Rafidain Journal of Science

https://rsci.uomosul.edu.iq

Vol. 34, No. 1, pp. 12-19/ March, 2025

Population Density of Certain Piercing-Sucking Insects Infesting Sunflower Crop in Erbil City

Azad H. Saleh **Khalid Q. Khidher** **Hazm S. Ahmed** **Nawzad B. Kadir**

Department of Plant Protection/ College of Agricultural Engineering Sciences/ University of Salahaddin- Erbil/ Iraq

p-ISSN: 1608-9391
e -ISSN: 2664-2786

Article information

Received: 8/8/2024
Revised: 1/10/2024
Accepted: 10/10/2024

DOI: 10.33899/rjs.2025.186491

Corresponding author:
Aazad H. Saleh
azad.saleh@su.edu.krd

ABSTRACT

A field trial was performed in Grdarasha Research Station College of Agricultural Engineering Sciences/ Erbil/ Kurdistan region/Iraq, to investigate the piercing and sucking insect pests of sunflower crop and study nature of damages, population density and seasonal incidence of two major sucking insect pests during the flower initiation of sunflower crop. The CRD design was used for the experiment implementation. The results of this study revealed that two major piercing and sucking insects were recorded infesting different parts of sunflower plants, insect pest were sunflower whitefly (*Bemisia tabaci*) and sunflower lace bug (*Galeatus scrophicus*), belonging to the insect families of Aleyrodidae and Tingidae, and both belong to the order Homoptera and Hemiptera respectively. According the results, lace bug insects were more abundant that the sunflower whitefly during the growing season, the highest population density of whitefly was at fourth sampling week (6.50 individuals/ plant) while its infestation percentage was low and averaged 20% infestation/ field plants, however, the highest population density of lace bug was at the fifth week of sampling which was 22.60 individuals/ plant, while the lace bug infestation percentage was 90% infestation/ field plants.

Keywords: Insects pest, insect survey, whitefly, lace bug.

INTRODUCTION

Sunflower is a short season plant classified into family *Asteraceae* and genus *Helianthus* with more than 70 species known worldwide (Vilvert *et al.*, 2018). The beauty of the sunflower has inspired both the poet and the artist, albeit more in Europe than in the homeland (Heiser Jr, 1978) and the most common species is *Helianthus annus L.* belongs to the plant family *Asteraceae* (Fernández-Luqueño *et al.*, 2014) and it is considered as the fifth largest oil seed crop globally (Seiler and Gulya Jr, 2016), also it contributes about 13% of total production of edible oil in the world (Potrykus, 1990).

Sunflower is considered as one of the most important crops among the three major oilseed crops, rapeseed, soybean, and sunflower in the world today. Sunflower has been recognized as a major source of high-quality edible oil importantly used for culinary purposes (Pal *et al.*, 2015). Sunflower is grown throughout the world for providing premium oil and dietary fiber that significantly useful for human health (Khan *et al.*, 2015). Its seeds contain (40 to 50%) oil and (17 to 20%) protein (Kakakhel *et al.*, 2000).

Several factors can be responsible for the low yield including poor agricultural practices, non-availability of improved seeds and damages due to plant diseases and insects (Soomro *et al.*, 2012). Various pestiferous insect contributes to cause damage to the sunflower plants in different levels (Panchabhavi and PN, 1978; Lohar, 1987).

Aslam *et al.* (2000) recorded nineteen pestiferous insects in Pakistan, many piercing and sucking insect pests have been recorded on sunflower crop in the world, among them, whitefly, leafhoppers (Lohar, 1987), whereas *Bemisia tabaci* (Genn), *Aphis gossypii* (Glover) reported to be pest insects on sunflower by Piracha (1989) and Misbah-ul-Haq *et al.* (2003), in addition, Lace bugs recorded on sunflower by Satti (2013) and Yazdanian and Hosseini Mighani (2021).

