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Susceptibility of selected date palm cultivars to *Parlatoria blanchardi* infestation in Saudi Arabia

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ABSTRACT

The current study examined the response of date palm cultivars in the Al-Qassim region of Saudi Arabia to infestation by the date palm scale insect, *Parlatoria blanchardi* (Targioni Tozzetti) (Hemiptera: Diaspididae), over two consecutive years (2021/2022 and 2022/2023). In addition, we evaluated the relationship between the total number of *P. blanchardi* individuals and the concentration of essential nutrients in date palm leaflets. The findings demonstrated that *P. blanchardi* populations were present throughout the year across all palm cultivars. The sensitivities of these cultivars to *P. blanchardi* were as follows: the Rashodia cultivar was categorized as highly susceptible to infestation because it had the highest number of pests; Red Sukary and Shakrah cultivars were found to be susceptible; Barhi was found to be relatively resistant in both years; the Nabtet Ali cultivar was moderately resistant during the first year and susceptible to infestation during the second year; while the Sajae cultivar exhibited the lowest number of *P. blanchardi* in both years, and was relatively resistant to pests. Over the two years, *P. blanchardi* numbers were adversely associated with the potassium content of date palm cultivars and positively correlated with nitrogen and phosphorus concentrations. According to principal component analysis, six date palm cultivars were significantly affected by *P. blanchardi* number.

Keywords: Scale insect, Population density, Date palm cultivars, Mineral elements

Desempenho de algumas cultivares de tamareira frente à *Parlatoria blanchardi* (Targioni-Tozzetti), infestação na Arábia Saudita

RESUMO

O estudo atual analisou como algumas cultivares de tamareiras na região de Al-Qassim, na Arábia Saudita, responderam à infestação pelo inseto da cochonilha parlatoria, *Parlatoria blanchardi* (Targioni-tozzetti) (Hemiptera: Diaspididae), durante os dois anos (2021/2022 e 2022/2023). Avaliamos adicionalmente a associação entre o número total de *P. blanchardi* e o nível de nutrientes necessários nos folíolos da tamareira. As descobertas demonstraram que as populações de *P. blanchardi* existiam o ano todo em todas as variedades de palmeiras. Essas cultivares variam significativamente em sua sensibilidade a *P. blanchardi*. A cultivar de tamareira Rashodia foi categorizada como altamente suscetível à infestação de *P. blanchardi* devido ao maior número de pragas. Foi descoberto que as cultivares Red Sukary e Shakrah eram suscetíveis. No entanto, em ambos os anos, a Barhi parecia relativamente resistente. No entanto, foi descoberto que a cultivar Nabtet Ali foi moderadamente resistente durante o primeiro ano e suscetível à infestação durante o segundo ano. Em ambos os anos, no entanto, a cultivar Sajae exibiu as estimativas mais baixas de *P. blanchardi* e foi avaliada como relativamente resistente a pragas. Ao longo dos dois anos, os números de *P. blanchardi* foram negativamente conectados com o conteúdo de potássio das cultivares de tamareira e positivamente conectados com os valores de nitrogênio e fósforo. Seis cultivares de tamareira mostraram-se significativamente impactadas pelos números de *P. blanchardi*, de acordo com a análise de componentes principais.

Palavras-chave: Cochonilha, Densidade populacional, Cultivares de tamareira, Elementos minerais

1. Introduction

In arid and semi-arid environments, date palms (*Phoenix Dactylifera* L.; Arecaceae) are among the oldest fruit trees (Krueger, 2021). Sixty percent of the world's 100 million date palms are found in the Middle East and North Africa (El Bouhssini, 2018). Local populations in the Middle East and North Africa rely heavily on dates as a food source, making them high-income crops. Thus, in these areas, it has a substantial impact on the environment, society, and economy (Elboghdady et al., 2023).

Owing to their high value as vital nutrients, dates offer nutritional security to millions of people in the dry regions of the world. They also play crucial roles in nutrition (Chao and Krueger, 2007). Date palms are among the most important horticultural crops cultivated commercially, providing orchards with a valuable source of additional revenue (Bakry, 2014). Palm trees are the mainstay of this dry, semi-arid ecosystem, making them particularly important to the Gulf countries. Additionally, it is regarded as the mainstay of the regional economy when it comes to exports to major international trading hubs (Rathore et al., 2020).

Date palm trees are affected by various insect pests (El-Shafie et al., 2017; Bakry and Tolba, 2025). One of the most damaging pests of date palm trees is *Parlatoria blanchardi* (Targioni Tozzetti), commonly known as Parlatoria date palm-scale insects or white date palm-scale insects (Al-Shuraym and Mohamed, 2020).

By ingesting plant sap using its rostrum, this insect damages leaves, fronds, and fruits of palm trees. The toxic saliva of this insect causes malformations, leaf fall, and frond death, contributing to lower yields (El-Said, 2000; Bakry et al., 2025). Damage to palm leaves results in curling, yellowing, falling, and reduced respiration and photosynthesis (Bakry, 2014; Martins-Mansani et al., 2021). The emergence and population buildup of date palm scale insects on leaves are key indicators of date palm-scale infestations (El-Sherif et al., 2001; Blumberg, 2008).

Antixenosis and antibiosis can lead to plant resistance. The reduced use of a host by insects for nutrition, egg laying, and safety is a characteristic of antixenosis (Fancelli et al., 2008). Various factors, such as chemical, physical, and morphological aspects, can influence an insect's ability to oviposit, feed, and remain on a plant (Khush and Panda, 1995; Resende et al., 2008; Dhillon et al., 2005). According to Duvick (1986), breeding programs rely heavily on genetic resources to produce insect-resistant plants. Insect populations are maintained at a manageable level, and pest-resistant plant varieties are regularly bred using resistant genotypes (Smith and Clement, 2012).

