Population dynamicsof*Tetranychus urticae*Koch.and associated predators in relation to certain ecological factors in sweet potatofields

ABSTRACT

The two spotted spider mite, *Tetranychus urticae* is a highly polyphagous sap sucking pest, without a hibernation period,efficacy all the year round. He is destructive pest of important and fieldsand vegetable crops. This investigation was carried out atBeheira Governorate during 2023 and 2024 seasons, to monitor the population fluctuations of the spider mite and their predators; *Stethorus gilvifrons*Mulsant,*Coccinella undecimpunctata* L., *Chrysoperla carnea* Stephand*Scymnus interruptus~~interuptus~~*Goeze. In the first season, the infestation of*T. urticae* started on sweet potato plants at low numbers, the population increased gradually to reach its highest peak during 22~~th~~nd July (19.75*Sc. interruptus*individ.). This peak was followed by a relatively high population of the four predators, *S. gilvifrons* (4.75), *C. undecimpunctata* (5.00individ.), *Ch. carnea* (8.00 individ.)and*Sc. interuptus.* (5.00individ.). The second peak of the mite was detected on 14~~st~~th Aug. (48.00individ.), synchronized with the peaks of the four predators. During 2022, the first incidence of the mite was recorded on 22~~th~~nd July~~.~~ (44.25individ). This peak was associated with the peak of the four predators. The second peak of *T. urticae* was observed on 14th Aug.(25.75 individ.), it coincided with the peaks of the four predators. The infestation of*T. urticae* and their predators were highly significantly correlated with weather factors (Max., Min°~~c~~C and RH). From the found data in this experiment,advise that together predators could be effectively application as biological control agents for*T. urticae* management.

Key words: *Tetranychus urticae*, weather factors, predators

Comment [A1]: Correct would be "22nd July" (or just "22 July")

Comment [A2]: The formulation is unclear, I think *Sc. interruptus* should not be included here,please rephrase

Comment [A3]: From 4 and above, use -th (exception: 21st, 22nd, 23rd)

INTRODUCTION

Sweet potato, *Ipomoeabatatas* L. crop is one of the feed crops in the around world for man and animal (FAO 2015). The two spotted spider mite,*Tetranychus urticae* Koch (Acari: Tetranychidae) is one of the most important pests causing severe economic losses~~reduce~~to producers~~to the produces~~, feeding on many plant species~~feeding on the mostspecies of plants~~(Jakubowska and Fiedler 2014). Also, Gaber *et al*., (2023) indicated

that is considered one important pest that caused damage to~~causeddamage on~~ multiple crops~~the more crops~~ and decrease in both quality and quantity of the product with one peak on~~thus was one peak~~ Aug. 7th. On the other hand, Mulukenet *al*., (2016) mentioned that the moving stages of the spider mite feed mostly on sweet potato plants. Bocianowskiet *al*., (2022) showed that the spider mite, *T. urticae* impact on both theupper and lowerside of the leaves in shining places. Nagrare 2012)Sweet potato *Ipomoeabatatas* L crop is one of the food crops in the Egyptian economy for man and animal. In general, through the two seasons, infestations of sweet potato plants, during the growth crop stage, cause severe economic reduced to the crop. Ibrahim (2018) found that five larvae of *Ch. carnea*/100 individual of the mealy bug can be applied as a biological control with *Phenacoccus~~P.~~ solenopsis*. Farhan *et al*., (2011) found that the lacewing, *Ch. carnea* was more efficient as biological control against cotton mealybug, *P. solenopsis*. The information generated may be used for designing a comprehensive pest management program and prediction models for the spider mite,*T. urticae*. The present study was was designed to investigate~~planned to infestation~~ the population density of the two-spotted spider mite~~the two spotted spider mite~~on sweet potato plants, as influenced by predators~~on sweet potato plants as affected by predators~~ and to determine its~~,~~ activity in response to certain synthetic predators under field conditions.Errardet *al*.,(2016) mentioned that the green lacewing, *Ch.carnae* could ~~therefore~~ contribute to the decreased of the spider mite infestation on ~~the~~ plants.Farazmandet *al*., (2014) showed that the adult and larval stages of *S. longlcorms* play on important role in decreased mite populations. El-khouly and Farag (2022) found that the coccinellid predator, *S. gilvifrons* is one of the most important natural enemies of *T. urticae*. El-Basha, (2015) found that the adult of the ~~intraguila~~intraguild predation (IG) predator, *S. gilvifrons* consumed more nymphs of IG mite species. The role of the predator,*S. gilvifrons* reduced population of *T. urticae* on cantaloupe plants at Ismailia Governorate (~~.~~Ahmed *et al*2006). The predator, *S. gilvifrons* (adult and larvae) play an important role in reduction mite populations and was associated with this mite on caster been and tomato~~.~~(EI Adawy *et al*., 2000, Abdel Gayed,2004 and Abo~~u~~ EI-EIa.2014).The established data~~The establish data~~ in this study~~work~~suggest~~advise~~ that ~~both,~~*S. gilvifrons*,*C. undecimpunctata*, *Ch. carnea*and*Sc. interuptus* could be effectively applied~~could be activity~~

