Effect of abiotic climatic on some pests and their predators on watermelon plants in Kafr El-Sheikh

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Received 10 Aug 2025; Accepted 17 Sep 2025; Published 1 Oct 2025
DOI: https://doi.org/10.64171/JAE.5.4.1-4

Abstract
Piercing sucking pests considered the most important dangerous pests infesting and destructive, a wide range of different agricultural crops especially watermelon fields. Amature stages and adults of the sucking pests are equally harmful for the green parts on the plants. This study investigated the population fluctuations of the piercing sulking pests, *Tetranychus urticae* (Acari: Tetranychidae) *Bemisia tabaci* (Hemiptera: Aleyrodidae), *Thrips tabaci* (Thysanoptera: Thripidae) and *A. gossypii* (Hemiptera: Aphididae, and *Aphis gossypii* and their predators in Kafr El-Sheikh Governorate, Egypt, over the 2024 and 2025 seasons. The findings showed the mite was the most prevalent pest, while thrips were the least common. Spider mite and whitefly populations reached their peak from mid-June to late July in both seasons. Aphid populations were consistently low throughout the study. Four key predatory species were identified: *Hippodamia tredecimpunctata* (Coleopteran: Coccinellidae), *Coccinella undecimpunctata* (Coleoptera: Coccinellidae), *Orius* spp (Hemiptera: Anthocoridae) and *Chrysoperla carnea* (Nuroptera: Chrysopidae). *H. tredecimpunctata* being the most abundant and associated with the peaks of the pests on June and July. However, regarding the obtained data in the first and second seasons, observed on June 2nd with 268.5 and 255.25 individuals, respectively. Our weather conditions are highly significant correlated with the pests and their predators in the first and second seasons. Therefore, no significant correlation with whitefly and highly significant correlation with the aphid. The overall impact of predators on pests was insignificant and significant on aphid. These results are crucial for developing integrated pest management strategies.

Keywords: Watermelon, Abiotic factors, Pests, Predators

Introduction

Cucurbitaceae family is a cornerstone of global agriculture, providing numerous widely consumed vegetables (watermelon, *Citrullus lanatus* L.,). In Egypt, cucurbit crops are a significant component of vegetable production, cultivated extensively in both traditional and newly reclaimed lands. The cultivation of watermelon for seed production is particularly vital for both local consumption and export, with major production centers located of Ismailia, Kafr El Sheikh and Beheira governorates (FAOSTAT, 2022) [12]. However, watermelon cultivation is constantly challenged by a complex of insect pests that inflict substantial dangerous to crops quality. Key pests include the whitefly and aphid. These pests feed on the phloem sap, leading to plant weakening and the secretion of honeydew, which in turn hampers photosynthesis and renders the fruits unmarketable. Furthermore, several of these pests are known to be vectors for viral diseases, posing an additional threat watermelon crop (Abou El-Saad, 2015) [2]. The population dynamics of these pests are intrinsically linked to the presence and effectiveness of their predators. For instance, common predators such as the ladybird, *C. undecimpunctata* and *Ch. carnea* play a crucial role in maintaining a balanced ecosystem (Refaei *et al*., 2016) [22]. Understanding the factors that influence the population fluctuations of both pests and their predators is essential for developing sustainable pest control strategies. Under climate changes the production of vegetable crops may be improved by using various novel agricultural practices, i.e., suitable new cultivars, modification of planting date, as well as spraying growth stimulants (Ali *et al*., 2024) [4]. Field conditions are known to significantly affect the population dynamic and life cycle of these pests, as highlighted in various studies (Maklad 2018) [17]. This data builds upon a foundation of previous studies that have explored the impacts of the pest infestation on different agricultural crops (Abou-Taka and Zohdy, 1990; El-Habi *et al*., 1999; Koschier *et al*., 2002; Mohamed, 2011; Ghallab *et al*., 2011; El-Saeidy *et al*., 2012; Maklad *et al*., 2012; Hanafy *et al*., 2014; Mousa, 2017 and Abdel-Aleim *et al*., 2023) [3, 10, 16, 19, 13, 11, 18, 15, 20, 1]. Therefore, the primary aim of this study is to investigate the influence of the field conditions the population fluctuations of key piercing sucking pests and their predators in watermelon plants, providing a scientific basis for pest control measures. Thus, the predators could be considered as an activity control element in the integrated pest management programs of piercing sucking pests.

