Journal homepage
www.ajas.uoanbar.edu.iq
Anbar Journal of Agricultural Sciences
(University of Anbar – College of Agriculture)

SEASONALITY AND BIOCONTROL OF MAIESTAS KNIGHTI (HEMIPTERA: CICADELLIDAE) ON SOME VEGETABLE PLANTS OF CUCURBITACEAE IN ERBIL PROVINCE, KURDISTAN REGION -IRAQ

H. Q. Hammamurad [1] Z. Z. Omar [2]* N. A. Mawlood [1]

[1] Plant Protection Department, College of Agricultural Engineering. Science, Salahaddin. University– Erbil, Iraq
[2] Biology Department, College of Education- Shaqlawa, Salahaddin. University– Erbil, Iraq

***Correspondence to:** Zewar Z. Omar, Biology Department, College of Education- Shaqlawa, Salahaddin. University– Erbil, Iraq.
Email: zewar.omar@su.edu.krd

Article info

Received: 2024-05-15
Accepted: 2024-05-20
Published: 2024-12-31

DOI-Crossref:
10.32649/ajas.2024.147988.1177

Cite as:
Hammamurad, H. Q., Omar, Z. Z., and Mawlood, N. A. (2024). Seasonality and biocontrol of maiestas knighti (hemiptera: cicadellidae) on some vegetable plants of cucurbitaceae in Erbil province, kurdistan region -Iraq. Anbar Journal of Agricultural Sciences, 22(2): 997-1006.

Abstract

Maiestas knighti belongs to the family Cicadellidae order Hemiptera. It is a severe insect that infects plants of the Cucurbitaceae family. The work was conducted to study the insect ecology and its management. Experiments were conducted, and population numbers were deemed in the field during spring and autumn on snake-cucumber and melon crops. Various yellow and blue sticky traps were used to catch and monitor the pests. *Bacillus thuriengiensis* and *Beauveria bassiana* were used as bio-pesticides, and the extracts of Tagetes erecta were applied with recommended concentrations to manage the insect. The bio-pesticides rates were involved (2g/L *B. thuriengiensis*, 5g/L *B. bassiana*, and 10 ml/L *T. erecta*) to be used in fields, then reduction was recorded on the 3rd, the 5th, and 7th days. The maximum population was observed on the vegetables and with yellow sticks in the fall season. The highest decrease was recorded with *B. bassiana* on snake cucumber and by the plant extract on melon vegetables.

Keywords: Seasonal Abundance, Maiestas knighti, Cicadellidae, Cucurbitaceae, Biocontrol.

الموسمية والمكافحة الحيوية لـ Maiestas knighti (Hemiptera: Cicadellidae) في بعض نباتات الخضروات من الفصيلة Cucurbitaceae في محافظة أربيل، إقليم كردستان – العراق

هوزان قادر حمه مراد [1] زيور زينل عمر [2]* نبيل عبدالقادر مولود [1]

[1] قسم وقاية النباتات، كلية علوم الهندسة الزراعية، جامعة صلاح الدين–أربيل، العراق

[2] قسم علوم الحياة، كلية التربية– شقلاوة، جامعة صلاح الدين–أربيل، العراق

*المراسلة الى: زيور زينل عمر، قسم علوم الحياة، كلية التربية– شقلاوة، جامعة صلاح الدين–أربيل، العراق.

