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Population Dynamics of Sunflower Lace Bug, *Galeatus Scrophicus* on Different Sunflower Varieties in Erbil City During the Summer Season

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ABSTRACT

A field experiment was conducted in Grdarasha research station which belongs to College of Agricultural Engineering Sciences- Erbil, Kurdistan region Iraq, in order to identify lace-bug infestations in sunflower crops and investigate the type of damage by this insect then measuring population density, surveys, and determines their seasonal occurrence during the summer flowering stage of sunflower crops. The RCBD design was used for the field experiment. The result of this study showed the attacks the lace bug, *Galeatus scrophicus* on various parts of sunflower which belong to the family Tingidae and order Hemiptera were very observable. The results of ecological study revealed that the Chinese variety was the largest rate of lace-bug samples at 36%, followed by the Aqmar variety with 25%. The Local variety contributed 24% of the total samples, while the Batoli variety was the smallest proportion at 15%. Based on the findings, lace bug was most abundant during the growing season, with the Chinese variety reaching its highest population density at (8.557 individuals/plant). At the same time, 36% of the plants in the field showed signs of lace bug infestation. According to the data obtained from the survey, the lace bug was found in 15 out of the 17 locations surveyed, while in the remained locations, there was no infestation recorded. The highest average infestation was recorded in Tandura, with (1,436) leaves affected per tree, whereas the lowest average infestation of (53) leaves per tree occurred in Daldaghan. No infestations were observed in Choman, Enne, and Qushtapa.

Keywords: Insect, Population, Sunflower, Lacebug, *Galeatus*.

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INTRODUCTION

Sunflower (*Helianthus annuus* L.) is a valuable oilseed crop with significant economic importance, used to produce a range of products. It ranks as the fourth most important oil crop globally, following soybean, oil palm, and canola [1]. Belonging to the Asteraceae family one of the largest families of dicotyledonous flowering plants sunflower is widely cultivated for its oil content [2]. Sunflower oil is utilized in both the food industry and in oleo-chemical applications. After the oil is extracted from the seeds, a protein-rich solid byproduct remains. Rather than being discarded or used solely as animal feed, this byproduct has potential as a valuable food ingredient. However, oil extraction processes like mechanical pressing and solvent extraction often involve high temperatures, which can denature proteins and diminish their functional properties [3]. Additionally, sunflower is a highly cross-pollinated crop, relying heavily on insect pollinators to produce high-quality edible oil [4].

Sunflower is one of the major oilseed crops grown globally for oil production [5]. Its cultivation benefits from insect visitors that forage for nectar or pollen [6]. However, reduced sunflower yields can result from various factors, including damage by sucking pests such as the sunflower lace bug, *Galeatus scrophicus* (Hemiptera: Tingidae). This insect undergoes five nymphal stages (instars), with body length increasing progressively from the first to the fifth stage in both male and female forms. The nymphs have thorn-like projections that lengthen with each molt, and in the fifth instar, bulb-like structures resembling those of adults develop.

On sunflower plants, both nymphs and adults feed primarily on the upper and lower leaf surfaces, as well as the upper and lower sides of the involucre bracts. Feeding damage typically begins at the leaf margins (or occasionally near the midrib) and gradually spreads toward the inner lamina [7].

This study aimed to monitor and analyze the population dynamics of sunflower lace bug pests, focusing on their seasonal abundance in relation to the sunflower plant's growth stages and various weather conditions in Erbil province.

Materials and methods

Field survey of sunflower lace bug

In this study, seventeen sunflower-growing sites were selected within Erbil Governorate. Sampling was conducted during the summer months of August and September, coinciding with the maturation stage of the sunflower plants.

Design of the study, cultivation practices, and sampling procedure

The present study was conducted without the application of pesticides at the Grdarasha experimental field, affiliated with the College of Agricultural Engineering Sciences, Salahaddin University–Erbil, Iraq, during the summer growing season of 2024. Four sunflower varieties (Local, Chinese, Aqmqr, and Batoli) were sown on July 20, 2024. The experiment was designed in three replications, with each replication consisting of a 20-meter-long row. Plant spacing within rows and between rows was maintained at 30 cm and 75 cm, respectively [8]. Seeds were sown at a depth of 5 cm in well-prepared soil, and irrigation was applied using plastic drip tape. All standard agricultural practices were followed throughout the experiment.

