per leaf was maximum in November (0.25±0.09) whereas it was minimum in February (0.10±0.07) ($P < 0.000$). Concerning *H. wellsina*, it was recorded in April, June, July, September, October, and December. Its density per leaf was maximum in October (1.20±0.54) whereas it was minimum in December (0.04±0.03) ($P < 0.000$). Concerning *Tydeus* sp., it was recorded all the year except September. Its density per leaf was maximum in February (11.85±4.33) whereas it was minimum in October (0.05±0.05) ($P < 0.000$). Concerning *S. longicornis*, it was recorded in April, July, September, October, November, and December. Its density per leaf was maximum in July (0.50±0.18) whereas it was minimum in December (0.04±0.03) ($P < 0.000$). Negative correlations were found between *B. phoenicis* egg or larvae was recorded with *S. longicornis* (-0.122, -0.168), respectively.

However, the population decline of *B. phoenicis* happened also without being affected by predators. In contrast to our results, Lacordaire (2011) recorded the following predators *Phytoseiulus persimilis* and *Feltiella acarisuga* on *G. jamesonii* who are not always sufficient for a good control of *T. urticae*. In addition, De Moraes & Tamai (1997) stated that *Tetranychus* sp. and *P. persimilis* was commonly found attacking ornamentals in production plants and indoor landscaping. In Iran, Haghghadam & Arbabi (2012) recorded *Tydeus* sp. only on ornamental plant (*Acalypha hispida*) which is similar to the present study. However no previous studies were found concerning the effects of temperature on predators.

Regarding insect pests, results showed the presence of aphids (*Myzus persicae*) (Hemiptera: Aphididae), whiteflies (*Bemisia tabaci*) (Hemiptera: Aleyrodidae), scale insects (Hemiptera: Coccoidea) and mealybugs (Hemiptera: Pseudococcidae). *M. persicae* was recorded in February, April, July, September, October, November, and December. Its density per leaf was maximum in April (2.31±0.53) whereas it was minimum in November (0.05±0.05) (P <0.000). *B. tabaci* was recorded in February, June, July, August, September, October, November, and December. Its density per leaf was maximum in December (2.15±0.79) whereas it was minimum in July (0.05±0.05) (P <0.001). Negative correlations between *B. phoenicis* adult or egg with *B. tabaci* (-0.139, -0.131), respectively was observed.

Our results agree with Pal & Sarkar (2009) who recorded in India the presence of *M. persicae*, *B. tabaci* on *G. jamesonii* during the dry summer months. Also Nucifora & Calabretta (1986) found in Sicily that *G. jamesonii* minor pests were *M. persicae*, *A. gossypii*, *Chrysodeixis chalcites*, *Nesidiocoris tenuis*, *Phylloperta lineata* and *Cacoecimorpha pronubana*.

The impact of environmental factors on mite population abundance were studied and illustrated in Table (3) and Figure (1). The *B. phoenicis* adult had a highly significant negative correlation with TºC, RH% and sunshine hrs. whereas it had a positive correlation with wind speed and rain. *B. phoenicis* eggs had only a positive significant correlation with sunshine (hrs.) while larvae had a highly significant negative correlation with TºC and a significant positive correlation with rain and sunshine hrs. *B. phoenicis* nymphs had a highly significant positive correlation with TºC, RH% and sunshine (hrs.) and a negative significant correlation with wind speed and rain.

Table 3: Correlation between *B. phoenicis* (life stages), its predators, other pests infesting *G. jamesonii*, and weather factors during one year survey 2015.

Factors	Correlation	*B. phoenicis* life stages				Predacious mite	Predacious insect	Insect
		Adults	Eggs	Larvae	Nymphs	*Tydeus* sp.	*S. longicornis*	*B. tabaci*
Temperature (ºC)	R	-0.465(**)	-	-0.451(**)	0.221(**)	-0.247(**)	-0.217(**)	0.159(*)
	P	0.000	-	0.000	0.001	0.000	0.001	0.014
RH (%)	R	-0.165(*)		-	0.129(*)	-0.220(**)	-	-
	P	0.010		-	0.045	0.001	-	-
Wind speed (km/h)	R	0.200(**)	-	-	-0.153(*)	-	-	-
	P	0.002	-	-	0.017	-	-	-
Rain (mm)	R	0.397(**)	-	0.231(**)	-0.165(*)	-	-	-
	P	0.000	-	0.000	0.010	-	-	-
Sunshine hours (hrs.)	R	-0.256(**)	0.204(**)	0.235(**)	0.394(**)	-	-	-
	P	0.000	0.002	0.000	0.000	-	-	-