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application as biological control agents for spider mite managementas biological control agents with spider mite management.

MATERIALS AND METHODS

1-Land preparation and sowing

This experiment was conducted in the This experiment was conducted carried out atEdfina Rasheed region, Beheira Governorate during the summer seasons of 2023 and 2024during 2023 and 2024 summer seasons, on an area of 2100 m²in an area 2100 m², divided into four equal parts. The land was prepared by plowing three timesThe land was prepared by laughing three times and applying calcium superphosphate at a rate of 250 kg/feddanwith calcium superphosphate at the rate of 250 kg /fed. Sweet potato (*Ipomoea batatas* L.) seedlings were transplanted in the presence of waterSweet potato (*Ipomoeabatatas* L.) seedlings were Trans in the presence of waterin the upper third of the furrows at the beginning of May in both years of the studyat the upper third of the furrows at the beginning of May in both years of study. Sulfate of potash (100 kg/feddan) and nitrogen fertilizer were applied as recommendedSulpha potassium (100 kg/fed.) and nitrogen fertilizer were app as recommended.

2-Sampling for counting the predators

One month after sweet potato tTransplanting, 25 plants were uprootedpulled out from each plot. The plants were gently placed in plastic bagsconfined in plastic bags and transferred to the laboratory for countingtransferred to the laboratory of countingthe three fourconsidered predators.:*S. gilvifrons*, *C. undecimpunctata* L., *Ch. carnea* Stephand*Sc. interruptus*..This sampling technique was applied four timesThis sampling technique was followed for four examine times, while the plants were still young and small in sizeas the plants were still young with small size. After that, the sample consisted of one branch per plant, which was carefully cut and placed in plastic bags. After that, the sample was one branch of potato plants that was cat gently and confined in plastic bagsA total of 25 branches were taken from each replicate to visually count the numbers of the three predators mentioned above, as 25 branches were taken from each replicate do visually count the numbers of the three abovementioned predators. Sampling took place from June 1st to June 5thThe sampling began on June 1st up to June 5th.

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3-Sampling for counting spider mite

The sSpider mite, *T. urticae* Koch (Agari: Tetranychidae) were counted on 25 leafletsleavesflets per replicated. The leafletsleaflets leaveswere collected weeklywere weekly picked up nd transferred to the laboratory for counting both arthropodsand transferred to the laboratory for counting both arthropods, using a binocular microscope.

Statistical analysis

Data of the present experiment indicated that the correlation coefficients for the relationship between the two spotted spider mite and their predators in sweet potato fields, results obtained were statistical analyzed using Duncan's Multipole test (Duncan. 1955).

RESULTS AND DISCUSSION

1. Population fluctuations of *T. urticae*

Results shown in Ttables (1 and 2)indicated that the two-spotted spider mite, *T. urticae* was observed in low population densities up to June 15nthd, and exhibited the first peak with 19.75 nymphs and adults/25 leaflets on Jule22thnd. Two-spider mite peaks; 48.00 and 21.50 individual /25 sweet potato leaflets were showed on July 14th and July 21tsth, respectivelyin 2023. In 2024 season,the two spotted spider mite, *T. urticae* population densities were observed in two peaks of occurrence; 44.25 and 25.75 individual/ 25 sweet potato leaflets on Jule 22ndthand Aug 14th, respectively.Overall means of the two seasons were very similar (13.64) and 13.25) individuals), 25 leaflets in the first and second seasons, respectively.

