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Impact of Seasonal Generations of Dubas Bug *Ommatissus binotatus* on Oviposition and Chlorophyll in Three Date Palm *Phoenix dactylifera* L. Cultivars

Ghazwan Faisal Al-Saedi **Firas M. Al-Hamoud** **Hazim M. Ali**
Date Palm Research Centre- University of Basrah, Basrah- IRAQ

Abstract

The study was conducted in the field in the Abu Al-Khasib area of Basrah Province, during the 2024 growing season to evaluate the impact of the dubas bug (*Ommatissus binotatus*) population density of spring and autumn generations on infestation rates, total chlorophyll concentration and oviposition in three date palms (*Phoenix dactylifera* L.) cultivars: Barhi, Sayer and Halawi. Infestation rates were highest in the during the two generations of dubas bug (Barhi cultivar 9.62%), (Sayer 8.17%), and Halawi (8.67%). This suggests that infestation rates significantly increased throughout the spring generation, particularly between March and June. As a result of a diminished insect impact at this time, infestation levels during the autumn generation were significantly lower or even nonexistent in certain months. Chlorophyll concentration varied between the two generations; higher values were generally observed during the autumn generation across most cultivars. The Sayer cultivar recorded the highest mean chlorophyll content, reaching 4.82 mg/g during the spring generation and 4.70 mg/g during the autumn, exceeding the levels recorded in Halawi and Barhi. Oviposition rates were also higher in the spring generation compared to the autumn. Barhi exhibited the highest average egg density with 0.61 eggs/cm² leaf area in the spring, slightly decreasing to 0.58 eggs/cm² in the autumn, with relatively stable values across the other cultivars. These findings indicate that the spring generation of *O. binotatus* exerts a greater adverse effect on date palm trees in terms of infestation and oviposition, while the autumn generation shows a comparatively milder impact. Insect density was shown to be negatively correlated with chlorophyll content and positively correlated with egg deposition. Differential susceptibility was demonstrated by the cultivars: Sayer had a comparatively higher level of resistance, whereas Barhi was the most sensitive. These findings highlight how crucial it is to include seasonal variation in integrated pest management (IPM) plans designed specifically for date palm production.

Keywords: *Phoenix dactylifera*; Dubas bug; population density; chlorophyll concentration.

Introduction

The date palm (*Phoenix dactylifera* L.) is one of the most significant agricultural crops that many Middle Eastern and North African nations depend on because of its high nutritional and economic value as well as its environmental (Zaid and deWet, 2002; Al-Khayri *et al*., 2015; Al-Abri *et al*., 2023). Despite its importance, date palm farming is difficult due to pest infestations, which have a direct impact on the plants' health and fruit yield. Such injuries can weaken the palms, resulting in a significant reduction in the quantity and quality of dates produced (El-Shafie et al., 2017). The Dubas insect (*O. binotatus*), is one of the most damaging pests. This phloem-sucking insect causes damage to palm leaves and stems by sucking on sap. Furthermore, the deposition of eggs by *O. binotatus* on the leaf surface interferes with the physiological processes of the host plant. This activity not only causes mechanical damage to the leaf tissues but also disrupts normal cellular development and photosynthetic efficiency, ultimately leading to reduced plant vigor and productivity. (El-Shafie et al., 2019; Al-Abri *et al.*, 2023; Tami et al., 2023). One of the most serious impacts of the Dubas bug (Ommatissus binotatus) on date palms is its ability to reduce the chlorophyll content in the leaves a key sign of the plant's overall health and ability to carry out photosynthesis. By feeding excessively on the plant's phloem sap, the bug weakens the tree, leading to a noticeable decline in chlorophyll levels. This, in turn, reduces the plant's productivity and limits its capacity to generate the energy it needs for healthy growth and development. (Al-Abri *et al*., 2023; Madhuri *et al*., 2023). Because of this cyclical change in population density, thorough research is required to determine the precise effects of each generation on date palm physiological indicators including oviposition and chlorophyll concentration. These kinds of information are essential for creating timely, sustainable, and successful pest management plans. In order to assess the effects of Dubas bug population density throughout the spring and autumn generations on infestation rates, chlorophyll concentration, and oviposition levels, this study focuses on three significant date palm cultivars: Bari, Sayer, and Halawi. This study aims to assess how the insect affects chlorophyll concentration in date palms and identify the cultivars that show the strongest resistance. The findings will help enhance integrated pest management (IPM) programs and guide the development of effective control strategies that consider the pest's seasonal patterns and behavior.