Based on their morphological characteristics and leaf chemical content, date palm plants react strongly to insect infestation (Baptista et al., 2001). While morphological characteristics have a significant impact on pest feeding, activity, and ingestion methods, biochemical parameters have a significant impact on pest behavior and metabolic processes (Moussa et al., 2012). As defense strategies against diverse pest attacks, wild or cultivated plants may employ specific morphological traits, biochemical components, and genetic adaptations that deter harmful insects from feeding or engaging in oviposition (Rani and Jyothsna, 2010).

Due to the role of host-plant resistance brought on by the integrated pest management (IPM) strategy, it is necessary to strategically employ resistant crop cultivars, either alone or in conjunction with other IPM elements, to reduce the negative impacts of insect pests on date palm yield and quality (Sharma and Ortiz, 2002; Jindal et al., 2013). According to Stout (2014), plant resistance to insect pests is defined as the expression of a resistance-related trait that affects one or more elements of insect pest-host plant interaction.

Numerous factors may be responsible for the variance in palm cultivars that are sensitive and resistant to Parlatoria-scale insect infestation. These factors include the genetic variety among farmed cultivars and the chemical makeup of nutritional mineral elements in the soil. Notably, genetic differences among date palm cultivars may also arise from other sources.

Insect-resistant cultivars are recommended in integrated pest management to reduce pest damage by enhancing plant tolerance to infestation. Planting pest-resistant cultivars is an easy and efficient way to reduce the damage caused by insect infestation (Horgan et al., 2020; Bakry and Abdel-Baky, 2020). A deeper understanding of the elements that encourage or prevent insect selection of host plants is essential for identifying low-sensitivity cultivars (Salem et al., 2006).

Owing to genetic variation, the vulnerability of date palm cultivars to parlatoria scale insect infestation varies. Therefore, this study aimed to determine the best date palm cultivar for controlling *P. blanchardi* by examining the response of several date palm cultivars to infestation. We also examined the relationship between the quantity of *P. blanchardi* and vital nutrients in date palm leaves.

2. Material and Methods

Field experiments on date palm cultivars were conducted in the Al-Qassim Region in Saudi Arabia spanning two consecutive years (2021/2022 and 2022/2023). Al-Qassim is one of the largest agricultural areas in Saudi Arabia, with approximately seven million date palm trees comprising different cultivars. Ten trees from each of six economically important date palm

cultivars (Rashodia, Sajae, Shakrah, Red Sukary, Barhi, and Nabtet Ali) in Saudi Arabia were selected. All selected trees were approximately the same age (10 years), uniform in growth, and randomly selected. The trees were in good physical condition and subjected to the same horticultural management practices applied to other date palms under cultivation.

Samples were collected at half-month intervals. Forty leaflets were collected from each tree, totaling 400 leaflets per cultivar. Sampling was conducted on a total of 57,600 leaflets (six cultivars × 10 trees × 40 leaflets × 24 sampling days) during one year, resulting in 115,200 leaflets sampled across the two years. Samples of palm leaflets were collected from all parts and layers of the tree, stored in paper bags, and transported to the laboratory to examine under a stereomicroscope. The number of live date palm scale insects on leaflet surfaces was accurately counted and recorded. Leaflet samples were then sorted according to the specific day of inspection, which occurred every two weeks. Following the classification criteria of Semeada (1985) and Nosser (1996), the tested date palm cultivars were categorized into the following susceptibility levels: highly susceptible (H.S.), susceptible (S), relatively resistant (R.R.), moderately resistant (M.R.), and resistant (R) (Table 1). The data were subjected to analysis of variance (ANOVA) using the general linear model procedures of the SPSS software (1999) and mean comparison using Tukey's HSD test at a 5% significance level.

The physical traits and chemical composition of date palm leaves, which may be influenced by certain plant nutritional elements, can affect how plants respond to insect infestation. Notably, some of these nutrients may act as resistance factors. Therefore, key plant nutrients were chosen and their contents in the studied cultivars were estimated. To assess the nitrogen, phosphorus, and K values in the tested date palm leaflets, ten leaflets were taken from each tree, and samples were randomly selected from every part of the tree. Samples were collected on February 15 of each year from medium-aged (two-year-old) leaves (based on dry weight).

Whole fresh leaf samples of all examined cultivars were collected. To remove any dust or other residues, they were first cleaned with tap water and then with distilled water (Cardoso et al., 2024). The samples were then dried for 48 hours at 70 ºC in an electric oven (Ni et al., 2001). Fresh and dried leaflets were also examined. For analysis, the dry material was stored on paper after processing in an electric mill. H2SO4 was used to degrade plant materials, following the recommendation of Jones (2001). The total nitrogen (N) in the ground material was measured using micro-Kjeldahl techniques, phosphorus (P) was colorimetrically measured using ascorbic acid, and potassium (K) was measured using a flame photometer Jones (2001). Analysis of variance (ANOVA) was performed on the collected data, and Tukey's HSD test was used to differentiate the means at $P \leq 0.05$.

Relationship between the three nutritional element values of the six date palm cultivar leaflets and *P. blanchardi* estimates. The present study sought to ascertain the correlation between the average annual population of *P. blanchardi* per leaflet and the levels of key nutrients in date palm leaflets at the conclusion of the study year (mid-February). Simple correlation and regression analyses were performed using SPSS software (1999) to assess the association between the average number of *P. blanchardi* during the year/leaflet and the values of the three nutrients in the six palm cultivars over both years.

Using R software, a scatterplot demonstrating the multidimensionality of *P. blanchardi* estimates on the six date palm cultivars was created using Principal Component Analysis (PCA) (R Core Team 2019). Principal component analysis was also employed to assess the influence of the three dietary minerals on *P. blanchardi* infestation estimates in the tested date palm cultivars over two consecutive years. Using the PAST program, hierarchical clustering analysis (HCA) of the unweighted pairwise group method with arithmetic mean (UPGMA) based on the Euclidean distance between clusters was used to create a plot visualizing the relationships between *P. blanchardi* infestation estimates on six date palm cultivars based on the similarity matrix (Guerreiro et al., 2022; Araújo et al., 2024).