2-Population fluctuations of the predators

Results of tables (1 and 2)mentioned thatmentioned that the numbers of *S. gilvifrons* appeared in June 30th(1.25 individual) and increased gradually to reached its peak in July 22thnd, represented by 19.75 individual, indicating a second peak during Aug. 14th, th, , represented by 5.00 individual during the first season. While, in the second season it appeared in late June and reached the first peak at the end July (4.75 individual) and the second peak in mid-Aug., represented by 4.25 individual.Data of tables (1 and 2) indicated that thepopulation fluctuation of the ladybird was very decrease up to June, and relatively increased by late June. Then, *C. undeciompunctataundecimpunctata* population fluctuation to exhibit low densities of 4.75 and 5.75predatory individuals by per 25 potato branches, in the first and second seasons,

respectively.Almost the same trend was detected, but with relatively high two peaks on July 22nd~~th~~ and Aug.14th, with 5.00 and 10.00 predatory individuals, respectively, in 2021, 9.50 and 5.75individuals, in the second season, respectively.Generally, in a comparison, *C. ~~undeciompunctata~~undecimpunctata* individuals were relatively in the second season than in the first one. Results of ~~T~~table (1) showed that the chrysopid, *Ch. carnea* appeared in sweet potato field in June 15th and increased gradually reached to highesttwo peakswith 8.00 and 11.75 larvae / 25 potato branches were detected on July 22nd~~th~~ and Aug. 14st~~h~~, respectively in 2023. While, in the second season, found the two peaks with 9.50 and 7.50 larvae / 25 branches on July 22nd~~th~~ and Aug.14th, respectively (t~~T~~able 2). Overall means in both seasons were similar. As shown in Tables (1 and 2) data obviously indicated that theoverall mean of*Sc. i~~I~~nterruptus*in 2024season was obviously higher (3.93 individual/ 25 branches) than that of 2023season (3.71individual). In the first season, the predator was observed with considerable highlynumbersby July 22thand Aug. 14st, represented by 5.00 and 9.75individual, respectively.However, in the second season, the insect densities were relatively high by late-June (3.50 individual), mid- Aug. (6.00 individual) and early September (6.25 individual).

3. Relationship between ~~the some~~some weather factors, numbers of *T. urticae* and their predators by correlation coefficients

Results presented in t~~T~~able ~~(~~3~~)~~indicate~~indicated~~that the correlation coefficients among some weather factors, the populations of the two-spotted spider mite, and their predators were recorded~~that the estimates of correlation coefficients among the somesome weather factors, populations of the two -spotted spider mite and their predators in 2023 and 2024 seasons are recorded~~. Therefore, the relationship between weather factors, mites, and predators showed a positive and highly significant correlation.~~the relationship between weather factors, mite and predators, showed positive and high significant.~~The maximum temperature was negatively correlated with the numbers of *T. urticae* and their predators in most cases~~the maximum temperature correlated with negative values, in most cases, with numbers of *T. urticae* and their predators~~. However, the relative humidity and minimum temperatures generally showed positive and highly significant correlations with the mite and their predators in both the first and second seasons~~However, the relative humidity and minimum temperatures were generally positive and highly significant values with the considered mite and their predators in the first and second seasons~~.

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Table 1:Population fluctuation of *T. urticae*and associated predators on sweet potatobranches, at Edfina- Rashed region in season 2023