Sampling for insect infestation began at the flower initiation stage and was conducted weekly until crop maturity. Infestation assessment was based on the presence of harmful stages (both adult and immature stages), and their numbers were recorded to determine population density in relation to prevailing weather conditions. In each replication, three plants were examined to estimate infestation percentages. For this purpose, plants were randomly selected, and the insect population was counted on the leaves taken from three different sections of each plant: the top, middle, and bottom. In addition, average weekly meteorological data such as temperature and relative humidity were recorded during the observation period. The percentage of infestation by the target insect pests in each replication was calculated using the following formula [9].

$$\% \text{ Infestation insect} = \frac{\text{Number of infested plants}}{\text{Total number of sampled plants}} \times 100$$

To estimate the population density of each insect pest, nine plants were selected from each sunflower variety. These plants were examined weekly to count the number of immature and adult stages. The collected data were recorded in a pre-designed table.

Identification samples

Specimens of the pest insect was collected and sent to the Plant Protection Department- Insect Museum at the Agricultural Research Center in Erbil for identification. The identification was carried out by comparing the collected samples with previously identified reference specimens preserved in the museum. Insect identification and diagnosis were also performed using molecular techniques.

Statistical analysis

The data collected in this study were organized in tables and analyzed using Excel software. Mean values were calculated and compared using the Statistical Analysis System (SAS) program (2002-2003) [10] survey data were analyzed through a Factorial Randomized Complete Block Design (RCBD). Additionally, the overall average insect population across different crop varieties and sampling periods was determined. Differences insect populations among the four sunflower varieties were evaluated using Duncan's multiple range tests at a significance level of $p < 0.05$.

Results and Discussion

Damage patterns and severity of lace bug on sunflower varieties

The current study conducted during the summer growing season of 2024 in Erbil province, major piercing and sucking insect pests were examined, focusing on the lace bug, *Galeatus scrophicus*, which belongs to the family Tingidae and order: Hemiptera. This insect possesses piercing-sucking mouthparts. Figure 1 illustrates the primary piercing and sucking pest (lace bug) affecting sunflower varieties during this period. According to the data shown in (Chart 1), the number of lace bug collected varied among the varieties. The highest proportion of lace bug samples, reaching 36%, was found on the Chinese variety, followed by 25% in the Aqmar variety. The local variety accounted for 24% of the collected samples, while the Batoli variety had the lowest at 15%. This suggests that lace bugs were most abundant on the Chinese variety compared to Aqmar, Local, and Batoli varieties. These pests were observed feeding on sunflower plants, targeting the leaves and the undersides of the flower heads. Using their needle-like piercing-sucking mouthparts, they penetrate the plant epidermis to feed.

As shown in (Figure 2), lace bugs were observed in large numbers, feeding on various parts of the sunflower plants, including the leaves and heads. Their feeding activity caused the leaves to become discolored due to a reduction in chlorophyll content. Additionally, the lace bugs' excrement (faeces) was found attached to the leaf surfaces at feeding sites, leading to a noticeable change in leaf coloration marked by numerous tiny, densely scattered black spots. These findings align with those of [7], who reported that both nymphs and adults of the sunflower lace bug cause damage to the upper and lower surfaces of leaves as well as the involucral bracts. The damage typically begins at the leaf margins (and occasionally near the midrib) before spreading inward across the leaf blade. Furthermore, the authors noted that the faeces of nymphs and adults appear as shiny small black spots, often present in high numbers at feeding locations. [11,12,13] reported that both nymphs and adult

lace bugs feed directly on plant leaves by piercing them and extracting nutrients from the cells located between the upper and lower epidermal layers. This feeding behavior can result in chlorosis, leaf discoloration, surface drying, reduced photosynthetic activity, and even early leaf drop. Additionally, [14] emphasized that piercing-sucking insects may act as vectors for various plant diseases by transmitting viral toxins through their saliva, causing significant crop damage.

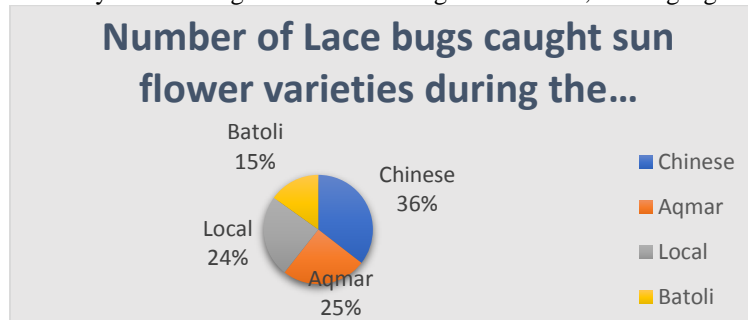


Figure 1: Total Number And Percentage Of Lace Bug, *Galeatus Scrophicus* Caught During The Growing Season