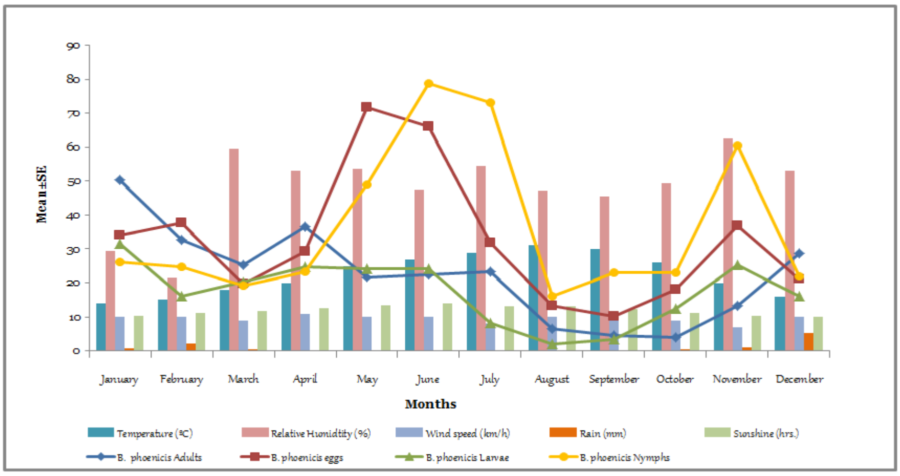

Fig. 1: Mean ± SE abundance of *B. phoenicis* adults, eggs, larvae, and nymphs infesting *G. jamesonii* influenced by weather factors during one year survey 2015.

The changes of the climatic conditions have determined the proliferation and dispersion of several pests associated with parks and ornamental gardens like tetranychid, eriophyid and tarsonemid mites (Gutue *et al*., 2012). The *B. phoenicis* adults and larvae had a negative significant correlation with temperature this was in agreement with Gupta *et al.* (1976) and Baradara *et al*. (2001) who indicated the negative correlation between TºC and *T. cinnabarinus* developmental stages and also female longevity studied on *Gerbera* sp. On the other hand, Shah & Shukla (2014) showed a non-significant negative correlation between *T. urticae* populations and temperature.

Concerning humidity, *B. phoenicis* adults had a significant negative correlation with relative humidity in agreement with Sağlam & Çobanoğlu (2010) who found a negative correlation between *B. phoenicis* density and relative humidity on pelargonium in Turkey. In contrast, Karmakar & Saha (2005) found that *B. phoenicis* had a positive correlation with temperature and relative humidity whereas correlations with other meteorological parameters were found to be non-significant. The positive influence of relative humidity on the population of mites was also reported by Gupta *et al.* (1976) and Shah & Shukla (2014) who showed a significant positive correlation between relative humidity and *T. urticae* population on *Gerbera* sp. Hence our study reflects great variations of temperature effects on *B. phoenicis* life stages and also on its predators.

The effect of *B. phoenicis* adult, egg, and nymph stages on the morphological characteristics of *G. jamesonii* during spring was shown in Tables (4) and (5). There were high significant negative correlations between *B. phoenicis* life stages and leaf, flower, bud numbers, and length of flowering stem while a positive significant correlation was found with deformed flower numbers. The physiological and morphological changes of plants caused as a result of mites' infestation that lead to various biochemical changes in plants minerals, inorganic and organic compounds (Shree & Nataraja, 1993).

Table 4: Effect of *B. phoenicis* adult, egg, and nymph stages on the morphological characteristics of *G. jamesonii* during spring 2015.

Infestation	***B. phoenicis***			**Leaf No.**	**Flower No.**	**Bud No.**	**Deformity flower No.**	**Length of floweringstem**
	Adults	**Eggs**	**Nymphs**					
Control	4.30 ±0.65	10.17 ±1.82	9.30 ±2.65	79.43 ±2.45	15.03 ±1.53	2.13 ±0.24	0	60.25 ±1.98
Heavy infestation	33.27 ±4.41	104.73 ±15.22	80.13 ±14.43	21.90 ±1.79	2.5333 ±0.33	0	2.33 ±0.23	41.50 ±1.00
Moderate infestation	12.90 ±1.82	35.63 ±6.39	24.50 ±5.11	28.83 ±1.93	4.97 ±0.58	0.97 ±0.195	0.63 ±0.14	43.56 ±1.75
Mild infestation	9.11 ±1.41	13.47 ±2.35	18.31 ±3.59	52.21 ±3.13	5.24 ±0.56	1.32 ±0.23	0.26 ±0.09	52.54 ±2.21

Table 5: Correlation between density of *B. phoenicis* adult, egg and nymph stages and the morphological characteristics of *G. jamesonii* during spring 2015.

