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

ABSTRACT

The two spotted spider mite, *Tetranychusurticae* 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; *Stethorusgilvifrons*Mulsant,*Coccinellaundecimpunctata* L., *Chrysoperlacarnea*Stephand*Scymnus interruptus* 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 22nd July (19.75±1.98individ.). This peak was followed by a relatively high population of the four predators, *S. gilvifrons*(4.75±1.57individ.), *C. undecimpunctata* (5.00±1.60individ.), *Ch. carnea*(8.00±1.58individ.)and*Sc. interuptus.* (5.00±individ.). The second peak of *T. urticae*was detected on 14th Aug. (48.00±2.91individ.), synchronized with the peaks of the four predators. During 2024, the first incidence of the mite was recorded on 22nd July. (44.25±3.76individ). This peak was associated with the peak of the four predators. The second peak of *T. urticae* was observed on 14th Aug.(25.75±3.01individ.), 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 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: *Tetranychusurticae*, weather factors, predators, sweet potato plants

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,*Tetranychusurticae* Koch (Acari: Tetranychidae) is one of the most important pests causing severe economic losses to producers,feeding on many plant species(Jakubowska and Fiedler 2014). Also, Gaber *et al*., (2023) indicated that is considered one important pest that causeddamage to multiple cropsand decrease in both quality and quantity of the product with one peak on Aug. 7th. On the other hand, Mulukene*t al.*, (2016) mentioned that the moving stages of the spider

mite feed mostly on sweet potato plants. Bocianowski*et 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 *Phenacoccussolenopsis*. 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 designed to investigate the population density of the two-spotted spider miteon sweet potato plants,as influenced by predators and to determine its, activity in response to certain synthetic predators under field conditions.Errard*et al.*,(2016) mentioned that the green lacewing, *Ch.carnae*could contribute to the decreased of the spider mite infestation on the plants.Farazmand*et al.*, (2014) showed that the adult and larval stages of *Scolothrippslonglcorms* 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 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 AboEI-EIa.2014).The established data in this study suggest that,*S.gilvifrons,C.undecimpunctata*, *Ch. carnea*and*Sc. interuptus* could be effectively applied as biological control agents for spider mite management.

MATERIALS AND METHODS

1-Land preparation and sowing

This experiment was conducted in theEdfina Rasheed region, Beheira Governorate during thesummer seasons of 2023 and 2024, on an area 2100 m^2, divided into four equal parts. The land was prepared by plowing three times and applying calcium superphosphate at a rate of

250 kg /fed. Sweet potato (*Ipomoeabatatas* L.) seedlings were transplanted in the presence of water at the upper third of the furrows at the beginning of May in both years of the study. Sulfate of potash (100 kg/fed.) and nitrogen fertilizer were applied as recommended.

2-Sampling for counting the predators

One month after sweet potato transplanting, 25 plants were uprooted from each plot. The plants were gently placed in plastic bags and transferred to the laboratory for counting the four considered predators;*S. gilvifrons, C. undecimpunctata*, *Ch. carnea*and*Sc. interruptus.*This sampling technique was applied fourtimes; will the plants were still young and small in size. After that, the sample consisted of one branch per plants, which was carefully cut and placed in plastic bags. A total of 25 branches were taken from each replicate to visually count the numbers of the three predators mentioned above. Sampling took place from June 1st to June 5th.

3-Sampling for counting spider mite

The spider mite, *T. urticae* Koch (Agari: Tetranychidae) were counted on 25 leavesflets per replicated. The leaflets were weekly pickedand 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 SPSS. 16.0 Software for windows was used to determine the correlation coefficients between the weather factors and the mean population of*T. urticae* and their predators Duncan's Multipole test (Duncan. 1955).

RESULTS AND DISCUSSION

1. Population fluctuations of*T.urticae*

Results shown in tables (1 and 2)indicated that the two- spotted spider mite, *T. urticae* was observed in low population densities up to June 15th, and exhibited the first peak with 19.75±1.98 nymphs and adults/25 leaflets on July22nd. Twospider mite peaks; 48.00± 2.98 and 21.50±2.01individ./25 sweet potato leaflets were showed on July 14th and July 21st, respectively in 2023season. In 2024 season,the two-spotted spider mite, *T. urticae* population densities were observed in two peaks of occurrence; 44.25±3.76 and 25.75± 3.01individ./ 25 sweet potato leaflets on July 22ndand Aug 14th, respectively.Overall means of the two seasons

were very similar (13.64±1.78 and 13.25±1.45individ.), 25 leaflets in the first and second seasons, respectively.

2-Population fluctuations of the predators

Results of tables (1 and 2) mentioned that the numbers of *S. gilvifrons* appeared in June 30th(1.25±0.89individ.) and increased gradually to reached its peak in July 22nd, represented by 4.75±1.57 individual, indicating a second peak during Aug. 14th, represented by 5.00±1.60 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±1.67 individual) and the second peak in mid-Aug., represented by 4.25±1.64individ..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. undecimpunctata* population fluctuation to exhibit low densities of 4.75±1.50 and 5.75±1.47predatory 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 and Aug.14th, with 5.00±1.60 and 10.00±1.95 predatory individuals, respectively, in 2023, 9.50±1.88 and 5.75±1.50individ., in the second season, respectively.Generally, in a comparison, *C. undecimpunctata*individ. were relatively in the second season than in the first one. Results of 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±1.58 and 11.75±1.98 larvae / 25 potato branches were detected on July 22th and Aug. 14st, respectively in 2023. While, in the second season, found the two peaks with 9.50±1.79 and 7.50±1.56 larvae / 25 branches on July 22nd and Aug.14th, respectively (Table 2). Overall means in both seasons were similar. As shown in tables (1 and 2) data obviously indicated that theoverall mean of*Sc. interruptus*in 2024season was obviously higher (3.93±1.34individ. /25 branches) than that of 2023season (3.71±1.08individual). In the first season, the predator was observed with considerable highlynumbersby July 22ndand Aug. 14th, represented by 5.00±1.57 and 9.75±1.82individ., respectively.However, in the second season, the insect densities were relatively high by late- June (3.50±1.12 individual), mid- Aug. (6.00±1.44 individ.) and early September (6.25±1.31individ.).