Materials and Methods

This study was conducted during the 2024 growing season in several orchards located in the Abu Al-Khasib area of Basrah Province, aiming to investigate the impact of Dubas bug (*O. binotatus*)

population density during the spring and autumn generations on infestation rates and chlorophyll concentration in date palms. The study involved three date palm cultivars: Barhi, Sayer, and Halawi, with monthly field monitoring of all cultivars for insect infestation. For each cultivar, ten homogeneous trees were selected as much as possible in terms of age and vegetative growth, with an approximate height of 1.5 to 2 meters, to minimize variability in the results. Samples were collected monthly from infested trees, with ten infected leaflets taken from the fronds of each tree, resulting in a total sample size of 30 leaflets per treatment per cultivar. Direct manual counting was used to estimate the number of insects present on the abaxial (lower) surface of the leaflets, and the counts were converted to infestation percentages. The monitoring period was divided into two seasons corresponding to the insect's two main generations: the spring generation (March–June) and the autumn generation (October–November). For chlorophyll concentration analysis, samples were collected from both infested and non-infested leaves to compare the physiological impact between treatments.

Assessment of Dubas bug infestation rate:

Leaflets infested with Dubas bug were collected monthly from each tree, from January 2, 2024, to December 31, 2024. The leaflets were placed in plastic bags and transported to the laboratory for examination of Dubas bug presence, based on visible symptoms and direct observation of adults and nymphs. The infestation rate was estimated monthly for each tree using the following formula:

Infestation rate (%) = (Number of infested leaflets / Total number of leaflets)×100.

Total chlorophyll content in date palm leaves:

Total chlorophyll content in the leaves of the studied date palm cultivars was estimated following the equation described by Mackinney (1941). One hundred milligrams of leaf tissue were collected, finely chopped with scissors, and ground in a ceramic mortar with the addition of 6 mL of 80% acetone until the residue became colorless and free of green pigment. The extract was then centrifuged, and the supernatant was collected in volumetric tubes covered with opaque paper to block light and prevent photodegradation of the pigment. The volume of the filtrate was adjusted by adding acetone, and the absorbance was measured at wavelengths of 645 and 663 nm using a Shimadzu UV-1700 spectrophotometer. Chlorophyll (a) and (b) concentrations were calculated based on mg/g of fresh leaflet tissue.

Oviposition density of Dubas bug on leaflets:

The number of Dubas bug eggs deposited on all examined leaflets of each studied cultivar was counted to assess oviposition density. The leaflets were examined using a light microscope. Oviposition density was calculated by dividing the number of eggs laid by the leaflet surface area (cm^2).

Statistical analysis:

Data were analyzed using SPSS software version 24. Two-way analysis of variance (ANOVA) was performed to determine significant differences among the studied cultivars (Barhi, Sayer, and Halawi) regarding infestation rate, chlorophyll concentration, and oviposition rates during the spring and autumn generations. Duncan's Test was applied at a significance level of 0.05 to compare means.