البريد الالكتروني: zewar.omar@su.edu.krd

الخلاصة

يعتبر *Maiestas Knighti* المنتمي الى عائلة قفاز الاوراق Cicadellidae ورتبة نصفية الاجنحة Hemiptera من الآفات الخطيرة التي تصيب بعض نباتات العائلة القرعية. تم اجراء هذا البحث لدراسة بيئة الحشرة ومعالجتها. أجريت تجارب حقلية وتم أخذ أعداد سكان الحشرة في الحقل خلال فصلي الخريف والربيع على نباتات القثاء والخيار والبطيخ وباستخدام مصائد لاصقة (صفراء وزرقاء) لغرض جذب ومراقبة الحشرة. تم استخدام نوعين من المبيدات الأحيائية وهي البكتريا *Bacillus thuriengiensis*، والفطر *Beauveria bassiana*، والمستخلص النباتي للقطيفة المخملية الحمراء (*Tagetes erecta*) وحسب المعدلات الموصى بها. استخدم ثلاثة تراكيز من المبيدات الأحيائية 2 جرام/ لتر *B. thuriengiensis*، 5 جرام/ لتر *B. bassiana* و10 مل/لتر من (*T.erecta*) في الحقول، ثم تم تسجيل التخفيض بعد اليوم الثالث والخامس والسابع. تم تسجيل أعلى عدد من الحشرة على الخضر باستخدام المصيدة الصفراء في الخريف. تم تسجيل اعلى انخفاض في اعداد الحشرة باستخدام الفطر *B. bassiana* على نبات القثاء وكذلك وبواسطة المستخلص النباتي *T. erecta* على نبات البطيخ.

كلمات مفتاحية: الوفرة الموسمية، Adiantum capillus–veneris، Maiestas knighti، Cicadellidae، Cucurbitaceae، المكافحة الحيوية.

Introduction

Maiestas knighti is an important insect that belongs to the family Cicadellidae, and the order Hemiptera (7 and 12). *Maiestas knighti*, for the first time, was distributed in New Zealand, Australia, Fiji, Guam, and Papua New Guinea, reviewed by Webb and Viraktamath (14). In addition, the genus *Maiestas* distribution in the Palearctic region has three species in Iran: *M. trifasciata*, *M. schmidtgeni*, and *M. horvathi* (13). However, leafhoppers of the *Maiestas* genus are considered mostly grass feeders, and some species have been described to transmit phytoplasmas to grass crops, such as the zigzag leafhopper *M. dorsalis* (Motschulsky), which is considered a vector of rice orange-leaf phytoplasma in Asia (14). Also, both nymph and adults can be considered

severe pests, as they can cause damage to crops directly and indirectly by feeding on a wide variety of vascular plants, such as grasses, herbaceous vegetation, shrubs, and trees, or transmitted vectors of plant diseases (2). Furthermore, the population patterns of leafhoppers can be partially explained by environmental variables (such as rainfall, humidity, and temperature), the quality and quantity of available nourishment sources, and the influence of natural enemies (3). Kumawat *et al.* (10) observed that the peak infestation of leafhoppers occurs during October and September. Several methods have been studied to manage the pest. Girish *et al.* (8) studied that Azadirachtin sufficiently affects leafhoppers using four neem derivatives 0.25%. The entomopathogenic fungus used to control pests that do not pollute the environment, humans and plants, such as *Beauveria bassiana*, can, directly and indirectly influence leafhoppers by directly killing and indirectly suppressing the population of leafhopper (9).

Materials and Methods

Sample collection and population of Maiestas knighti: Samples were collected in the Grdarasha field of the College of Agricultural Engineering Science / Salahaddin University–Erbil during the Autumn and Spring seasons in 2021 and 2022. The soil was managed; then, the land design was based on Randomized Complete Block Design (RCBD) by three replications for planting some Cucurbitaceae vegetables such as (melon, snake cucumber, cucurbit, cucumber, and pumpkin). Every experiment-unit area was 12 m2 (6×2 m). The abundance population of (Maiestas knighti) was noticed and monitored during growth of the vegetable plants.

The samples were collected by different ways including vials, aspirator, (different size), aerial nets and sticky traps (yellow and blue), as they were common tools used to find population density and observation this pest; also, via light traps. Blue and yellow sticky-traps were placed for collecting the pest from the Cucurbitaceae crops.

Sticky traps were used to show their role in decreasing the number of insects or monitoring and estimating the population. The sticks were 25cm L and 12cm W and applied on woody stands between the 8th of Aug to 29th Oct, 2021 and 20th April to 2nd of Jul, 2022 during both seasons. Five sticks of each colour were applied in five directions.