Few research has been reported on sunflower flower insects in Iraq (Karso *et al.*, 2023), however, in Kurdistan region of Iraq, no comprehensive research has been conducted on sunflower insects especially sucking insect pest, therefore, this study aimed to survey piercing and sucking insect pests, investigate the seasonal abundance of the two major sucking insects (whitefly and lace bugs) in relation to plant age and weather parameters, on sunflower crop plants in Erbil province.

MATERIALS AND METHODES

Study design, cultivation and sampling

The current experiment was carried out in the Grdarasha field which belongs to College of Agricultural Engineering Sciences/Salahaddin University-Erbil-Iraq during summer growing season of sunflower-2022. For this study, the seeds of sunflower crop (local variety) were sown at 25/6/2022, and with three replications, each replication consisted of a line of 20 meter sown with seeds of sunflower, the space between plans and rows (lines) were 50 cm and 100 cm respectively.

The seeds were sown at a depth of 5 cm in the previously prepared soil for cultivation and irrigated was done using plastic tape lines, also all agricultural the services were implemented during the trial.

Sampling for infestation percentages was taken place starting from the flower initiation on the crop in the field of the experiment and continued weekly until maturity of the sunflower crop. The infestation ratio sampling was counted depending on the presence of damaging stage (adult or immature stages) and their number also was counted in order to calculate their population density in relation to weather factors in the experiment area, for this, ten plants in each replication were checked for infestation percentage. Infestation percentage for the studied insect pests on each replication was calculated by using the following equation.

$$\%\ \text{infestation} = \frac{no.\ of\ infested\ plants}{total\ number\ of\ sampled\ plants} \times 100$$

3 g of the sample was taken and 3 ml of hydrochloric acid (6 M) with 0.1% phenol was added to it. The mixture was placed in a 10 ml volumetric bottle and tightly closed. After that, it was placed in a convection oven at 45 °C for a day. Then 3 ml of sodium hydroxide and 0.1 mg of tartaric acid were added to it, and mixed well for 15 minutes. then the sample was filtered using a plastic filter 0.45um, and the injection process was performed (Dahl-Lassen *et al.,* 2018).

Derivation process

We followed the method used (Scriver *et al*., 2001) where 1 ml was taken from the extracted sample and 200 microliters of orthophthalene aldehyde (5%) (OPA) was added to it. The sample was shaken for 2 min, after which 100 microliters was taken from the last mixture and injected into the Amino acid analyses device (Korean origin) and according to the data: Acetonitrile, methanol, and formic acid make up the mobile phase 60: 20: 20, Derivatization with OPA is part of the injection program,100 µl is the injection volume, column: ZORBAX Eclipse-AAA; 3.5 m; 150 x 4.6 mm in length and width and Florescence detector (Ex = 445 nm, Em = 465 nm).

Preparation of the calibration curve

In order to prepare the calibration curve, 0.1 grams of high-purity amino acid mixture 99.9% was dissolved in nonionic water, transferred to a conical flask 250 ml, and the appropriate volume was added until its concentration became 250 ppm. Use the dilution law to prepare the calibration curve concentrations injected into the device.

RESULTS AND DISCUSSION

Nature and extent of damages of whitefly and lace bug on sunflower crop

The Fig. (1) shows the major piercing and sucking insect pests on the sunflower plants during summer growing season of 2022 in Erbil province.

In the current study, two major piercing and sucking insects were investigated, the first was whitefly (*Bemisia tabaci*) belonging to insect family *Aleyrodidae*, and lace bugs (*Galeatus scrophicus*) belonging to the insect family *Tingidae*, both insects belong to the order *Homoptera* and their mouthparts are of piercing and sucking type.

According to the data provided in the Chart (1), the number of two insects collected during the season unequal, the higher number of caught insect samples collected was lace bug which reached to 90%, while the whitefly number was comprised only 10% of collected samples during the study period. This indicates that the lace bugs were more abundant than whitefly insects.