Results and Discussion

Infestation rate of the Dubas bug (*Ommatissus binotatus*):

The study results presented in Table (1) revealed a clear variation in infestation rates across the months, with peak Dubas bug activity observed in April and October, corresponding to the peak activity of the spring and autumn generations, respectively. The average annual infestation rate was highest in the Barhi cultivar at 9.62%, followed by Halawi at 8.67%, and Sayer at 8.17%. The spring generation was characterized by a higher peak infestation, reaching 39.43% in April for the Barhi cultivar, compared to 28.59% in October during the autumn generation. This indicates that infestation intensity is greater during the spring, while activity declined during the summer and was completely absent from July to September, confirming the seasonal nature of the pest.

Table 1. Monthly infestation rates (%) of Dubas bug on date palm cultivars.

Month	Barhi (%)	Sayer (%)	Halawi (%)	Monthly Average (%)
January	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00
March	10.26	7.88	9.34	9.16
April	39.43	34.13	37.08	36.88
May	20.99	16.55	19.76	19.10
June	9.23	7.98	8.51	8.57
July	0.00	0.00	0.00	0.00
August	0.00	0.00	0.00	0.00
September	0.00	0.00	0.00	0.00
October	28.59	25.37	23.44	25.80
November	6.98	6.12	5.87	6.32
December	0.00	0.00	0.00	0.00
Cultivar Average (%)	9.62	8.17	8.67	

The results of this study indicate that the Dubas bug (*Ommatissus binotatus*) exhibits a bimodal seasonal population pattern, with two distinct infestation peaks occurring in April and October, corresponding to the spring and autumn generations, respectively. The heightened infestation observed during the spring generation is attributed to moderate temperature and elevated relative humidity, environmental conditions that have been demonstrated to enhance the insect's activity and survival (Khalaf and Mohammed, 2015; El-Shafie *et al.*, 2017). Similarly, Al-Saedi (2023) reported that spring infestation commenced in early March, reaching a peak infestation rate of 30.50% insects per leaf on Halawi cultivar trees in April. The autumn generation activity began in early October, with a maximum infestation rate of 25.60% recorded on Halawi trees.

Chlorophyll concentration in date palm leaves:

The analyses of total chlorophyll (a + b) revealed significant differences between the cultivars and the spring and autumn generations. The Sayer cultivar recorded the highest average chlorophyll concentration during the spring generation at 4.823 mg/g, followed by Halawi at 4.521 mg/g, while the Barhi cultivar showed the lowest concentration at 3.629 mg/g. In the

autumn generation, an overall improvement in chlorophyll concentration was observed across all cultivars, with Sayer again having the highest concentration at 4.704 mg/g, followed by Barhi at 4.007 mg/g, and Halawi at 4.519 mg/g (Figure 1). These results indicate that the spring generation of the insect had a more pronounced negative impact on chlorophyll levels, with a significant decrease in concentration compared to the autumn generation, reflecting the physiological effect associated with the severity of spring infestation. The marked reduction in total chlorophyll (a + b) concentration in the infected date palm leaves, especially in the Barhi cultivar, is attributed to the insect's feeding on the plant sap, which disrupts the physiological functions of the leaves and reduces photosynthetic efficiency. Previous studies have supported this effect, showing that piercing-sucking insects cause deterioration in chlorophyll content and leaf tissue (Diaz-Montano *et al.,* 2007; Goławska *et al*., 2010; Al-Abri *et al*., 2023). Moreover, the accumulation of honeydew resulting from severe infestation leads to leaf weakening and a color change to yellowish-green (Mokhtar and Nabhani, 2010). In a previous study, Shah (2014) exposed three date palm cultivars to varying initial population densities of *O. binotatus*, ranging from 5 to 30 first-instar nymphs per leaf enclosed in fine cages. The results showed a significant reduction in chlorophyll content in leaves infested with 30 nymphs per leaf compared to the control, while no significant differences were observed at lower insect densities. Additionally, Al-Abri *et al*. (2023) reported that chlorophyll loss in leaves increases once nymphs mature into adults and noted that date palms can tolerate low infestations of up to 100 nymphs for approximately 11 weeks without severe damage.