3. Results and Discussion

P. blanchardi populations occurred on all date palm cultivars throughout the year (Table 2, Figure 1). The average estimates of *P. blanchardi* throughout the entire season were 72.30 ± 2.21 and 64.52 ± 1.82 individuals per leaflet during the first and second growing seasons, respectively. Statistical analyses indicated highly significant differences between date palm cultivars with respect to the number of *P. blanchardi* counts during both years. The *F* value, which is used to determine differences in *P. blanchardi* infestation levels among cultivars, was 387.89 ($df = 142$, $P < 0.0000$) in the first season, and 560.71 ($df = 142$, $P < 0.0000$) in the second season. The *F* value between the two seasons was 276.02 ($df = 286$, $P < 0.0000$) (Figure 1).

Compared to the other date palm cultivars tested, Rashodia had the highest number of *P. blanchardi* populations during the two years (an average of 96.70 ± 6.59 and 89.39 ± 5.11 individuals per leaflet, respectively). This variety was categorized as highly

susceptible (H.S.), indicating that it is more suitable for *P. blanchardi* nymphs and adults for feeding and egg-laying. In contrast, the Sajae date palm cultivar was categorized as moderately resistant (M.R.) and had the lowest overall average number of *P. blanchardi* during the two years (Table 2). This indicates that it is not the preferred feeding and/or egg-laying host of this pest. Thus, this cultivar should be promoted in areas where *P. blanchardi* infestation is high.

Shakrah and Red Sukary cultivars were classified as susceptible (S), with an overall average of 81.76 ± 5.58 and 79.62 ± 4.87 individuals per leaflet during the first year, and 72.17 ± 4.26 and 68.21 ± 3.45 individuals per leaflet during the second year, respectively (Table 2). The Barhi cultivar exerted some resistance and appeared relatively resistant (R.R.) with an overall mean of 61.73 ± 3.47 and 53.10 ± 2.57 individuals per leaflet during years one and two, respectively.

Table 1. Categorization of resistance of six-date palm cultivars to *P. blanchardi* infestation.

Description	Category
Greater than (MN + UC) Greater than 96.33 individuals in 2021/2022 Greater than 87.29 individuals in 2022/2023	Highly susceptible (H.S.)
From MN to (MN+UC). From 72.30 to 96.33 individuals in 2021/2022 From 64.52 to 87.29 individuals in 2022/2023	Susceptible (S)
Less than MN to (MN-UC). Less than 48.28 to 72.30 individuals in 2021/2022 Less than 41.76 to 64.52 individuals in 2022/2023	Relative resistant (R.R.)
From less (MN-UC) to (MN-2UC). From less than (48.28) to (24.25) individuals in 2021/2022 From less than (41.76) to (19.00) individuals in 2022/2023	Moderate resistant (M.R.)
Less than (MN- 2UC). Less than 24.25 individuals in 2021/2022 Less than 19.00 individuals in 2022/2023	Resistant (R)

Explanations: MN= General mean number of *P. blanchardi* individuals; range of change= (maximum number of *P. blanchardi* individuals per cultivars- minimum number of *P. blanchardi* individuals per cultivar); UC= amount of change in cultivars.

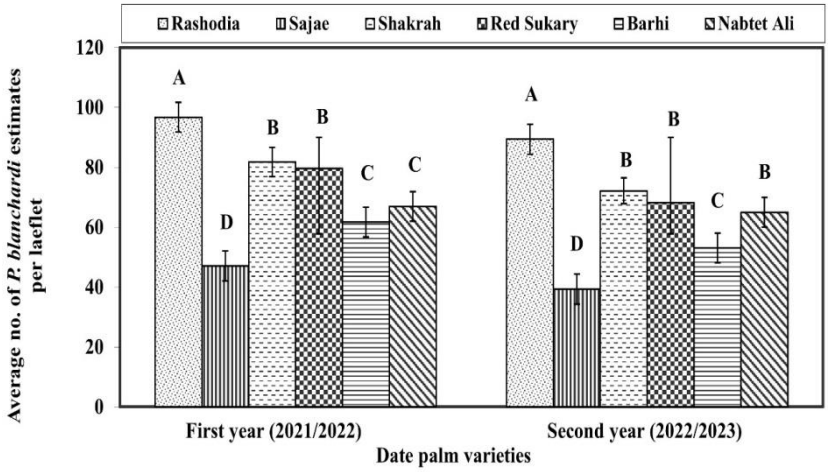

Figure 1. Average numbers of *P. blanchardi* individuals per leaf on certain date palm cultivars during two successive years (2021/2022 and 2022/2023). Values indicated by different letters for the numbers of *P. blanchardi* between six date palm cultivars are statistically significant differences at $P \leq 0.05$ (Tukey's HSD test).

Notably, the Nabtet Ali cultivar was classified as relatively resistant (RR) to *P. blanchardi* infestation in the first year, with an average of 66.96 ± 4.14 individuals per leaf, but was considered susceptible (S) in the second year, with an average of 64.98 ± 3.58 individuals per leaf. Dent (1991) highlighted that the abundance of insect populations in any location is influenced by environmental conditions and the susceptibility of the host/species to infestation. In general, it could be concluded that *P. blanchardi* had the highest preference for the Rashodia date palm cultivar, while the Sajae cultivar was the least preferable. The tested varieties were arranged according to their susceptibility in descending order as follows: Rashodia > Shakrah > Red Sukary > Nabtet Ali > Barhi > Sajae

Differences in *P. blanchardi* estimates on different date palm cultivars may result from a variety of factors, including the morphological and biochemical characteristics of date palm leaves and differences in environmental conditions.

Table 2. Average number of *P. blanchardi* individuals per leaf and degrees of sensitivity of date palm cultivars over two successive years (2021/2022 and 2022/2023).