These insect pests were found on the plants of sunflower crop feeding on the leaves and back of heads by their piercing and sucking mouthparts with a needle like styles penetrating the epidermis of the plant parts. For white flies, they were seen in small numbers during the study period and they were of different life stages including immature stages and adults, both stages of nymphs and adults were seen sucking the plant parts especially leaves and secret honeydew from their body onto the feeding substrate. This caused to contaminate the surface of the leaves and finally affected on the productivity by rendering the leave surface unsuitable for photosynthesis. Accordingly, various research papers have been published concerning the plant injuries due to whitefly, based on the findings of Horowitz *et al.* (2020) the whitefly individuals remove sap from the phloem in the leaves and stems and other plant parts. Naranjo *et al.* (2002) mentioned that both the immature and mature stage secret honeydew making the sticky leaves and forming of substrate which is medium for initiation of sooty mold. These research paper results are in conformity with the findings of the current study.

Turning to lace bugs as it can be seen in the Fig. (1), they were noticed in large numbers and was seen feeding on each of the plant parts including leaves and sunflower heads, the feeding by lace bug were caused to leave plant leaves discolored condition due to lowering chlorophyll content of the leaves whose fed upon by lace bugs and also their feeding by products (faeces) were present

and attached to the leaf surfaces at the feeding site. This was also led to change the surface color of the leaves with many patches of densely scattered tiny black spots (faeces). The findings of the present study are in line with those reported by other researchers, Yazdanian and Hosseini Mighani (2021) found that on sunflower, nymphs and adults of sunflower lace bug caused injuries just on upper and lower leaf surfaces and also on upper and lower surfaces of involucral bracts. Damage on both upper and lower surfaces began mainly at leaf margin (sometimes at the adjacent of midrib) and then extended to the inner parts of lamina. Moreover, authors stated that the faeces of nymphs and adults were visible individually and at high numbers at feeding sites as shiny small black spots.

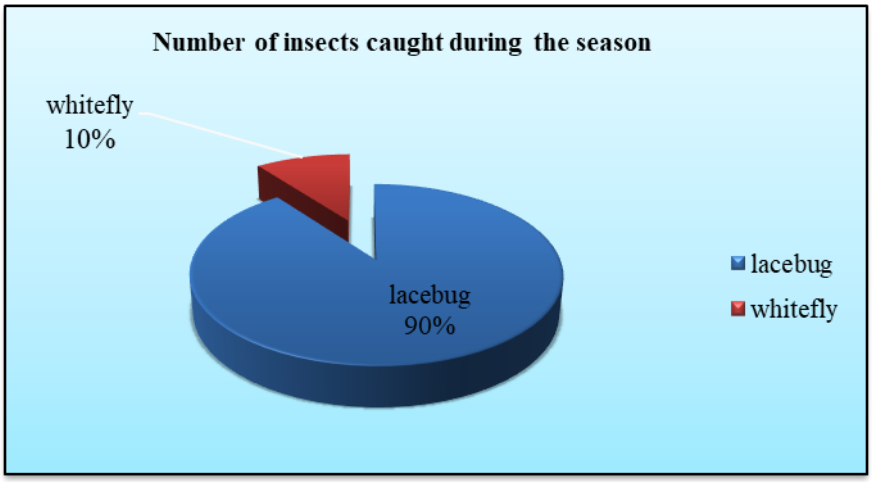

Fig. 1: Total number and percentage of whitefly and lace bug caught during the growing season.

Fig. 2: Damage; A- Lace bug and B- whitefly.

Infestation and copulation density of whitefly on sunflower crop:

The data in (Table 1) shows infestation percentages and population density of sunflower whitefly over seven weeks, during flower initiation stage of sunflower crop, summer growing season-2022.

Based on the data (Table 1), the infestation of sunflower plant by whitefly started lately in the flower initiation stage of sunflower crop (during the studied sampling weeks of the season), whitefly infestation appeared at the fifth week of sampling during flowering stage when it was averaged 20% infestation/ field and the population density of whitefly on the plants ranged from zero to 62.0 and averaged 6.50 individuals/ plant in the date of sampling while the average temperature and relative humidity were 27C° and 37% respectively. This data increased and decreased for infestation percentages and population density respectively, until the end of season (harvesting time), then the infestation percentage reached to its peak 40% infestation/ field plants, whereas the population density decreased to the bottom which was ranged 0.00 to 5.00 and averaged 1.20 whitefly individuals/ plant in the average temperature and relative humidity of 22.5C° and 49%, respectively.