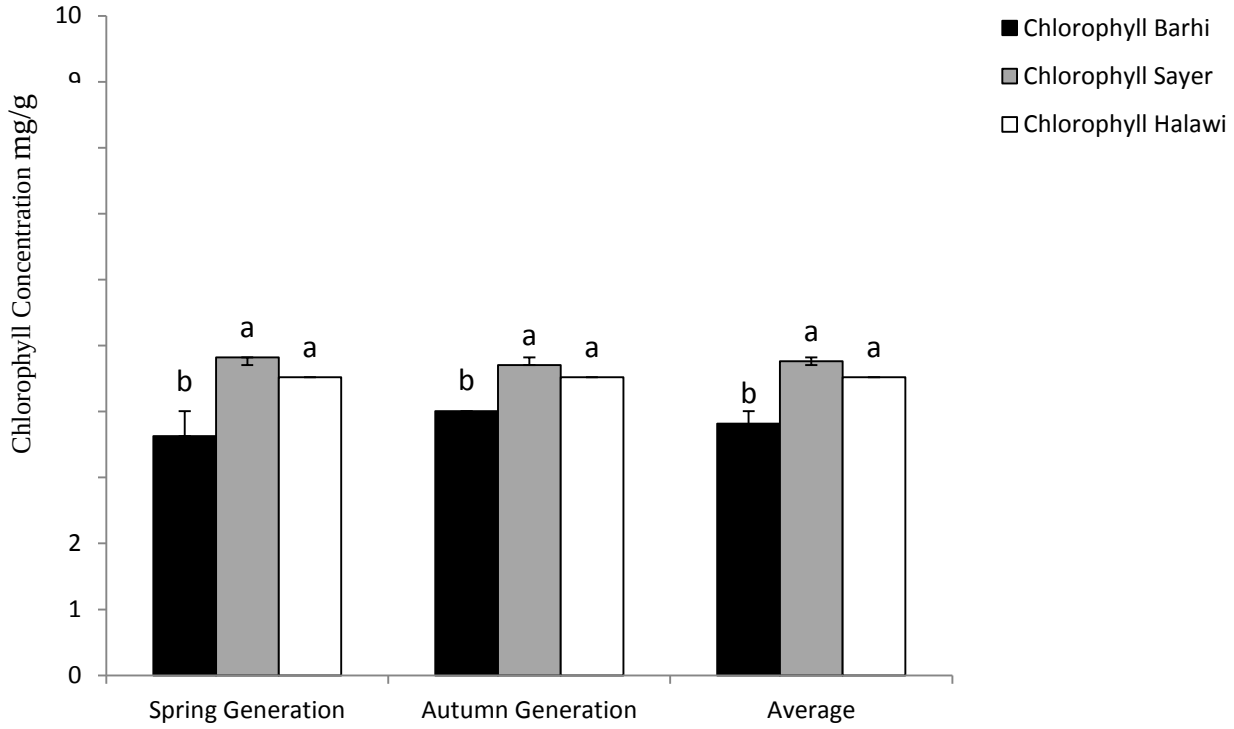

Figure 1: Chlorophyll concentration in date palm varieties during spring and autumn generations.

Oviposition rates of the Dubas bug on date palm leaves:

The results presented in Figure (2) indicate that the number of eggs laid by female Dubas bug varied depending on the date palm variety and generation. During the spring generation, the Barhi cultivar recorded the highest oviposition rate (0.612 eggs/cm²), while lower rates were observed in the Halawi (0.502 eggs/cm²) and Sayer (0.481 eggs/cm²) cultivars. In the autumn generation, the oviposition rates decreased across all cultivars, reaching 0.576, 0.473, and 0.497 eggs/cm² in Barhi, Sayer, and Halawi, respectively.