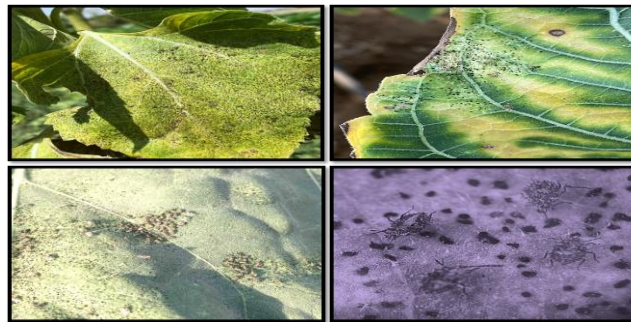


Figure 2: The Damage Of Lace Bug, *Galeatus Scrophicus* On Sunflower Plant

Population density of lace bug on sunflower crop varieties

The data in table (1) shows that the study was conducted to monitor the population dynamics of lace bugs (both nymphs and adults) on four sunflower varieties (Chinese, Local, Batoli, and Aqmar) during the early growth and flowering stages across three months (August, September, and October 2024) in Erbil City. The findings are presented as weekly mean population densities (\pm SE), accompanied by weather conditions (temperature and relative humidity), to assess their influence on lace bug infestation levels. Based on the data (table 1), the infestation of sunflower plant by lace bug in Chinese variety. The population began modestly in week 1 at ($2.110 \pm 0.485bc$), gradually increasing through weeks 2 and 3 ($2.443 \pm 0.868b$ and $2.667 \pm 0.193c$ respectively), suggesting the initiation of lace bug colonization under high temperatures ($43-39^\circ C$) and low relative humidity (10–18%). However, in week 4, there was a quite decrease to ($1.667 \pm 0.693d$), likely due to slight increase humidity (20%) or plant phenological changes affecting insect preference. A resurgence in population occurred from week 5 ($4.45 \pm 1.682c$), maintaining high levels through weeks 6 and 7 ($4.22 \pm 2.725c$ and $5.553 \pm 3.223b$ respectively). The peak infestation was recorded in week 7 ($5.553 \pm 3.223b$), indicating optimal climatic conditions for lace bug proliferation around $36^\circ C$ and 18% RH. However, a gradual decrease began in week 8 ($3.443 \pm 1.568b$), followed by a fully drop in week 9 to $0.557 \pm 0.294c$, possibly due to cooler temperatures ($32^\circ C$) and increased humidity variability, which are known to reduce nymphal survival and adult activity. October showed an unusual population spike in weeks 10 and 11, reaching the highest recorded in population density ($8.557 \pm 4.717abc$) in week 10 and ($8.000 \pm 3.077b$) in week 11. These values suggest either overlapping generations or favorable late-season conditions despite moderate temperatures ($32^\circ C$) and increasing humidity (17–21%). However, this was followed by a dramatic crash in weeks 12 and 13, with the population reducing to ($0.110 \pm 0.110c$) and ($0.557 \pm 0.557a$), respectively. The sudden decline correlates with a sharp temperature drop to ($21^\circ C$), which likely disrupted lace bug development or survival.

The local variety displayed inconsistent population patterns. It peaked in week 6 ($5.33 \pm 1.261c$) but maintained relatively moderate to low densities in other weeks and moderate increase in weeks 1-4 of August. There was a significant increase during the 6 and 13 weeks, recorded at ($4.443 \pm 4.443a$), likely stemming from variations in local climate conditions or the inherent susceptibility of certain plant varieties. In October, the population stabilized at approximately (2.000 to 2.333), without experiencing a sudden rise, hinting at either a moderate level of resistance or reduced attract for lace bugs.

Batoli variety showed the lowest population density overall, especially in the early weeks. The population remained at or near zero for the first five weeks, indicating possible resistance or deterrent plant traits. Population density began only in week 3 which ($1.110 \pm 0.588c$) and slightly increased thereafter. A notable spike in week 10 ($5.667 \pm 3.975abc$) and week 12

(3.110±3.110bc) may reflect late-season oviposition or changing host preference. Otherwise, Batoli remained less preferred by lace bugs.