Parameters	**Correlation**	**Leaf No.**	**Flower No.**	**Bud No.**	**Deformity flower No.**	**Length of flowering stem**
***B. phoenicis* Adults**	R	-0.485(**)	-0.383(**)	-0.320(**)	0.411(**)	-0.355(**)
	P	0.000	0.000	0.000	0.000	0.000
***B. phoenicis* Eggs**	R	-0.436(**)	-0.291(**)	-0.329(**)	0.502(**)	-0.350(**)
	P	0.000	0.000	0.001	0.005	0.000
***B. phoenicis* Nymphs**	R	-0.403(**)	-0.295(**)	-0.256(**)	0.334(**)	-0.288(**)
	P	0.000	0.001	0.000	0.000	0.000

Gerbera sp. is infested with different mite species causing a great morphological deformation in leaf, flowers, and even buds. Broad mites, *Polyphagotarsonemus latus* (Tarsonemidae) are often found damaged *Gerbera* leaves which split have a rugged appearance followed by discoloration or blistering. It also injured flowers which became distorted with discoloured rays. Cyclamen mite, *Phytonemus pallidus* (Banks) (Tarsonemidae) in addition to damaging leaves, reducing its size; it affects rays of flower which are deformed when attacked in the bud stage. Also Bulb mite, *Rhizoglyphus echinopus*, when feeding in the bud stage, results in malformation of the flower base (Zhang, 2003). *Breviplapus californicus* when feeding resulted in the formation of rounded leaves that were severely stunted, marginal necrosis appeared and end with burned leaf tip. Mite also affected the new shoot growth with the formation of corky swollen buds referred to as *Brevipalpus* gall by Knorr & Denmark (1970).

Table (6) showed the effect of *B. phoenicis* adult's infestation on total Chl., Chl. a, Chl. b and carotenoids in *G. jamesonii* leaves. There is high significant negative correlation between adult mite numbers and total Chl. while positive significant correlation was found with Chl. a, Chl. b, and carotenoids. The decrease in chlorophyll level is due to mechanical damage of chloroplasts of leaves due to mite feeding or it may be due to discoloration of chloroplasts. In agreements with our results, Kolodoziej *et al*. (1979) indicated positive correlation between increases in mite density with decrease of chlorophyll. Chatterjee & Gupta (1997) reported chlorophyll damage to the extent of 33.62% on *Luffa acutangula* due to infestation of *Tetranychus ludeni*. Parađiković *et al*. (2008) showed that Chl. b concentration was correlated to longer flower stem length in *G. jamesonii*.

Table 6: Effect of *B. phoenicis* adult's infestation on Total Chl., Chl. a, Chl. b, and carotenoids in *G. jamesonii* leaves.

Treatments	**Adult Mite No.**	**Photosynthetic pigments (mg/ g fresh weight)**			
		Total chlorophyll	**Chlorophyll a**	**Chlorophyll b**	**Carotenoids**
Control	4.80±0.29	2.23±0.06	1.19±0.04	1.04±0.02	0.69±0.02
Mild infestation	8.50±1.22	1.90±0.05	1.09±0.31	0.08±0.02	0.63±0.02
Moderate infestation	12.90±1.29	1.48±0.04	0.93±0.02	0.54±0.01	0.56±0.02
Heavy infestation	33.27±4.08	1.20±0.03	0.74±0.02	0.46±0.01	0.47±0.02
Correlation with mite number	R	-0.768(**)	0.797(**)	0.725(**)	0.749(**)
	P	0.000	0.000	0.000	

Adult mite no. expressed as average no. of mites/ sq. cm leaf.

A reduction in the chlorophyll content is a primary response to spider mite infestation and has been reported in many plants including rose (Landeros *et al*., 2004), cotton (Reddall *et al*., 2004), and bean (Farouk & Osman, 2011). It was found that decrease in Chl. a was more pronounced than Chl. b at different stages of *T. urticae* infestation. Also, a great loss in leaf carotenoid content of bean leaves as a result of *T. urticae* infestation was reported by Farouk & Osman (2011). In corroboration with our studies, Landeros *et al*. (2004) reported that the chlorophyll content of rose was negatively correlated with *T. urticae* population density. The change in amount and rate of the chlorophyll depend on *T. urticae* density and duration of feeding (Alatawi *et al*., 2007). Since little data dealing with interactions between *Gerbera* sp. and false spider mites were available, few data on mite's infestation effects on chlorophyll contents are available.

In conclusion, *G. jamesonii* is recorded as a new host for *B. phoenicis* with a marked deformation in the plant morphology. In addition, environmental factors had a great effect on its abundance hence further studies are needed to assess most congenial period for this mite to develop better management strategy for pest control to increase ornamental plants productivity.

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