Date palm cultivars	Average no. of *P. blanchardi* individuals per leaf ± S.E.			
	First year (2021/2022)		Second year (2022/2023)	
	Mean ± SE	Sensitivity degree	Mean ± SE	Sensitivity degree
Rashodia	96.70 ± 6.59	H.S.	89.39 ± 5.11	H.S.
Sajae	47.04 ± 3.14	M.R.	39.29 ± 2.17	M.R.
Shakrah	81.76 ± 5.58	S	72.17 ± 4.26	S
Red Sukary	79.62 ± 4.87	S	68.21 ± 3.45	S
Barhi	61.73 ± 3.47	R.R.	53.10 ± 2.57	R.R.
Nabtet Ali	66.96 ± 4.14	R.R.	64.98 ± 3.58	S
Grand mean	72.30 ± 2.21 A		64.52 ± 1.82 B	

Means followed by the same letter (s) in each column are not significantly different at a probability level of 0.05, according to the Tukey's HSD test. The F value was 387.89, df= 142; P < 0.0000 between the cultivars in the first season; F = 560.71, df= 142; P < 0.0000 between the cultivars in the second season; and the F value was 276.02, df= 286; P < 0.0000 between the two seasons.

The current findings are generally in line with the available data; however, there are different date palm cultivars and regions that may produce differing results. For instance, Mourad and Zanuncio (1998) found that the leaves of Zaghloul and Semmany cultivars at Idku, Egypt, were more sensitive to *P. blanchardi*.

In Egypt, Moussa et al. (1999) discovered that the Amhat cultivar had the greatest *P. blanchardi* infestation, followed by Samani and Hayani, while Bent Aisha had the lowest. Analysis of biophysical properties revealed that date palm susceptibility was unaffected by leaflet thickness. In Egypt, Youssef (2002) observed that the Hayany variety was the most vulnerable to *P. blanchardi*. According to Jamahor et al. (2007), all reported coastal cultivars in Libya (Bronsi, Taboni, Bekrari, Bayodi, Helawi, Hora, Om-Hanash, Om-Fteti, Om-Adam, Elfarash, Fezar, and Najma) were found to be susceptible to infection by *P. blanchardi*. Bekrari had the highest population density (5000 insects per 10 leaflets), but the Saeds variety showed no signs of infestation. Al-Dosary (2009) in Iraq mentioned that the Hillawi cultivar exhibited the highest infestation percentage and severity, whereas the Khadrawi cultivar had the lowest infestation percentage, at 10.67% and 1.88 insects/cm², respectively. According to Bakry (2014) Egypt, the Gendeila variety was the least preferred type over the course of two years, whereas the Parlatoria scale insect was the most preferred, followed by Malakaby, Seedy Balady, and Shamia. However, during the first and second years, Balady appeared to be sensitive and relatively resistant, respectively.

Nevertheless, throughout the course of the two years, the Shamia and Gendeila types showed signs of relative resistance.

The Rashodia date palm cultivar had the lowest percentage of K content, greater N and P concentrations, and exhibited the greatest *P. blanchardi* infestation (Table 3). Conversely, the Sajae cultivar had the lowest N and P values, the highest percentage of K, and was the least infested. In addition, the results showed that the tested cultivar leaflets had highly significant variance among the concentrations of the three nutritional elements (Table 3).

The relationships between *P. blanchardi* estimates and the values of the three nutrients for the six palm tree cultivars are shown in Table 4. The rate of *P. blanchardi* infestation and the element contents of N and P in the leaflets of six date palm cultivars revealed highly significant positive correlations in 2021/2022 and 2022/2023 (r= +0.98 and +0.94, respectively) (Table 4). However, during the years one and two, there were significant negative associations with K content in the leaflets of the date palm cultivars evaluated (r = -0.97 and -0.93, respectively) (Table 4).

Table 3. Chemical analysis of three nutritional elements in six date palm cultivars during the two seasons (2021/2022 and 2022/2023).

Parameter / Cultivar	Mineral element contents (%) ± S.E.					
	N		P		K	
	2021/2022	2022/2023	2021/2022	2022/2023	2021/2022	2022/2023
Rashodia	2.12 ± 0.003 A	2.09 ± 0.013 A	0.37 ± 0.006 A	0.37 ± 0.004 A	0.89 ± 0.006 E	0.76 ± 0.003 D
Sajae	1.47 ± 0.062 E	1.53 ± 0.055 D	0.05 ± 0.020 E	0.06 ± 0.016 D	1.12 ± 0.009 A	1.18 ± 0.003 A
Shakrah	1.98 ± 0.020 B	1.98 ± 0.013 AB	0.30 ± 0.047 B	0.30 ± 0.010 A	0.93 ± 0.019 DE	0.78 ± 0.022 CD
Red Sukary	1.88 ± 0.009 C	1.85 ± 0.009 BC	0.18 ± 0.035 C	0.22 ± 0.023 B	0.98 ± 0.020 CD	0.84 ± 0.009 C
Barhi	1.60 ± 0.006 D	1.63 ± 0.049 D	0.07 ± 0.015 DE	0.09 ± 0.010 CD	1.05 ± 0.003 B	0.95 ± 0.003 B
Nabtet Ali	1.82 ± 0.057 C	1.78 ± 0.067 C	0.12 ± 0.002 CD	0.13 ± 0.010 C	0.99 ± 0.003 BC	0.90 ± 0.003 B
Average	1.81 ± 0.05	1.81 ± 0.05	0.18 ± 0.03	0.19 ± 0.03	0.99 ± 0.02	0.90 ± 0.03
F -value	74.08	23.99	43.51	80.66	48.54	64.88
C.V.%	2.69	4.09	18.63	11.88	2.09	1.54
Prob.	0.000	0.000	0.000	0.000	0.000	0.000

Means followed by the same letter (s) in each column are not significantly different at a probability level of 0.05, according to Tukey's HSD test.

Table 4. Simple correlation, regression coefficients, and explained variance estimates between the three nutritional minerals and *P. blanchardi* counts over two years (2021/2022 and 2022/2023).