The Aqmar variety showed variable trends but demonstrated extreme values a steep increase in week 4 (4.887±1.444cd) and week 5 (4.67±3.512c). Population density decreased to (0.33±0.193b) in week 8, reflecting a regional temperature decline. A notable increase in week 13 (7.110±5.983a) represented the highest lace bug density observed on any variety throughout the study. This suggests that Aqmar might become more susceptible in the late season or under specific climatic conditions.

The Chinese variety was highly susceptible to lace bug infestation, with peak densities observed in weeks 7, 10, and 11, especially under temperatures of (32–38°C) and relative humidity between (17–21%). While Batoli exhibited significant resistance across most weeks, Aqmar and Local varieties showed intermediate responses. Environmental conditions, particularly temperature and humidity, played a significant role in shaping the population dynamics of lace bugs across all sunflower varieties.

Effective management strategies should prioritize early-season monitoring and late-season interventions, especially for the Chinese and Aqmar varieties. Further investigation into varietal resistance traits, particularly in Batoli, may help in breeding more resistant cultivars.

Similarly, this insect pest was recorded on sunflower plants in Iraq, [15] 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%. The presence of lace bugs on walnut trees was limited to a few branches, with feeding activity confined primarily to the underside of the leaves. Their tendency to cluster in groups appeared to be linked to their behavioral traits. As temperatures rose from spring into summer, lace bug populations increased, reaching their peak during the summer months, an observation consistent with the findings of [16]. Temperature was found to be a key factor in lace bug development, with lower temperatures reducing their abundance, aligning with the results reported by [17]. Temperature is considered one of the most significant abiotic factors directly influencing herbivorous insect populations. Additionally, moisture was shown to be vital during the insects' developmental stages, with seasonal fluctuations in humidity having the potential to impact the number of generations (voltinism), as noted by [18].

However, [19] mentioned that the higher numbers of nymphs and adults were reported on the upper surfaces than on the lower sides of plant leaves 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. On the other hand, the mean total durations of pre-imaginal stages were shorter in autumn (14.12±0.15 days) than in winter (25.27±0.26) season.

Table 1: Population density of lace bug, *Galeatus scrophicus* on sunflower plant varieties at initiation stage in Erbil city- 2024.

Months	Weeks	Number (mean±SE) of Lace Bugs per plant varieties				Weather condition	
		Chinese	Local	Batoli	Aqmar	Temperature °C	Relative humidity
August	1	2.110±0.485bc	2.220±0.110bc	0.000 ±0.000c	1.557±0.802c	43	10
	2	2.443±0.868b	2.557±0.294b	0.000± 0.000b	2.777±0.447b	42	16
	3	2.667±0.193c	1.667±0.882c	1.110±0.588c	3.113±0.294c	39	18
	4	1.667±0.693d	3.553±0.909cd	2.333±0.839d	4.887±1.444cd	40	20
	5	4.45±1.682c	2.45±1.176c	1.22±0.294c	4.67±3.512c	38	22
September	6	4.22±2.725c	5.33±1.261c	1.33±0.882c	2.78±1.059c	38	19
	7	5.553±3.223b	1.667±1.202b	1.337±0.333b	1.777±1.447b	36	18
	8	3.443±1.568b	3.110±1.175b	0.33±0.333b	0.33±0.193b	33	26
	9	0.557±0.294c	2.333±2.170c	0.553±0.400c	0.777±0.777c	32	14
October	10	8.557±4.717abc	1.890±1.061c	5.667±3.975abc	0.110±0.110c	32	17
	11	8.000±3.077b	2.000±0.964b	0.000±0.000b	0.000±0.000b	32	21
	12	0.110±0.110c	0.110±0.110c	3.110±3.110bc	0.000±0.000c	21	21
	13	0.557±0.557a	4.443± 4.443a	1.667±0.961a	7.110±5.983a	24	19

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

General survey of lace bug

The survey results of the sunflower lace bug (*Galeatus scrophicus*) present (Figure 3) across seventy locations in Erbil Governorate based on infestation levels in 2024. The data indicate that lace bugs were found in most surveyed sites (15 locations), while no infestation was detected in the remaining areas. Among the infested sites, the highest average infestation was recorded in Tandura, with (1,436) leaves affected per tree, whereas the lowest average infestation of (53) leaves per tree occurred in Daldaghan. No infestations were observed in Choman, Enne, and Qushtapa.