Overall, the average egg laying rate across both generations was highest in the Barhi cultivar (0.594 eggs/cm²), followed by Halawi (0.500 eggs/cm²), while the lowest rate was recorded in Sayer (0.477 eggs/cm²). This indicates a preference of Dubas bug for oviposition on the Barhi cultivar, which corresponds with its higher infestation rates and lower chlorophyll concentration.

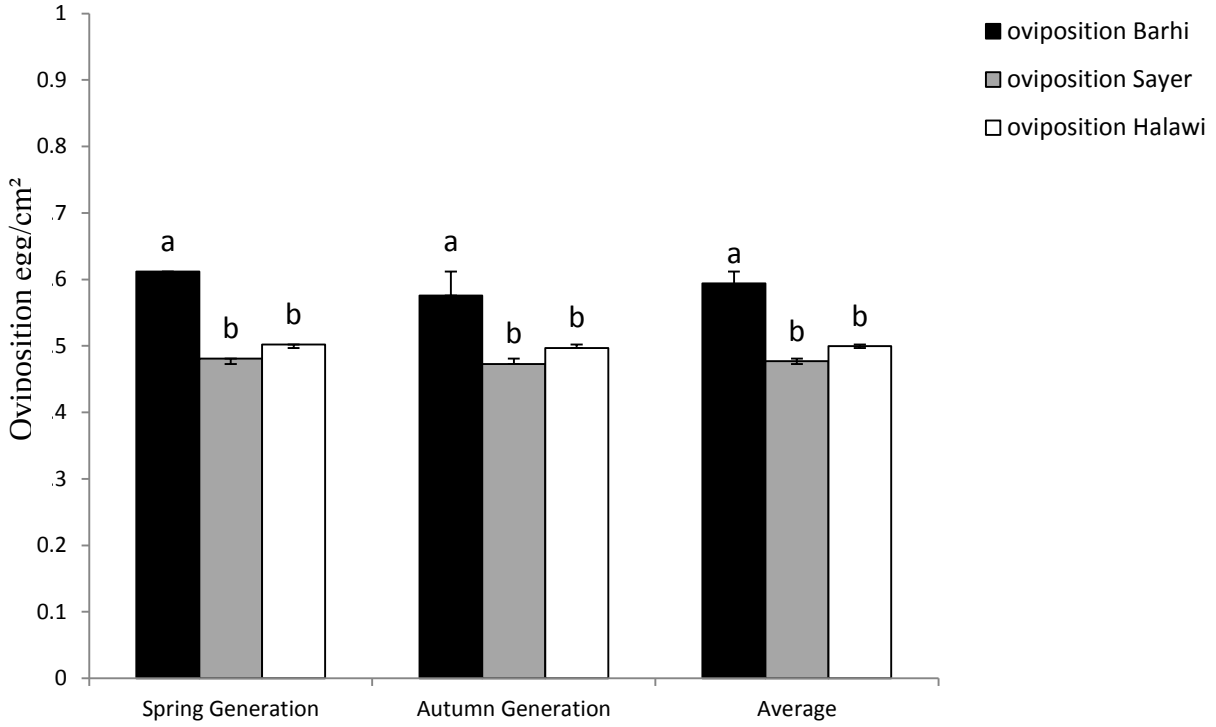

Figure 2: Oviposition in date palm varieties during spring and autumn generations.

Oviposition rates were generally higher during the spring generation across all cultivars, particularly in Barhi. This increase is attributed to higher temperatures and favorable environmental conditions in spring, which stimulate female activity, as reported by Shah et al. (2012), Al-Khatib (2005), and Payandeh *et al.* (2010). Additionally, studies such as Shah *et al.* (2016) have shown that leaf characteristics, including thickness and moisture content, influence female preference for certain cultivars over others. Al Shidi *et al.* (2019) noted that insect population density is affected by complex environmental and spatial factors, which aligns with our observations of varying infestation rates between months. Moreover, Almansoori *et al.* (2021) emphasized that pest management strategies should consider the dynamics of generations and differential cultivar susceptibility, a conclusion supported by our results showing significant differences among the three cultivars.