Materials and Methods

The field experiments on watermelon plants were carried out at Farm of Sakha Agricultural Research Station, Kafr El Sheikh Governorate during the two successive seasons, 2024 and 2025. An area of approximately 2000 m^2 population dynamic on the previously mentioned watermelon fields. seeds were sown in the first week of May during the two seasons. The experiments are divided to four plots. The examination started one month after planting, 20 leaves were selected randomly spaced along a diagonal across the field and from each plot. This study concludes the population fluctuations of the main piercing-sucking pests; *B. tabaci* (Hemiptera: Aleyrodidae), *T. urticae* (Arthropoda: Arachnida), *T. tabaci* (Thysanoptera: Thripidae) and *A. gossypii* (Hemiptera: Aphididae) as well as the its predators (10 plants/plot) under field conditions. To assess infestation, weekly samples were taken from plots, with 10 leaves randomly examined for pests. A specific sampling protocol was used for the associated predators, where plants were randomly collected weekly from watermelon plants during specific periods, then examined for its presence. Results were recorded on every week basis by counting pests and predators number per plant. This experiments field did not receive any insecticide treatments through the two seasons. The examination pests and their predators numbers were recorded from leaf. The examination was carried out under field conditions using a naked eye and a hand magnifying lens. Climatic data was obtained from the Metrological Department at Sakha Agricultural Research Station.

Statistical analysis

Data were subjected to ANOVA (analysis of variance), and treatment means were compared using the Least Significant Difference (LSD) test at a 5% significance level, as described by Gomez and Gomez (1984) [14]. SPSS (2006) [23] was used to calculate correlation and regression coefficients to analyze these relationships.

Results and Discussion

Relationship between the sucking pests and their predators on watermelon fields

The data presented in Table (1) mentioned that the population density of *Tetranychus urticae, Bemasia tabaci*, *Thrips tabaci* and *Aphis gossypii* and associated predators on watermelon plants varied according to the sowing date in the two studied seasons. In 2024 season, the infestation started at highest populations, was observed throughout the first week on June 2st for all pests and their predators. The two spotted spider mite, *T. urticaee, B. tabaci*, *T. tabaci* and *A. gossypii* population fluctuations gradually increased until exhibited to the first peak with 516.25, 157.25, 24.50 and 163.00 individual on July 7st. This peak was synchronized with the peaks of predators, *H. tredecimpunctata* (42.25 individual), *C. undecimpunctata* (10.75 individual), *Orius* spp. (15.25 individual) and *Ch. carnea* (13.25 larvae). The second peak was calculated in Joule 21rd with 34.25, 7.75, 6.75 and 9.50 individual, respectfully. This peak was synchronized with the peaks of the four main pests; *T. urticaee* (531.00 individual), *B. tabaci* (137.25 individual), *T. tabaci* (87.00 individual) and *A. gossypii* (157.00 individual). However, the population average in the second season (Table 2), took same trend, was similar to those of 2024 season, the population of the predators with the first peak was noticed on Joule 7st of 28.25 individ., 4.50 individ., 13.75 individ. and 5.50 individ. for both four predators, *H. tredecimpunctata*, *C. undecimpunctata*, *Orius* spp and *Ch. Carnea*, respectfully. Peaks were observed with the peaks of the pests. The second peak was found on Joule 21rd for four predators, *H. tredecimpunctata*, (5.75 individ.) *C. undecimpunctata* (7.25 individ.), *Orius* spp. (8.00 individ.) and *Ch. carnea* (7.00 larvae). Therefore, the population fluctuations of the pests and its predators in 2024 season was increased than that of 2025 season. As far as relationship between the pests and the associated predators are synchronized in both seasons, was observed in all the peaks.