Season / Element	First season (2021/2022)						Second season (2022/2023)					
	r	b	S.E.	T-test value	Y = a ± bx	E.V.%	r	b	S.E.	T-test value	Y = a ± bx	E.V. %
N	+0.98	+70.30	8.02	8.79 **	–54.99 + 70.30 x	95.44	+0.98	+79.95	8.70	9.13 **	–80.12 + 79.95x	95.72
P	+0.94	+126.45	23.28	5.45 **	49.26 + 126.45 x	88.83	+0.93	+130.68	24.60	5.26 **	39.13 + 130.68x	86.79
K	–0.97	–202.28	24.46	–8.38 **	273.34 – 202.28x	94.33	–0.93	–104.38	20.02	–5.17 **	158.52 – 104.38x	87.37

r = simple correlation; b = simple regression; S.E. = Standard error; E. V. % = explained variance; ** highly significant at P < 0.01.

The defense system of date palm leaflets against pest invasion may be influenced by K content. The leaf K content affects plant quality and may be a significant factor in soybean aphid infestation (Myers and Gratton 2006). The current results are largely consistent with the collected data. According to Saighi (2007), insect infestation by *Parlatoria ziziphi* was inversely correlated with potassium, sodium, and magnesium levels in both lemon and clementine types. Bakry (2014) concluded that there were highly significant positive relationships between the percentages of N and P in date palm leaflets and the rate of *P. blanchardi* infestation.

According to the PCA, *P. blanchardi* estimates based on the pooled data over two years had a significant impact on the six date palm cultivars (Figure 2). As shown in Figure 2, the first two PCA components explained 98.39% of the variance, while PCA1 and PCA2 explained 96.92% and 1.47% of the variance, respectively.

The Rashidi, Nabtet Ali, and Sajae cultivars were negatively correlated with the first component of *P. blanchardi* abundance (Figure 2). PCA2 showed a positive correlation with *P. blanchardi* estimates for Shakrah, Red Sukary, and Barhi (Figure 2).

Based on the number of individuals of *P. blanchardi*, a date palm cultivar clustering tree dendrogram was constructed and divided into four groups (Figure 3): Group 1, a distinct group containing the Sajae cultivar; Group 2, the Rhodia cultivar; Group 3, Red Sukary and Shakrah cultivars; and Group 4, Barhi and Nabtet Ali cultivars.

Principal component analysis was used to assess the effects of the three dietary elements and *P. blanchardi* counts on date palm cultivars over the course of two years (Figure 4). Principal component analysis revealed variation among date palm cultivars in both the levels of the three mineral elements and *P. blanchardi* populations (Figure 4).

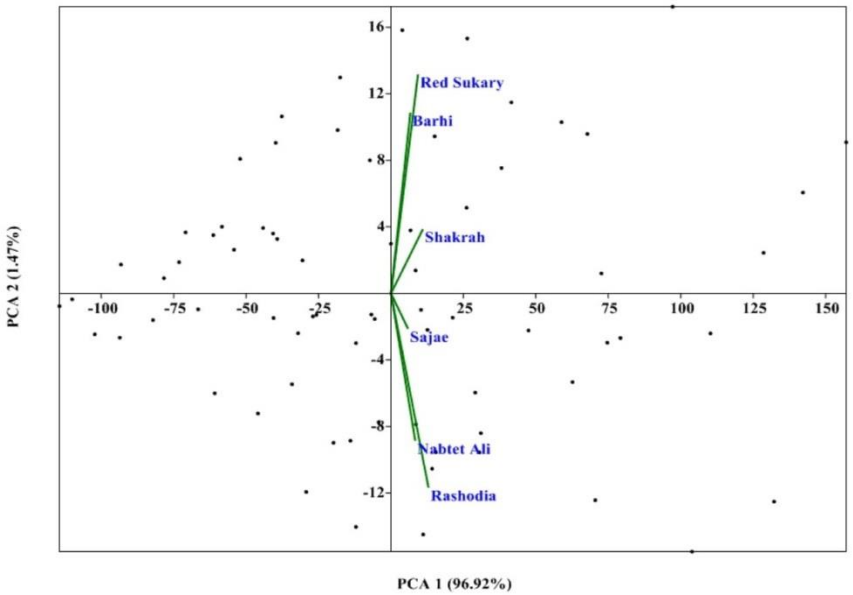

Figure 2. Biplot based on principal component biplots for *P. blanchardi* counts on six date palm cultivars based on *P. blanchardi* estimates pooled over two years.

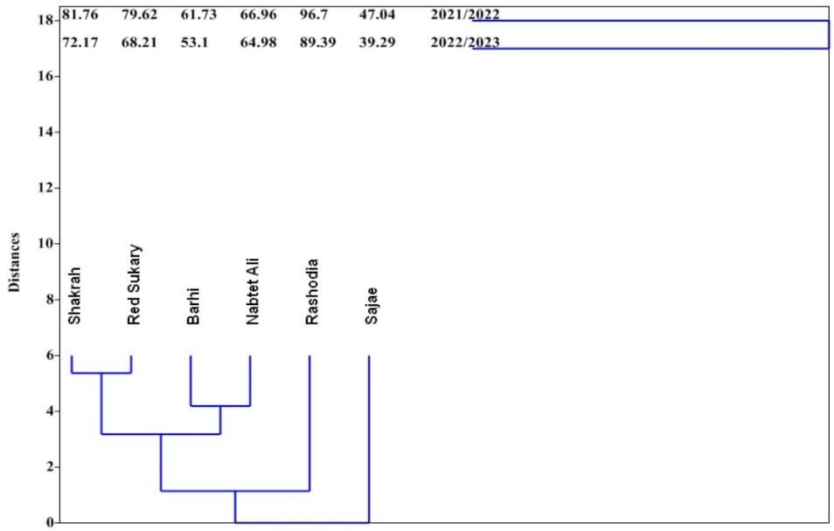

Figure 3. The classification of the six date palm cultivars based on the two-year average *P. blanchardi* counts.