Date of examination	No. of *Tetranychus urticae* / ~~25 leaflets~~25 leaflets	No. of predators / 25 plant			
		Stethorus gilvifrons	*Coccinella undecimpunctata*	*Chrysoperla carnea*	*Sc. ~~interuptus~~interruptus*
June 1	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
15	5.75	0.00	1.50	2.50	1.75
22	9.50	0.50	2.75	4.25	3.25
30	13.50	1.25	4.75	5.00	3.75
No. /25 leaf		No./25 branches			
July7	15.25	2.75	3.00	1.50	2.00
15	16.00	2.75	4.25	3.00	3.75
22	19.75	4.75	5.00	8.00	5.00
30	8.50	4.50	3.75	3.00	4.75
Aug.7	9.25	4.25	6.75	8.75	6.00
14	48.00	5.00	10.00	11.75	9.75
21	21.50	2.25	6.00	8.75	5.00
8	8.25	2.75	4.00	4.25	4.00
Sept. 5	15.75	0.05	5.75	5.00	3.00
Overall+SE	13.64+1.78	2.34+1.01	4.10+1.41	4.69+1.50	3.71+1.08

Table 2: Population fluctuation of*T. urticae*and associated predators on sweet potato plants, at Edfina- Rashed region in season 2024

Date of examination	No. of *Tetranychus urticae* / ~~25~~	No. of predators / 25 plant			
		Stethorus gilvifrons	*Coccinella undecimpunctata*	*Chrysoperla carnea*	*Sc. ~~interuptus~~inte*

	~~leaflets~~25 leaflets				*rruptus*
June 1	0.00	0.00	1.00	1.05	1.25
8	4.25	0.00	2.00	1.75	1.75
15	4.75	0.00	2.50	3.75	2.75
22	7.25	1.05	5.50	4.00	3.50
30	6.75	2.25	5.75	4.75	2.05
No. / 25 leaf		No. /25 branch			
July7	11.50	3.25	4.75	4.00	1.75
15	16.50	3.75	7.25	3.50	6.75
22	44.25	4.75	9.50	9.50	8.00
30	14.75	4.25	4.25	5.25	2.75
Aug.7	10.75	4.05	2.75	7.00	3.00
14	25.75	4.25	5.75	7.50	6.00
21	12.75	2.75	4.00	4.75	5.25
8	9.75	2.00	2.50	3.75	4.00
Sept. 5	16.50	1.75	4.00	5.75	6.25
Overall+SE	13.25±1.45	2.43±0.98	4.36±0.01	4.73±0.21	3.93±0.01

Table (3). Correlation coefficients between some weather factors and main pests and their predators on sweet potato plants during 2023 and 2024 seasons.

Factor	*Tetranychus urticae*	*Stethorus gilvifrons*	*Coccinella undecim-punctata*	*Chrysoperla carnea*	*Sc. ~~interruptus~~interruptus*
2021					
Max.Tem(°c)	0.788**	+0.754**	+0.567**	-0.244	-0.198
Min. Tem (°c)	+0.327*	+0.653**	+0.276	+0.567**	+0.408*
RH%	+0.201	+0.644**	+0.745**	+0.664**	+0.453*
2022					
Max. Tem(°c)	-0.288	0.234	+0.356	+0.313	-0.209
Min. Tem (°c)	+0.633**	+0.744**	+0.579**	+0.546**	+0.323

RH%	+0.543**	+0.587**	+0.654**	+0.698**	+0.388*

*significant, P ≤ 0.05 -** highly significant, P ≤ 0.01

These results are in agreement with those obtained by Mulukenet *al* 2016 indicated that the adults and immature stages of *T. urticae*, feeding on sweet potato, result in high levels of plant destruction damage of 103 million bales, resulting in very large economic damage. Ramzan *et al.*, (2019) observed that both *Chrysoperla sp*and coccinellids spp were active, in cotton fields in June and September, respectively.El- Shamy *et al.*, (2023) observed that significantly correlation between populations of spider mite by onion intercropping with tomato and each of maximum and minimum temperature. Contracting to our results, they also found significant correlations between both predators and*T. urticae*. El-Khouly and Farag (2022) found that integrated pest management is the best way to control *T. urticae*and they added that biological control. Farag *et al*., (2023) concluded that *T. urticae* caused significant economic losses of the agricultural crops. Taghizadeh *et al.*, (2008) mentioned that the studied growth of *S. ~~gilvfrons~~gilvifrons*, a predator of *T. urticae* under laboratory conditions at constant temperatures of 15, 20, 25, 28, 30, 35 and 40°C. No growth occurred at 40°C. The total growth time at temperatures established was 65.47, 31.19, 18.53, 17.54, 12.49 and 9.27 days, correspondingly.

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