According to statistical analysis, Duncan test at 0.05 of significant level, there is no significant difference between the weekly recorded data regarding the population density of sunflower whitefly; however, Basit *et al*. (2016) recorded *B. tabac*i infestation occurred throughout the crop season and its population continuously increased until harvest of the crop. Maximum population (3.80 ± 0.03 and 5.65 ± 0.51 individuals/leaf) was during third week of April 2008, 2009, respectively. Moreover Ghante *et al*. (2020) observed the activity of whiteflies throughout the year in sunflower ecosystem

with population ranging from 0.40 to 60.56 /6 leaves per plant.

In contrast, El Sayess et al. (2005) found that the Whitefly population increases by increasing nitrogen fertilization levels and decreases significantly when sunflower plants are 15 cm apart. Moreover, Khanzada et al. (2016) observed in the initiation of the whitefly's population, it was very low (1.15 + 0.10) in 2nd week of January, thereafter the population increased to reach the highest point which was (17.77 + 0.78), in the 2nd week of April.

Table 1: Infestation ratio and population of whitefly on sunflower plants at flower initiation stage - Erbil city, 2022

Weeks	Mean of Infestation percentage %	Number of nymph and adults/ plant		Weather condition	
		Range	Mean ± SE	Temperature C°	Relative humidity %
1	0.00	0.00-0.00	0.00 ± 0.0	35	34
2	0.00	0.00-0.00	0.00 ± 0.0	32.5	36.5
3	0.00	0.00-0.00	0.00 ± 0.0	29	32
4	0.00	0.00-0.00	0.00 ± 0.0	31.5	34
5	20	0.00-62.0	6.50 ± 6.17	27	37
6	30	0.00-16.0	2.90 ± 1.7	30.5	48.1
7	40	0.00-5.00	1.20 ± 0.55	22.5	49

Different letters in the same column vertically are significantly different from each other at 0.05 of significant level.

Infestation and population density of lace bug insect on sunflower crop:

The data in (Table 2) shows infestation percentages and population density of sunflower lace bug over seven weeks, during flower initiation stage of sunflower crop, summer growing season-2022.

According to the date shown in the (Table 2), the infestation of sunflower plant by lace bug insects early in the season of sunflower crop, so the infestation percentage from the beginning of the studied weeks was 100% infestation/ field plants and the population density of lace bug insects on the plants ranged from 1.0 to 62.0 individuals and averaged 16.90 individuals/ plant in the same date of sampling while the average temperature and relative humidity were 35C° and 34% respectively. The data of infestation percentage remained the same until third week of sampling, then it decreased in the fourth week of sampling to 90% infestation/ field plants, the infestation percentage continued decreasing gradually until the end of sampling week which was 50% infestation/ field plants, while the population density of same insects increased gradually until it reached to its peak in fourth week of sampling which ranged from zero to 88.0 individuals/ plant and averaged 22.60 individuals/ plant, whereas the mean temperature and relative humidity were 31.5C° and 34% respectively, the population of the pest insect decreased until the end of the growing season it surged to range from zero to 6.0 and averaged 2.00 individuals/ plants, in the mean temperature and relative humidity of 22.5C° and 49% respectively.

Based on statistical analysis, Duncan test at 0.05 of significant level, there are significant differences among sampling weeks regarding the population density of insect pest (lace bug) during the flower initiation stage of the summer cultivated sunflower. It is noteworthy to mention that, first week data and sixth week data are at par, second- and fifth-week data are also at par with each

other; in addition, there is no significant difference between third- and fourth-week data in terms of population density of lace bug.

Similarly, this insect pest was recorded on sunflower plants in Iraq, Al-Mallah (1999) observed that the Galeatus scrophicus preferred the lower part of plants and lower surface of leaves and a single- flowered variety of sunflower and the infestation ratio on plants was 67.6%. Satti (2013) reported that the number of nymphs and adults on the upper surface was higher than on the lower surface of plant leaves. However, the pest was found in all sunflower areas in central Sudan. The seasonal counts showed that the highest population of the pest occurred in winter as compared with autumn season.