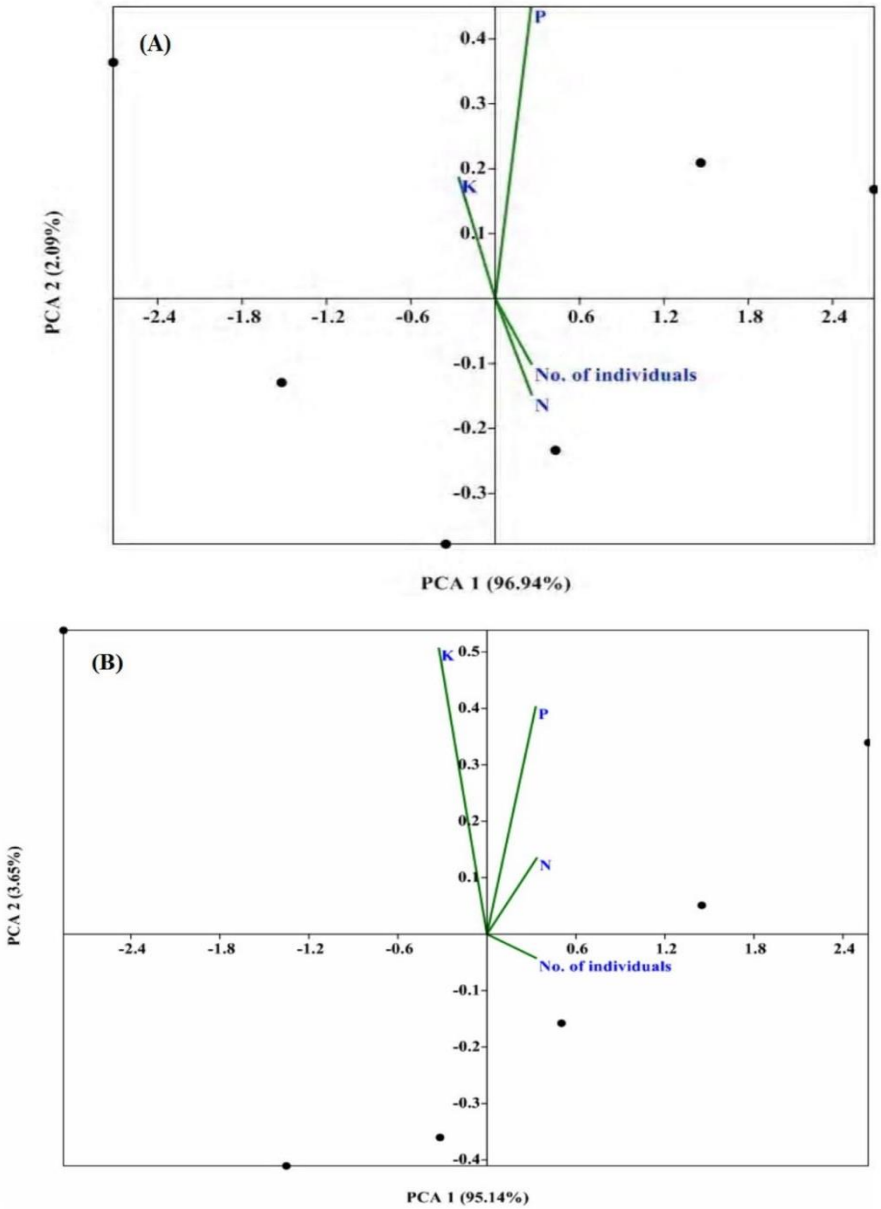

Figure 4. Biplot based on principal component analysis of parameters to evaluate the impact of the three nutritional minerals and *P. blanchardi* counts on date palm cultivars over the first (A) and second (B) years.

During the first year (2021/2022), PC1 accounted for 96.94%, and PC2 accounted for 2.09% of the total variance, whereas the first two PCA components accounted for 99.03% (Figure 4A). In contrast, PC1 accounted for 95.14% and PC2 accounted for 3.65% of the variation throughout the second year (2022/2023), whereas the first two PCA components accounted for 98.79% of the overall variance (Figure 4 B). A positive relationship between the first component and the abundance of *P. blanchardi* and the two mineral elements (N and P) was found (Figure 4). However, PCA2 showed a negative correlation between K content and *P. blanchardi* (Figure 4).

4. Conclusions

Parlatoria blanchardi (Targioni-tozzetti), a scale insect, is a serious pest of date palm trees, causing damage to leaflets, leaves, and fruits, which reduces yield. This two-year study investigated the susceptibility of six economically important date palm cultivars in the Al-Qassim region, Saudi Arabia, to *P. blanchardi* infestation and examined the relationship between infestation levels and leaflet nutrient content. The results showed that *P. blanchardi* was present across all cultivars throughout the year, but infestation levels varied significantly. Out of the six cultivars, the Sajae cultivar was relatively resistant to pests and exhibited the lowest estimates of *P. blanchardi*. Therefore, this date palm cultivar should be promoted in areas where *P. blanchardi* infestation is high. We conclude that cultivar choice influences pest development and should be considered in IPM programs of date palm trees.

Nutrient analysis revealed positive correlations between *P. blanchardi* counts and nitrogen and phosphorus values, and a negative correlation with the potassium content. Principal component analysis confirmed strong associations between cultivar type, nutrient composition, and pest abundance. Thus, studies along these lines could shed light on the susceptibility of date palm cultivars to *P. blanchardi* infestations to inform targeted IPM strategies.

Bibliographic References

Al-Dosary, N.H., 2009. Effect of leaf pinaes chemical composition of different date palm cultivar on Infection by whit scale insect *Parlatoria blanchardii* (Targioni- Tozzetti) (Homoptera: Diaspidae). Biology J. Al-Kufa Univ., 1(2), 171-181.

Al-Shuraym, L.A.M., Mohamed, R.A.E.H., 2020. Fauna of *Parlatoria blanchardi* scales (Targioni-tozzetti) on date palm trees (*Phoenix dactylifera*) in Saudi Arabia. Pakistan Journal of Biological Sciences, 23(3), 391-397.