The presence of lace bug infestations in these locations may be influenced by environmental factors such as temperature and relative humidity. These results align with the findings of [20] that highlighted temperature's role in increasing insect infestation rates. Additionally, the absence of insects in some areas might be related to insecticide use, as [21] noted that pesticide applications can sometimes trigger pest outbreaks by eliminating natural enemies. Moreover, herbicide use can reduce floristic diversity and food sources, leading to declines in pollinator populations and natural pest control agents

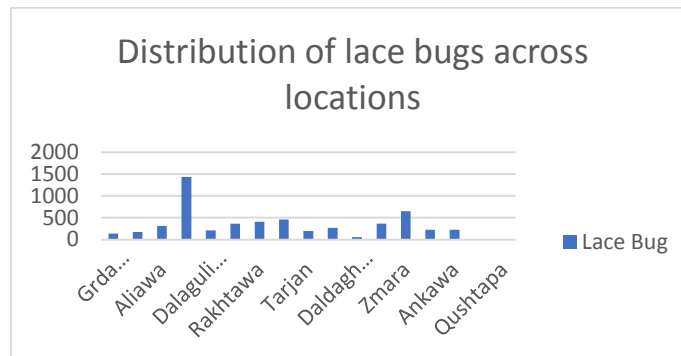


Figure 3: Infestation Of Sunflower Plants Caused By Lace Bug In Survey Areas In Summer - 2024

Conclusion

Sunflower is a widely cultivated oilseed crop around the world. However, it is vulnerable to numerous insect pests that significantly reduce the yield. This study focused on the lace bug insect pests infesting sunflower plants. Among these, the lace bug was identified as the most prevalent pest, feeding on various parts of the plant, including leaves and flower heads, using their piercing-sucking mouthparts. The findings suggest that controlling lace bugs at the early growth stages of the plant is crucial to prevent population outbreaks and minimize damage. Understanding the specific damage sites, feeding behaviors and ecological characteristics of these insect pests is essential for developing effective management strategies. Such approaches aim to enhance sunflower productivity and improve the overall quality of the crop.

Acknowledgment

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الكثافة السكانية لحشرة البق المطرز (*Galeatus scrophiicus*) على أصناف مختلفة من زهرة الشمس في مدينة أربيل خلال موسم الصيف

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تقسم وقتية النبات، كلية علوم الهندسة الزراعية، جامعة صلاح الدين، أربيل، العراق.

الخلاصة

أجريت هذه الدراسة الحقلية في محطة بحوث كردشة- كلية علوم الهندسة الزراعية- أربيل، إقليم كردستان- العراق، لغرض تحديد إصابات حشرة البق المطرز على محاصيل زهرة الشمس ودراسة في نوع الضرر الذي تسببه هذه الحشرة ثم قياس الكثافة السكانية والمسوحات وتحديد حدوثها الموسمي خلال مرحلة الإزهار الصيفي لمحاصيل عباد الشمس. تم استخدام تصميم القطاعات العشوائية الكاملة (*RCBD*) لتنفيذ التجربة الحقلية. أظهرت نتائج هذه الدراسة أنه هجمات حشرة البق المطرز (*Galeatus scrophiicus*) على أجزاء مختلفة من زهرة الشمس والتي تنتمي إلى عائلة الحشرات *Tingidae* ورتبة *Hemiptera*. أظهرت نتائج الدراسة البيئية أن صنف صيني شكّل أعلى نسبة في عينات حشرة البق المطرز بنسبة 36%، يليه صنف أقمار بنسبة 25%. وساهم صنف محلي بنسبة 24% من إجمالي العينات، بينما شكّل صنف باتولي نسبة أقل بنسبة 15%. أظهرت النتائج أن حشرة البق المطرز كانت أعلى كثافة سكانية خلال موسم النمو على الصنف الصيني (8.557 فردًا / نبات). في نفس الوقت، أظهرت 36% من النباتات مصابة في الحقل عن طرق تغذية البق المطرز. وفقًا للبيانات التي تم الحصول عليها من المسح، تم العثور على حشرة البق المطرز في 15 موقعًا من أصل 17 موقعًا التي تم مسحها، بينما لم يتم تسجيل أي إصابة في المواقع المتبقية. سُجّلت أعلى متوسط إصابة في تندورا، حيث تأثرت (1.436) ورقة لكل شجرة، بينما سُجّلت أقل متوسط إصابة (53) ورقة لكل شجرة في دالداغان. ولم تُلاحظ أي إصابة في جومان، ويني، وقوشته.

الكلمات المفتاحية: الحشرة، السكان، زهرة الشمس، البق المطرز، *Galeatus*.