Correlations between the weather conditions، some pests and their predators

Correlations between weather factors and populations of the pests and their predators was presented in Table (3) indicated that the negative correlation between the temperature and numbers of the pests and its predators. However, the minimum temperatures and relative humidity were usually correlated with positive highly significant values with the considered pests and their predators in the both seasons. On the other hand, Predators showed a significant negative correlations with maximum temperature in the both seasons and a significant positive correlations with minimum temperature, reflecting findings by (Archana *et al.,* 2024) [6] the highly numbers of *B. tabaci* and *T. tabaci men*tioned a significant positive correlation with temperatures. Bhattacharyya *et al.,* 2019 [8], Divya *et al.,* 2020 [9] mentioned decrease temperature reduces of the numbers pests. However, the reproduction of these pests increased during temperature raises, a trend corroborated by Barbosa *et al.,* 2019 [7]. Who found lower numbers of thrips in watermelon plants through the rainy season compared to the dry season. Aishwarya *et al.,* 2019 found a negative correlation between both relative humidity and thrips and a positive correlation between temperature and thrips, similar to the findings of the present study. These environmental factors must be considered when development IPM strategies. By understanding how relative humidity and temperature, growers can better time their interventions. Whiteflies emerged during the vegetative stage, observed increased numbers during the mid- vegetative to flowering stages., aligning with Barbosa *et al.,* 2019 [7] and Oliveria *et al*., 2001 [21].

Correlation between the pests and their predators was based on the data presented in Table 4, the analysis indicates a weak, statistically highly significant correlation between the population fluctuations of *T. urticae* and *B. tabaci*, its two key predators, *C. undecimpunctata* and *C. carnea*, across both study seasons, alongside significant correlation with *T. tabaci* and *A. gossypii*. The population of sucking pests, including thrips and whiteflies, increased during periods of high temperatures in march, informing targeted integrated pest management in watermelon fields, this data similar with findings Abou El-Saad, (2015) [12] indicated that the relation between of *C. undecimpunctata* and *C. carnea* and their pests was positively and significantly on watermelon plants. Refaei *et al*., (2016) [22]. Found that highly significant correlation between the aphids, whitefly, thrips and spider mites and their predators on watermelon, *Citrullus lanatus.*

Table 1: Population dynamics pests and their predators on watermelon plants in Kafr El-Sheikh during 2024 season

Data of sampling	Mean No. pests /20 leaves				Mean No. predators/10 plants			
	Tetranychus urticae	*Bemaia tabace*	*Thrips tabaci*	*Aphis gossypii*	*Hippodamia tredecimpunctata*	*Coccinella undecmpunctata*	*Orius spp*	*Chrysoperla carnea*
June 2	145.00±2.00	110.25±1.55	72.50±1.15	35.25±0.94	1.75±0.92	2.25±0.35	3.50±0.62	3.00±0.62
9	159.25±2.01	133.25±1.86	120.25±1.65	67.75±1.00	46.00±0.91	1.25±0.33	14.25±0.90	3.75±0.67
16	296.25±2.25	46.75±0.99	32.00±0.95	69.75±1.10	5.75±0.58	2.25±0.34	6.25±0.71	8.25±0.80
23	437.50±2.91	100.75±1.47	11.00±0.48	93.25±1.39	2.00±0.38	1.50±0.39	1.75±0.35	7.00±0.78
30	450.00±2.95	75.25±1.20	15.25±0.57	65.50±0.96	27.00±0.98	4.50±0.64	12.75±0.85	3.25±0.39
July 7	516.25±3.01	157.25±2.85	24.50±0.86	163.00±2.91	42.25±0.85	10.75±0.95	15.25±0.93	13.25±0.89
14	397.75±2.50	84.75±1.33	23.50±0.81	126.25±1.83	6.50±0.75	6.00±0.73	9.50±0.91	8.25±0.82
21	531.00±3.25	137.25±1.95	87.00±1.30	157.00±2.00	34.25±0.69	7.75±0.85	6.75±0.72	9.50±0.90
Total	2933.00±5.50	846.00±3.90	336.00±2.44	777.75±3.25	165.50±1.95	36.25±0.72	70.00±0.98	56.25±0.88
Mean±SD	366.62±32.87	105.75±1.53	42.00±0.97	97.22±0.97	20.68±0.91	4.53±0..66	8.75±.0..90	7.03±0.79

Table 2: Population dynamics pests and their predators on watermelon plants in Kafr El-Sheikh during 2025 season