Araújo, J.M., Andrade Neto, R.C., Tavella, L.B., Leite, H.F.M., Lessa, L.S., Abreu, M.G.P., 2024. Yield and genetic dissimilarity of sour passion fruit genotypes cultivated in the Southwestern Amazon. Revista de Agricultura Neotropical, 11(4), e8318. https://doi.org/10.32404/rean.v11i4.8318

Bakry, M.M.S., 2014. Studies on the white date palm scale insect, *Parlatoria blanchardii* (Targ.) infesting date palm trees in Luxor Governorate. Ph.D. Thesis. Fac. Agric. Sohag Univ., 288p. https://dx.doi.org/10.22161/ijhaf.4.3.4

Bakry, M.M.S., Tolba, E.F.M., 2025. Occurrence of *Fiorinia phoenicis* (Hemiptera - Diaspididae) population on date palm trees based on climatic variables applying regression and principal component analyses. J. of Plant Protection and Pathology, Mansoura Univ., 16 (3): 125-135. https://doi.org/10.21608/JPPP.2025.360414.1316

Bakry, M.M.S., Salem, E.H., Taha, R.M. Tolba, E.F.M., 2025. Relationship between the *Fiorinia phoenicis* counts and biochemical traits and nutritional status of certain date palm cultivar leaflets. Assiut Journal of Agricultural Sciences 56(3):114-137. https://doi.org/10.21608/AJAS.2025.385460.1486

Baptista, D.F., Buss, D.F., Dorvillé, L.F.M., Nessimian, J.L., 2001. Diversity and habitat preference of aquatic insects along the longitudinal gradient of the Macaé river basin, Rio de Janeiro, Brazil. Revista Brasileira de Biologia, 61(2), 249-258. https://doi.org/10.1590/S0034-71082001000200007

Blumberg, D., 2008. Review: Date palm arthropod pests and their management in Israel. Phytoparasitica, 36(5), 411-448.

Cardoso, M.P., Moraes, C.A.R., Muniz, L.C., Reis, V.R.R., Macena, C.V.S.P., Silva, R.B., Morais, P.A.O., 2024. Chemical attributes and soil carbon and nitrogen stocks in pastures in the Maranhão Amazon. Revista de Agricultura Neotropical, 11(4), e8542. https://doi.org/10.32404/rean.v11i4.8542

Chao, C.T., Krueger, R.R., 2007. The date palm (*Phoenix dactylifera* L.): overview of biology, uses, and cultivation. Hortscience, 42(5), 1077-1082. http://dx.doi.https://org/10.21273/HORTSCI.42.5.1077

Dent, D., 1991. Insect pest management. C.A.B. International.

Dhillon, M.K., Sharma, H.C., Singh, R., Naresh, J.S., 2005. Mechanisms of resistance to shoot fly, *Atherigona soccata* in sorghum. Euphytica, 144(3), 301-312.

Duvick, D.N., 1986. Plant breeding: past achievements and expectations for the future. Economic Botany, 40(3), 289-297.

Ei-Shafie, H.A.F., Abdel-Banat, B.M.A., Ai-Hajhoj, M.R., 2017. Arthropod pests of date palm and their management. *CABI Reviews*, 12(49), 18. http://dx.doi.org/10.1079/PAVSNNR201712049

El Bouhssini, M., Faleiro, J.R., 2018. Date palm pests and diseases: integrated management guide. Beirut, Lebanon: Int. Cntr for Agricultural Research in the Dry Areas (ICARDA), ISBN-13: 978-92-9127-505-2, 232. Available from: https://hdl.handle.net/20.500.11766/8914

Elboghdady, A.E.A., Gomma, A.H., Hamed, A.M., Abdallatif, A.M., 2023. Assessment of phenotypic diversity of some date

palm male genotypes growing under Egyptian conditions. Revista Brasileira de Fruticultura, 45, e-896. https://dx.doi.org/10.1590/0100-29452023896

El-Said, M.I., 2000. Survey of date palm insects in North Sinai with special reference to the ecology and biology of the species, *Parlatoria blanchardii* (Targ.-Tozz), supper family Coccoidea. M.Sc. Thesis. Fac. of Agric., Cairo Univ., 97.

El-Sherif, S.I., Elwan, E.A., Abd-El-Razik, M.I.E., 2001. Ecological observations on the date palm Parlatoria scale, *Parlatoria blanchardii* (Targioni- Tozzettii) (Homoptera: Diaspididae) in north Sinai, Egypt. Second International Conference on Date Palms (Al-Ain, UAE, March 25-27).

Fancelli, M., Vendramim, J.D., Lourenção, A.L., 2008. Oviposição e dispersão de ninfas de *Bemisia tabaci* biótipo B em genótipos de tomateiro. Bragantia, 67(4), 933-939.

Guerreiro, J.C., Azevedo, A.P., Prado, E.P., Pietrowski, V., Ringenberg, R., Moritz, C.M.F., Ghiotto, T.C., Pascutti, T.M., Ferreira-Filho, P.J., 2022. Cassava roots damaged by *migdolus fryanus* produce poor quality starch. Revista de Agricultura Neotropical, 9(2), e6884. https://doi.org/10.32404/rean.v9i2.6884

Hammer, O., Harper, D.A.T., Ryan, P.D., 2001. PAST: paleontological statistics software package for education and data analysis. Palaeontologia Electronica, 4(1), 1-9.

Horgan, F.G., Garcia, C.P.F., Haverkort, F., de Jong, P.W., Ferrater, J.B., 2020. Changes in insecticide resistance and host range performance of planthoppers artificially selected to feed on resistant rice. Crop Protection, 127, 104963. http://dx.doi.org/10.1016/j.cropro.2019.104963.

Jamahor, E., Kerra, H.M., Magharbi, H., 2007. Susceptibility of date palm cultivars of the white date scale *Parlatoria blanchardi* (Targioni- Tozzettii) in western regions of Libya. Arab Journal of Plant Protection, 25(1), E-17.