In addition, the specimens were collected by light traps, and the light traps were made by a plastic funnel, a cylindrical (dimensions: 60 cm in height and 30 cm in diameter) and also a light bulb. The funnel was placed in bottom and the light hold up above. The funnel was used to determine number of the insect on the Cucurbitaceae vegetables.

Environmental effect: Effect of abiotic factors such as relative humidity and temperature on this species and the crops were recorded. The meteorological data (relative humidity and temperature) for ecological study were provided by the Planning Departments/General Directorate of Agriculture in Erbil governorate shown in Figure 1:

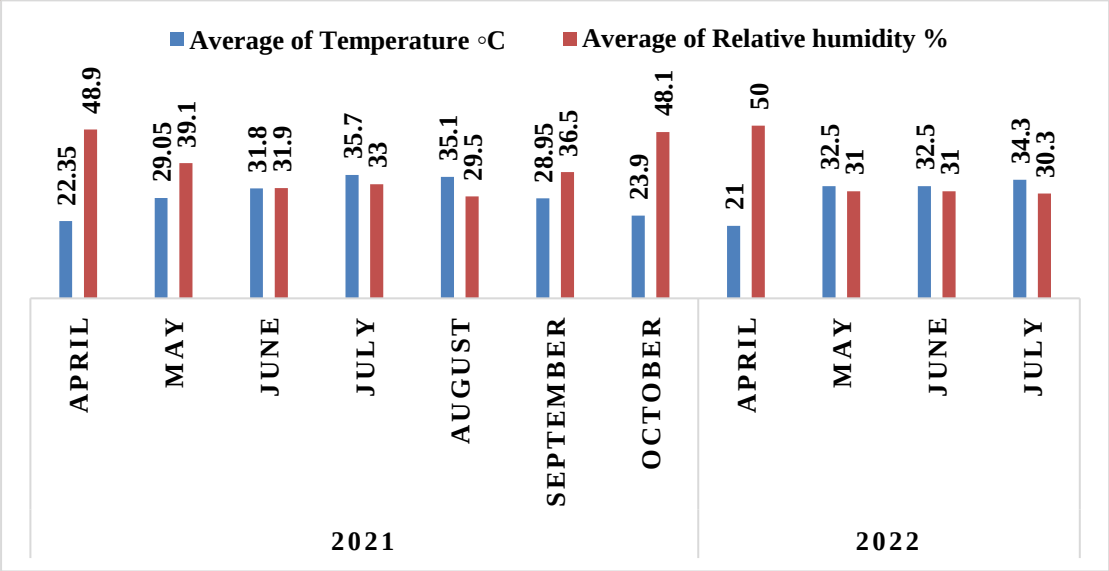

Figure 1: Temperature and Relative Humidity Data During 2021 and 2022.

Biological control (Microbial control): the endospores of Bacillus thuringiensis were obtained as commercial product LIPEL, and its formulation was as 18,00IU/mg (WP). In addition, commercial product RACERTm is bio-insecticide, which naturally is selected strain of entomopathogenic fungus Beauveria bassiana (NCIM1216ATCC26851). Its formulation is WP with CFU count of 108. Both products were recorded by Board of Indian Pesticides Regulatory Authority Central Insecticides. Govt of India, and they were affirmed to be applied in Organic agriculture.

Tagetes erecta extract: After collection of Tagetes plants, the samples were washed and preserved at laboratory condition. The dried parts of the plant were milled to fine powder by simple grinder. Then, mixed powder (10g) of seeds, flower and leaves of Tagetes plant was placed in distilled water (1L.) for about 24 hrs.

Field Experiment: Two bio pesticide and a plant extract were applied in the field to treats this pest. The most effective concentration according to the lab experiment was chosen. (2 and 5 g/L) of B. thuriengiensis and B. bassiana; respectively, as well as 10 ml/L of Tagetes erecta extracts were sprayed based on Randomized Complete Block Design (RCBD) with three replications on the cultivated vegetables, also control spray used distilled water. The mortality was documented by the 3rd, 5th and 7th days.