Data of sampling	Mean No. pests /20 leaves				Mean No. predators/10 plants			
	Tetranychus urticae	*Bemaia tabaci*	*Thrips tabace*	*Aphis gossypii*	*Hippodamia tredecimpunctata*	*Coccinella undecimpunctata*	**Orius insulana**	*Chrysoperla carnea*
June 2	145.25±1.50	127.00±1.50	69.50±0.79	33.75±0.41	40.25±0.91	14.00±0.35	8.00±0.25	9.00±0.72
9	187.75±1.58	171.25±1.50	114.00±1.35	83.75±0.92	34.00±0.82	4.25±0.16	11.50±0.30	8.50±0.24
16	285.00±2.54	41.25±0.56	29.75±0.45	48.25±0.59	5.50±0.15	2.25±0.13	4.50±0.15	10.75±0.29
23	356.50±2.75	89.25±0.98	13.25±0.25	83.75±0.93	1.75±0.18	1.75±0.10	6.25±0.18	12.50±0.31
30	384.00±2.98	97.25±1.00	25.50±0.37	146.00±1.56	22.00±0.20	7.00±0.20	10.50±0.29	5.25±0.16
July 7	459.75±3.20	67.75±0.77	25.00±0.33	63.00±0.72	28.25±0.23	4.50±0.14	13.75±0.32	5.50±0.17
14	421.50±3.02	73.00±0.80	25.75±0.0.35	114.00±1.35	1.50±0.10	1.00±0.09	1.00±0.10	6.00±0.17
21	591.25±3.50	142.00±1.96	43.00±0.59	146.00±1.55	5.75±0.18	7.25± 0.22	8.00±0.26	7.00±0.21
Total	2831.00±4.52	808.75±3.95	345.75±2.77	718.50±3.33	139.00±1.42	42.00±0.57	63.50±0.73	54.00±0.69
Mean±SD	353.87±2.71	101.09±1.05	43.22±0.60	89.81±0.97	17.37±0.36	5.25±0.16	7.93±0.25	6.75±0.23

Table 3: Statistical correlation between the weather conditions and some pests, their predators at Kafr El-Sheikh during 2024 and 2025 seasons

Factors	Pests				Predators			
	Tetranychus urticae	*Bemasia tabaci*	*Thrips tabace*	*Aphis gossypii*	*Hippodamia tredecimpunctata*	*Coccinella undecimpunctata*	*Orius insulana*	*Chrysoperla carnea*
2024								
Max. tem.°c	+0.576**	+0.371	-0.235	-0.221	-0.276	-0.199	-0.267	-0.246
Min. tem. °c	+0.685**	+0.355	+0.376	+0.467*	+0.568**	+0.389*	+0.512**	+0.456*
RH%	+0.468*	-0.213	+0.532**	+0.534**	+0.612**	+0.477*	+0.466*	+0.388
2025								
Max. tem.°c	-0.622**	+0.343	-0.198	-0.287	-0.266	-0.299	-0.189	-0.254
Min. tem.°c	+0.569**	+0.532**	+0.378*	+0.498**	+0.477*	+0.566**	+0.611**	+0.488*
RH%	+0.590**	-0.198	+0.654**	+0.543*	+0.622**	+0.712**	+0.536**	+0.377*

Table 4: Statistical correlation between some pests and their predators in watermelon plants at Kafr El-Sheikh during 2024 and 2025 seasons

Seasons	Predators	*Tetranychus urticae*	*Bemasia tabaci*	*Thrips tabace*	*Aphis gossypii*
2024	*Hippodamia tredecimpunctata*	+0.344	-0.293	-0.223	-0.246
	Coccinella undecimpunctata	+0.548**	+0.454**	+0.432*	+0.359*
	Orius insulana	-0.279	+0.500**	+0.544**	+0.487*
	Chrysoperla carnea	+0.456**	+0.476**	+0.421*	+0.325
2025	*Hippodamia tredecimpunctata*	-0.254	+0.342	-0.234	+0.622**
	Coccinella undecimpunctata	+0.611**	+0.621**	+0.422*	+0.546**
	Orius insulana	+0.189	+0.387	+0.432*	+0.367
	Chrysoperla carnea	+0.522**	+0.455**	+0.399*	+0.213

Conclusion

Based on a two-season study, planting watermelon on May 1st is an effective, eco-friendly method for controlling piercing-sucking pests. This early planting date significantly reduces pest infestation, minimizing the need for chemical pesticides. The findings support a sustainable pest management strategy that protects crop yields and promotes a healthier agricultural ecosystem.

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