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

Results presented in table (3) indicate that the correlation coefficients among the some weather factors, the populations of the two- spotted spider mite, and their predators were recorded. Therefore, the relationship between weather factors, mite, and predators showed a positive and high significant correlation. The maximum temperature was negative correlated with thenumbers of *T. urticae* and their predators in most cases. However, the relative humidity and minimum temperatures generally showed positive and highly significant correlation with the mite and their predators in both the first and second seasons.

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 *Tetranychusurticae* / 25 leaflets	No. of predators / 25 plant			
		Stethorusgilvifrons	*Coccinellaundecimpunctata*	*Chrysoperlacarnea*	*Scymnus interruptus*
June 1	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
8	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
15	5.75±1.67	0.00±0.00	1.50±0.92	2.50±1.40	1.75±1.00
22	9.50±1.90	0.50±0.90	2.75±1.54	4.25±1.34	3.25±1.25
30	13.50±1.70	1.25±0.89	4.75±1.50	5.00±1.51	3.75±1.32
No. /25 leaf		No./25 branches			
July7	15.25±1.80	2.75±1.09	3.00±1.20	1.50±0.97	2.00±1.42
15	16.00±1.99	2.75±1.08	4.25±1.52	3.00±1.11	3.75±1.31
22	19.75±1.98	4.75±1.57	5.00±1.60	8.00±1.58	5.00±1.57
30	8.50±1.80	4.50±1.55	3.75±1.32	3.00±1.23	4.75±1.52
Aug.7	9.25±1.87	4.25±1.54	6.75±1.72	8.75±1.61	6.00±1.62
14	48.00±2.91	5.00±1.60	10.00±1.95	11.75±1.98	9.75±1.82
21	21.50±2.01	2.25±1.05	6.00±1.65	8.75±1.60	5.00±1.56
8	8.25±1.77	2.75±1.08	4.00±1.40	4.25±1.42	4.00±1.41
Sept. 5	15.75±1.81	0.05±0.60	5.75±1.68	5.00±1.50	3.00±1.09
Overall±SE	13.64±1.78	2.34±1.01	4.10±1.41	4.69±1.50	3.711±1.08

Data are present as mean ± SE

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 *Tetranychusurticae* / 25 leaflets	No. of predators / 25 plant			
		Stethorusgilvifrons	*Coccinellaundecimpunctata*	*Chrysoperlacarnea*	*Scymnus interruptus*
June 1	0.00±0.00	0.00±0.00	1.00±0.78	1.05±0.89	1.25±0.78
8	4.25±0.97	0.00±0.00	2.00±0.89	1.75±0.95	1.75±0.88
15	4.75±1.00	0.00±0.00	2.50±1.00	3.75±1.22	2.75±0.91
22	7.25±1.21	1.05±0.42	5.50±1.49	4.00±1.23	3.50±1.12
30	6.75±1.09	2.25±1.01	5.75±1.47	4.75±1.41	2.05±1.00
No. / 25 leaf		No. /25 branch			
July7	11.50±1.43	3.25±0.89	4.75±1.07	4.00±1.21	1.75±0.86
15	16.50±2.00	3.75±1.00	7.25±1.81	3.50±0.99	6.75±1.50
22	44.25±3.76	4.75±1.67	9.50±1.88	9.50±1.79	8.00±1.53
30	14.75±1.99	4.25±1.60	4.25±1.00	5.25±1.47	2.75±0.92
Aug.7	10.75±1.89	4.05±1.51	2.75±0.97	7.00±1.50	3.00±1.09
14	25.75±3.01	4.25±1.64	5.75±1.50	7.50±1.56	6.00±1.44
21	12.75±2.00	2.75±1.11	4.00±0.98	4.75±1.37	5.25±1.33
8	9.75±1.87	2.00±1.01	2.50±0.1.06	3.75±1.24	4.00±1.21
Sept. 5	16.50±2.05	1.75±0.96	4.00±0.99	5.75±1.53	6.25±1.31
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	*Tetranychusurticae*	*Stethorusgilvifrons*	*Coccinellaundecimpunctata*	*Chrysoperlacarnea*	*Sc. interruptus*
2023					
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*
2024					
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, $P \leq 0.05$ -** highly significant, $P \leq 0.01$

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 *Chrysoperlasp*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. 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.

Conclusion

The aim of this investigation is to assessment the population dynamics of the two spotted spider mite, *T. urticae* and their predators, *St. gilvifrons*Mulsant, *C. undecimpunctata* L., *Ch. carnea*Stephand*Sc.interruptus*Goeze in sweet potato as an economic important crop for better controlling this mite. As well as, assessment the impact of temperature and related humidity affecting its population, as there was a clear significant relationship between mite and their predators and impacts of temperature and related humidity on mite during the two seasons.

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