Via the Abbott formula, data of mortality was converted into corrected% (1).

$$Corrected\ \% = \left(1 - \frac{n\ in\ T\ after\ treatment}{n\ in\ Co\ after\ treatment}\right) * 100$$

Where: n = population of insect, T = treated and Co = control

Data Analysis: The data were analysed statistically by using IBM SPSS program (vers. 26) (4). Duncan test was used to differentiate among the treatments.

Results and Discussion

Density population of Maiestas knighti on Cucurbitaceous vegetables: the results of fall season are explained in (Fig.2). The highest population of leaf hopper was found on melon vegetable in the 3rd weeks in August/2021, and the lowest population at the 4th weeks in August. The highest population of cucumber in 13th weeks October, and

the lowest population at the 7th weeks of September. The highest population on pumpkin crops was observed in the 3rd weeks experiments (August/2021), and the lowest population was recorded in the 9th weeks September. While, the highest Population density on cucurbit crops was found in the 3rd weeks of August, the lowest population was recorded in the 9th weeks September /2021. In addition, the highest population density on snake cucurbit crops was observed at the 2nd weeks August and the lowest population found in the 1st weeks August/2021 experiments.

The outcomes of spring season are elucidated in (Fig.3). The maximum population of leaf hopper was found by 12th weeks July, 6th weeks May, and 4th weeks of May in 2022; while, the lowest population was observed by 1st weeks April, 12th weeks July, 12th weeks in July, 12th weeks July and 9th weeks Jun/2022 on melon, cucumber, pumpkin, cucurbit and snake cucurbit respectively.

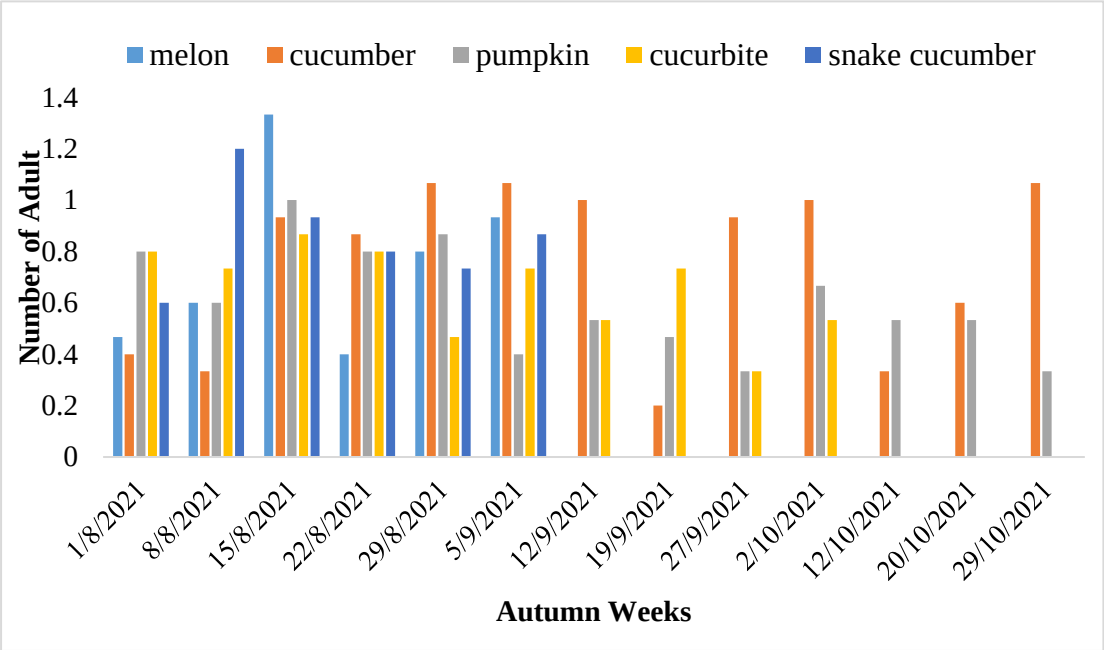

Figure 2: Density population of *Maiestas knighti* on Cucurbitaceous Vegetables Fall 2021.