Table 2: Infestation ratio and population of lace bug on sunflower plants at flower initiation stage - Erbil city, 2022

Weeks	Mean of Infestation percentage %	Number of nymph and adults/ plant		Weather condition	
		Range	Mean ± SE	Temperature C°	Relative humidity %
1	100	1.0-62.0	16.90±6.9abc	35	34
2	100	2.0-70.0	19.50±7.7ab	32.5	36.5
3	100	3.0-71.0	21.50±7.9a	29	32
4	90	0.00-88.0	22.60±9.5a	31.5	34
5	80	0.00-12.0	4.30±1.5ab	27	37
6	50	0.00-32-0	6.80±3.5abc	30.5	48.1
7	50	0.00-6.0	2.00± 0.7c	22.5	49

Different letters in the same column vertically are significantly different from each other at 0.05 of significant level.

CONCLUSION

Sunflower is an oil seed crop grown globally. So many insect pests attack sunflower plants and play a significant role in decreasing productivity of the crop. This research paper has focused on the piercing and sucking insect pests infesting sunflower plants and it has been revealed that there were two main insect pests possessing piercing and sucking mouth including sunflower whitefly and lace bug. The later was the most abundant insect pest on the plant's parts including both leaves and sunflower heads feeding by their mouthparts style, we concluded that it is preferable to control these insects especially lace bugs in the early stage of the plant to prevent the pest from mass producing and cause large damages on the plants. Recognizing the damage site and damaging behavior with ecological secrets of studied insect pests on sunflower are of great importance to find the most suitable management method to control the insect pests effectively aiming to increase the productivity of sunflower and improve the quality of production.

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الكثافة السكانية لبعض الحشرات الثاقبة الماصة التي تصيب محصول زهرة الشمس في مدينة اربيل

ازاد حسن صالح خالد قادر خضر حازم سعيد احمد نوزاد باوكر قادر

قسم وقاية النبات/ كلية علوم الهندسة الزراعية/ جامعة صلاح الدين– اربيل/ العراق

الملخص

أجريت هذه الدراسة في محطة بحوث كردرشة – كلية علوم الهندسية الزراعية – جامعة صلاح الدين/ أربيل – إقليم كردستان – العراق، لغرض مسح الآفات الحشرية الثاقبة الماصة على محصول زهرة الشمس ودراسة طبيعة الأضرار والكثافة السكانية والإصابة الموسمية لاثنين من أهم الحشرات الماصة أثناء تزهير محصول زهرة الشمس. تم استخدام تصميم القطاعات العشوائية الكاملة (CRD) لتنفيذ التجربة. أظهرت نتائج هذه الدراسة أنه تم تسجيل حشرتين رئيسيتين ذوات اجزاء الفم الثاقبة الماصة التي تصيبان أجزاء مختلفة من نبات زهرة الشمس، وهما الذبابة البيضاء (*Bemisia tabaci*) وحشرة البق المطرز (*Galeatus scrophicus*)، التي تنتميان الى العائلتين Alyerodidae و Tingidae وكلاهما ينتميان إلى رتبة Homoptera و Hemiptera على التوالي. أظهرت النتائج أن حشرة البق المطرز كانت أكثر وفرة من الذبابة البيضاء خلال موسم النمو، وكانت أعلى كثافة سكانية للذبابة البيضاء في الاسبوع الرابع (6.50 فرد/ نبات) بينما كانت نسبة الإصابة بها منخفضة وبلغ متوسط الإصابة 20%. أما أعلى كثافة لحشرة البق المطرز كانت في الأسبوع الخامس حيث بلغت 22.60 فرداً/ نبات، في حين بلغت نسبة الإصابة للبق المطرز 90% إصابة/ نبات.

الكلمات الدالة: الآفات الحشرية، المسح الحشري، الذبابة البيضاء، البق المطرز.