Jindal, V., Dhaliwal, G.S., Koul, O., 2013. Pest management in 21st century: road map for future. Biopesticides International, 9(1), 22.

Jones, J.B., 2001. Laboratory guide for conducting soil tests and plant analysis. Boca Raton: CRC Press. http://dx.doi.https//org/10.1201/9781420025293

Khush, G.S., Panda, N., 1995. Host plant resistance to insects. Wallingford: CAB International, 431p.

Krueger, R.R., 2021. Date palm (*Phoenix dactylifera* L.) biology and utilization. In: J.M. Al-Khayri, S.M. Jain and D.V. Johnson, eds. T*he date palm genome*, vol. 1, vol. 1*: phylogeny, biodiversity and mapping*. Cham: Springer, 3-28. http://dx.doi.org/10.1007/978-3.

Martins-Mansani, M., Faita, M.R., Orth, A.I., Nodari, R.O., 2021. Production of honeydew by scale insects associated with Bracatinga (*Mimosa scabrella* Benth.) in Serra Catarinense, Southern Brazil. Revista Brasileira de Entomologia, 65(1), e20200072.

Mourad, A.K., Zanuncio, J., 1998. Population dynamics of the date scale insect *Parlatoria blanchardi* (Homoptera: Diaspididae) on two date-palm varieties. 50th International Conference of Crop Protection, 5 May. Belgium, Gent., 63(2a), 389-395.

Moussa, S.F.M., El-Awady, S.M., Helal, H.A., Eraki, M.M.A., 1999. Susceptibility of certain date palm varieties to infestation by the white date palm scale, *Parlatoria blanchardii* (Targ.) (Homoptera, Diaspididae)**.** Annals of Agricultural Sciences, Moshtohor, 37(2), 1425-1434.

Moussa, S.F.M., Salman, A.M.A., Bakry, M.M.S., 2012. The negative effects of *Parlatoria blanchardii* (Targ.) infestation on the morphological and chemical characters of certain varieties leaflets of date palm trees at Luxor Governorate, Egypt. Egyptian Academic Journal of Biological Sciences. A, Entomology, 5(1), 169-181.

Myers, S.W., Gratton, C., 2006. Influence of Potassium Fertility on Soybean Aphid, *Aphis glycines* Matsumura (Hemiptera: Aphididae), Population Dynamics at a Field and Regional Scale. Environmental Entomology, 35(2), 219-227.

Ni, X., Quisenberry, S.S., Heng-Moss, T., Markwell, J., Sarath, G., Klucas, R., Baxendale, F., 2001. Oxidative responses of resistant and susceptible cereal leaves to symptomatic and non-symptomatic cereal aphid (Hemiptera: Aphididae) feeding. Journal of Economic Entomology, 94(3), 743-751. http://dx.doi.org/10.1603/0022-0493-94.3.743

Nosser, M.A., 1996. Mechanism of resistance in bean and cowpea varieties to certain sucking insects' infestation. M.Sc. Thesis Fac. Agric. Cairo Univ., 190 p.

Rani, P.U.U., Jyothsna, Y., 2010. Biochemical and enzymatic changes in rice plants as a mechanism of defense. Acta Physiologiae Plantarum, 32(4), 695-701. http://dx.doi.https://org/10.1007/s11738-009-0449-2

Resende, J.T.V., Maluf, W.R., Cardoso, M.G., Faria, M.V., Gonçalves, L.D., Nascimento, I.R., 2008. Resistance of tomato genotypes with high level of acylsugars to *Tetranychus evansi* Baker & Pritchard. Scientia Agricola, 65(1), 31-35.

R Core Team, 2019. R, a Language and Environment for Statistical Computing. Vienna: R Foundation for Statistical Computing. Available from: http://www.R-project. org.

Rathore, M.S., Patel, P.R., Siddiqui, S.A., 2020. Callus culture and plantlet regeneration in date palm (*Phoenix dactylifera* L.): an important horticultural cash crop for arid and semi-arid horticulture. Physiology and Molecular Biology of Plants, 26(2), 391-398. http://dx.doi.org/10.1007/s12298-019-00733-w. PMID:32158143.

Saighi, H., 2007. The relation of mineral salts content in foliage of two citrus varieties (Lemon and Clementine) to invasion with *Parlatoria ziziphi* in Algeria. Ninth Arab Congress of Plant Protection, 19-23 November, Damascus, Syria, vol. E-12 pp.

Salem, M.S., El-Said, M.I., Abd-El-Ghany, A.M., Abd El-Rahman, M.M., 2006. Susceptibility of five mango cultivars to *Icerya seychellarum* (Westwood) (Homoptera: Margarodidae) in relation to leaf quality, nutrients and inhibitors. Egypt. Journal of Agricultural Research, 84(3), 679-711.

Semeada, A.M., 1985. Relative Susceptibility of certain maize germplasm to infestation with greater sugar - can borer,

Sesamia critica Led. (Lepidoptera: Noctuidea) M.Sc. Thesis Fac. Agric. Cairo Univ. 240p.

Sharma, H.C., Ortiz, R., 2002. Host plant resistance to insects: an eco-friendly approach for pest management and environment conservation. Journal of Environmental Biology, 23(2), 111-135. PMID: 12602847.

Smith, C.M., Clement, S.L., 2012. Molecular bases of plant resistance to arthropods. Annual Review of Entomology, 57, 309-328.

SPSS, 1999. SPSS base 9.0 user's guide. Chicago, IL: SPSS.

Stout, M.J., 2014. In: D.P. Abrol, ed. I*ntegrated pest management*. Dordrecht: Acad. Press, 1-21. http://dx.doi.org /10.1016/B978-0-12-398529-3.00002-6.

Wang, W., Battiti, R., 2005. Identifying intrusions in computer networks based on principal component analysis.

Youssef, A.E., 2002. Ecological studies on date palm scale insect, *Parlatoria blanchardii* (Targ.) on two date palm varieties at Kafr El-Sheikh Governorate. Journal of Agricultural Science, Mansoura, 27, 1291-1299.