Population Density of Maiestas knighti on Yellow and Blue Stick Traps: the data of yellow and blue sticks of Autumn and Spring season are illustrated in (Fig.4) and (Fig.5), respectively.

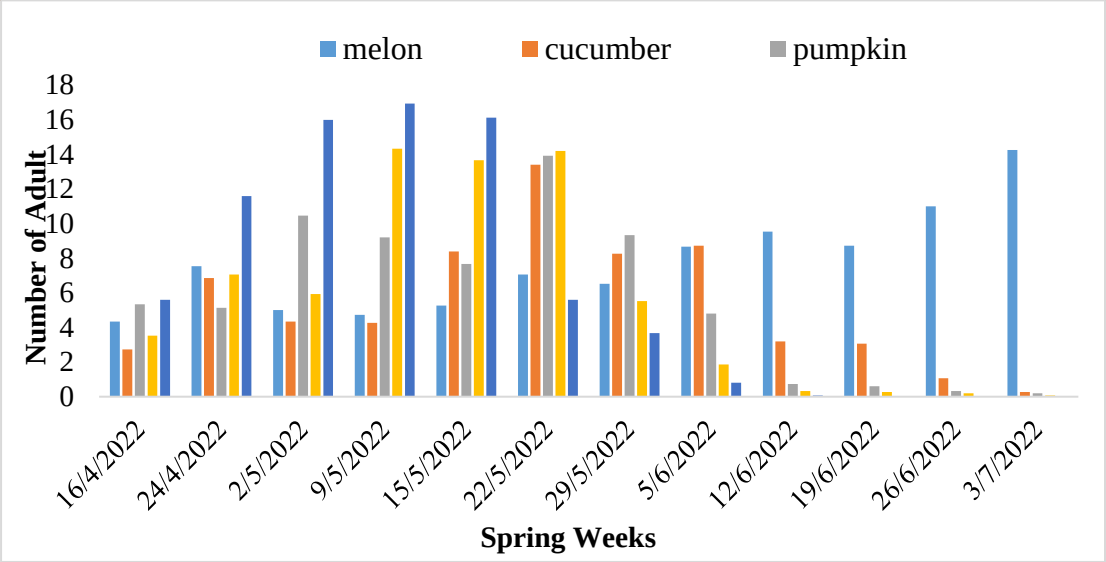

Figure 3: Density population of Maiestas knighti on Cucurbitaceous Vegetables in Spring 2022.

The maximum populations were found in the 8th weeks; while, the minimum was observed in the 4th weeks by yellow sticky-trap. In addition, the highest and lowest population for blue stick were found at 5th and 9th weeks; respectively, in Autumn season. Demirel and Yildirim (5) observed that the yellow traps are specific, helpful for monitoring and capturing leafhoppers.

However, the maximum populations were noted at 10th weeks; whereas, the lowest was observed at 4th weeks for yellow sticky-traps. Also, the highest and minimum of number population were found at the 7th and 4th weeks for the blue stick traps in the Spring season.