Conclusion

These findings suggest that the spring generation of the Dubas bug poses a greater threat than the autumn generation, with higher infestation levels, more severe physiological effects, and increased egg-laying activity. This underscores the importance of prioritizing preventive control measures during the spring season. Moreover, continued research into the environmental and

physiological resistance of different date palm cultivars is crucial to help minimize future infestations

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تأثير الأجيال الموسمية لحشرة دوباس النخيل *Ommatissus binotatus* على وضع البيض ومحتوى الكلوروفيل في ثلاثة أصناف من نخيل التمر

غزوان فيصل خلف الساعدي فراس مهدي عباس الحمود حازم محسن علي

مركز ابحاث النخيل– جامعة البصرة –العراق

الخلاصة

اجريت هذه الدراسة حقليًا في منطقة أبي الخصيب بمحافظة البصرة خلال موسم النمو لعام 2024، بهدف تقييم تأثير الكثافة السكانية لحشرة دوباس النخيل (*Ommatissus binotatus*) لجيلَي الربيع والخريف على نسب الإصابة، وتركيز الكلوروفيل الكلي، ووضع البيض في ثلاثة أصناف من نخيل التمر (*Phoenix dactylifera L.*) هي البرحي، الساير، والحلاوي. سُجِّلت أعلى نسب الإصابة خلال جيلي الحشرة، حيث بلغت 9.62% لصنف البرحي، و8.17% للساير، و8.67% للحلاوي، مما يشير إلى أن معدل الإصابة ارتفع بشكل ملحوظ خلال جيل الربيع، لا سيما في الفترة ما بين شهري آذار وحزيران. وفي المقابل، تراجعت مستويات الإصابة بشكل كبير خلال جيل الخريف نتيجة لانخفاض تأثير الحشرة، بل انعدمت أحيانًا في بعض الأشهر. اختلف تركيز الكلوروفيل بين الجيلين، حيث سُجِّلت قيم أعلى في جيل الخريف لمعظم الأصناف. وحقق صنف الساير أعلى متوسط لمحتوى الكلوروفيل، إذ بلغ 4.82 ملغم/غم خلال جيل الربيع، و4.70 ملغم/غم في جيل الخريف، متفوقًا بذلك على صنفي الحلاوي والبرحي. أما بالنسبة لوضع البيض، فقد كانت معدلاته أعلى خلال جيل الربيع مقارنة بالخريف، حيث سجل صنف البرحي أعلى كثافة بيض بلغت 0.61 بيضة/سم² من سطح الورقة في الربيع، وانخفضت قليلاً إلى 0.58 بيضة/سم² في الخريف، مع تباين طفيف بين الأصناف الأخرى. تشير هذه النتائج إلى أن الجيل الربيعي لحشرة *O. binotatus* يُحدث تأثيرًا سلبيًا أكبر على نخيل التمر من حيث معدلات الإصابة ووضع البيض، مقارنةً بجيل الخريف الذي أظهر تأثيرًا أقل. كما أظهرت الدراسة وجود علاقة ارتباط سلبية بين كثافة الحشرة ومحتوى الكلوروفيل، وعلاقة إيجابية مع كثافة وضع البيض. وقد تبيّنت الفروقات في قابلية الأصناف للإصابة، إذ أظهر صنف الساير درجة مقاومة أعلى نسبيًا، في حين كان صنف البرحي الأكثر حساسية. وتبرز هذه النتائج أهمية أخذ التغيرات الموسمية بنظر الاعتبار عند تصميم برامج الإدارة المتكاملة للآفات (IPM) الموجهة لإنتاج نخيل التمر.

الكلمات المفتاحية: حشرة الدوباس؛ الكثافة السكانية؛ تركيز الكلوروفيل؛ مقاومة الاصناف