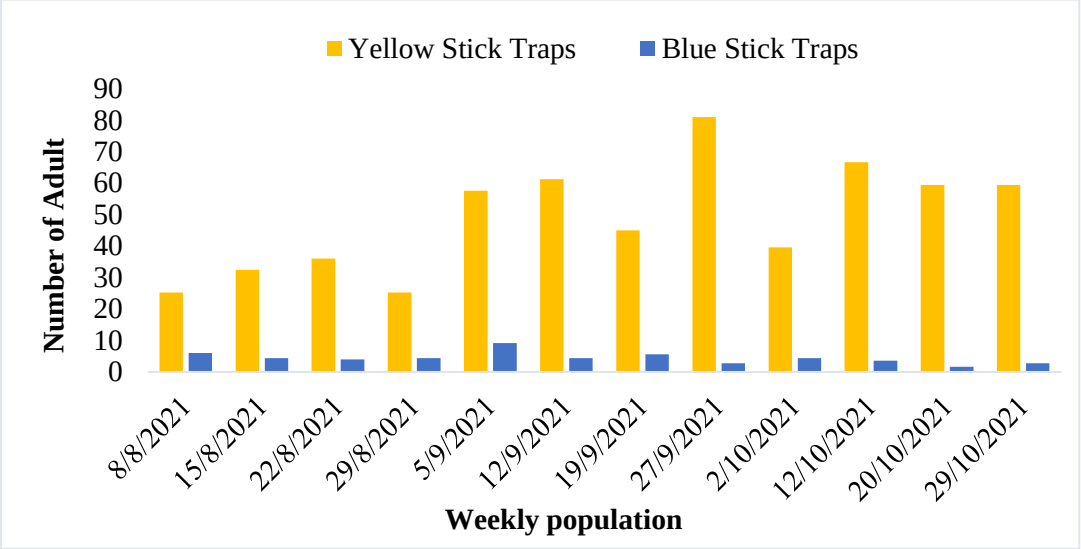

Figure 4: Yellow and Blue Stick Traps used for Monitoring and Population Maiestas knighti during Autumn 2021.

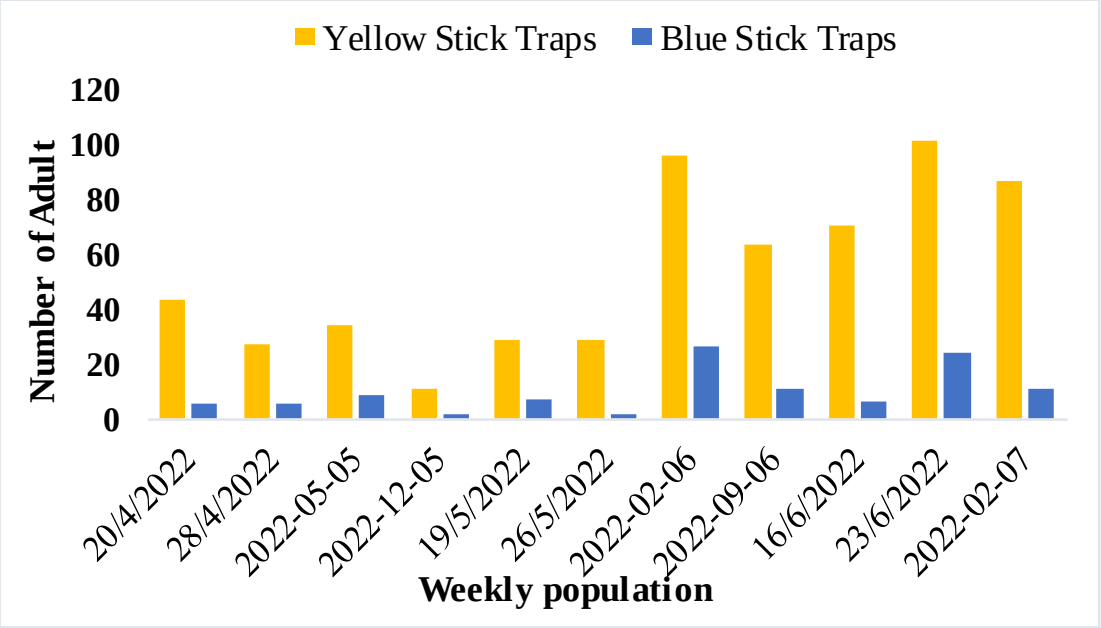

Figure 5: Yellow and Blue Stick Traps used for Monitoring and Population Maiestas knighti during Spring 2022.

Biological control effect on the population of Snake-cucumber: application of Bacillus thuriengiensis, Beauvera bassiana and Mexican marigold (Tagetes) extract resulted to decrease the population of Maiestas knighti on snake-cucumber in the field. The maximum reduction (50.74 ± 6.69) was occurred by B. bassiana and the minimum (21.17 ± 6.08) by the plant extract in the 3rd day of application. In addition, by the 5th day, the maximum decrease was found by the B. bassiana (71.83 ± 4.19) and the minimum by plant extract (63.38 ± 4.30). The maximum diminish also was observed by the B. bassiana (80.33 ± 1.41) and the minimum by plant extract (77.19 ± 2.68) on the 7th day (Table 1). The results explained that Beauvera bassiana was more effective to diminish the population of the insect than Bacillus thuriengiensis and plant extract. Entomopathogenic fungi can decrease the green leafhopper imago populations by directly killing and indirectly suppressing the green leafhopper (15). Green leafhopper nymphs were effectively killed by the entomopathogenic fungi B. bassiana (11).

Table 1: Effect the Bio-Pesticide on Adult Stage Maiestas knighti on Snake-Cucumber.

Bio-Pesticide	Reduction% of adult/ day (Mean ± SE)		
	Third day	Fifth day	Seventh day
B. thuriengiensis	28.04 ± 7.68 d	69.01 ± 6.90 a-b	79.27 ± 1.62 a
B. bassiana	50.74 ± 6.69 c	71.83 ± 4.19 a-b	80.33 ± 1.41 a
T. erecta	21.17 ± 6.08 d	63.38 ± 4.30 b-c	77.19 ± 2.68 a-b

Biological control effect on population on Melon: population number of Maiestas knighti on melon in the field was decreased by applying Bacillus thuriengiensis, Beauvera bassiana and Tagetes extract. The maximum reduction (24.99 ± 6.15) was found by B. thuriengiensis and minimum (14.12 ± 4.98) by the B. bassiana in the 3rd day of spraying. Also, by the 5th day, the highest reduction was occurred by the B. thuriengiensis (56.78 ± 5.28) while the lowest by B. bassiana (23.64 ± 7.01). The maximum decrease also was noted by the extract of Tagetes (76.25 ± 4.73) and the

minimum by B. bassiana (57.50 ± 8.37) in the 7th day (Table 2). The results elucidated that extract of Tagetes was more efficient to diminish populations than Bacillus thuriengiensis and Beauvera bassiana.

Table 2: Effect the Bio-Pesticide on Adult Stage Maiestas knighti on Melon.

Bio-Pesticide	Reduction% of adult/ day (Mean ± SE)		
	Third day	Fifth day	Seventh day
B. thuriengiensis	24.99 ± 6.15 d-e	56.78 ± 5.28 b-c	68.75 ± 5.01 a-b
B. bassiana	14.12 ± 4.98 e	23.64 ± 7.01 d-e	57.50 ± 8.37 b-c
T. erecta	20.64 ± 5.38 e	42.06 ± 7.76 c-d	76.25 ± 4.73 a

Conclusions

The environmental factors have a great impact on the activity and population of the insect, and the yellow and blue sticky traps are useful methods for monitoring and time collecting insects. However, both entomopathogenic fungi Beauvera bassiana and bacteria Bacillus thuringiensis are promising agents to be consider as bio-insecticide to diminish the pest problem in Cucurbitaceae vegetables. In addition, the Tagetes plant contains chemical components that act as an agent and effective to reduce the insect population.

Supplementary Materials:

No Supplementary Materials.

Author Contributions:

Author 1, 2, and 3; methodology, writing—original draft preparation, Author and Author writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Funding:

This research received no external funding.

Institutional Review Board Statement:

The study was conducted in accordance with the protocol authorized by the College of Education-Shaqlawa, Head of the Biology Dept., Salahaddin University, Kurdistan region, Iraq.

Informed Consent Statement:

No Informed Consent Statement.

Data Availability Statement:

No Data Availability Statement.

Conflicts of Interest:

The authors declare no conflict of interest.

Acknowledgments:

We do thank the staff of Department of Entomology in Research Center and Museum of Iraqi Natural History at University of Baghdad; particularly, Prof. Dr. Razzaq S. Akeel and Assist. Prof. Dr. Hanna H. Alsafar for their scientific collaboration to confirm the identify the species.

References

1- Abbott, W. S. (1925). A method of computing the effectiveness of an insecticide. J. econ. Entomol, 18(2): 265-267. https://doi.org/10.1093/jee/18.2.265a.

2- Abdul Kareem, R., R., & H. Sayer, Sh. (2024). Phytochemical And Protective Effect Of Saussurea Costus Extract On Some Physiological And Histological Parameters In Albino Rats Induced With Chlorpromazine In The Testis. Anbar Journal Of Agricultural Sciences, 22(1), 82–94. https://doi.org/10.32649/ajas.2024.142234.1066.

3- Ahmed, M., Y., & M. Abed, J. (2024). Effect Of Melatonin And B -Amino Butyric Acid (Baba) Against The Fungus Botrytis Cinerea Growth And Yield In Strawberry. Anbar Journal Of Agricultural Sciences, 22(1), 369–382. https://doi.org/10.32649/ajas.2024.183738.

4- CORP, I. B. M. Released. (2019). IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.

5- Demirel, N., and Yıldırım, A. (2008). Attraction of various sticky color traps to thrips tabaci Lindeman (Thysanoptera: Thripidae) and Empoasca decipiens Paoli. J Entomol, 5: 389-394.

6- Dietrich, C. H. (2004). Phylogeny of the leafhopper subfamily Evacanthinae with a review of Neotropical species and notes on related groups (Hemiptera: Membracoidea: Cicadellidae). Systematic Entomology, 29(4): 455-487. https://doi.org/10.1111/j.0307-6970.2004.00250.x.

7- Dietrich, C. H. (2005). Keys to the families of Cicadomorpha and subfamilies and tribes of Cicadellidae (Hemiptera: Auchenorrhyncha). Florida Entomologist, 88(4): 502-517. https://doi.org/10.1653/0015-4040(2005)88[502:KTTFOC]2.0.CO;2.

8- Girish, B.R., Sharanbasappa, Kalleswara swamy C.M. and Advappar, N. (2018). Evaluation of different biopesticides against mango leafhoppers. International Journal of Chemical Studies, 6(6): 2139-2143.

9- Hasnah, H., Susanna, S., and Sably, H. (2012). Keefektifan cendawan Beauveria bassiana Vuill terhadap mortalitas kepik hijau Nezara viridula L. pada stadia nimfa dan imago. Jurnal Floratek, 7(1): 13-24. https://doi.org/10.17969/floratek.v7i1.515.

10- Kumawat, R. L., Pareek, B. L., and Meena, B. L. (2000). Seasonal incidence of jassid and whitefly on okra and their correlation with abiotic factors. Annals of Biology, 16(2): 167-169.

11- Ladja, F. T., Santoso, T., and Nurhayati, E. (2011). Potential of entomopathogenic fungi Verticillium lecanii and Beauveria bassiana in controlling green leafhopper and suppressing the intensity of tungro disease. Food Crop Agriculture Research, 30(2): 114-120.

12- Naveed, H., Shah, B., Khan, B. S., Cao, C., Webb, M., and Zhang, Y. (2021). Checklist and keys to Deltocephalinae leafhoppers (Hemiptera, Cicadellidae) from Pakistan. ZooKeys, 1078: 135. https://doi.org/10.3897%2Fzookeys.1078.47616.

13- Pakarpour Rayeni, F., Nozari, J., and Seraj, A. A. (2015). A checklist of Iranian Deltocephalinae (Hemiptera: Cicadellidae). Iranian Journal of Animal Biosystematics, 11(2): 121-148. https://doi.org/10.22067/ijab.v11i2.44211.

14- Webb, M. D., and Viraktamath, C. A. (2009). Annotated check-list, generic key and new species of Old World Deltocephalini leafhoppers with nomenclatorial changes in the Deltocephalus group and other Deltocephalinae (Hemiptera, Auchenorrhyncha, Cicadellidae). Zootaxa, 2163(1): 1-64. https://doi.org/10.11646/zootaxa.2163.1.1.

15- Widiarta, I. N., Kusdiaman, D., and Hasanuddin, A. (1999). Dinamika populasi Nephotettix virescens pada dua pola tanam padi sawah. Jurnal Perlindungan Tanaman Indonesia, 5(1): 42-49. https://doi.org/10.22146/jpti.9965.