https://doi.org/10.17221/156/2024-PPS

Occurrence of the white cochineal *Parlatoria blanchardi* in the fur of the black rat and potential risks for its spread to the date palm stands

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Citation: Mlik R., Kherbouche Y., Meddour S., Aouadi A., Sekour M., Rasool K.G., Aldawood A.S. (2026): Occurrence of the white cochineal *Parlatoria blanchardi* in the fur of the black rat and potential risks for its spread to the date palm stands. Plant Protect. Sci., 62: 71–78.

Abstract: The current study presents the first documented interaction between the date palm scale insect (*Parlatoria blanchardi*) and the black rats (*Rattus rattus*). For a year, this study investigated whether *R. rattus* could serve as a means of phoresy for the survival of *P. blanchardi* and the potential risks associated with its spread to date palm stands. Our research revealed a prevalence rate of *P. blanchardi* on *R. rattus* of 5.79% during the year, while a higher rate of 9.33% was observed during a specific five-month period. The mean infestation intensity was 3.39 parasites/rat during these five months. Statistical data revealed a highly significant difference in the distribution of the three age classes of *P. blanchardi* among the age categories of *R. rattus* (χ^2 = 62.067, df = 24, P = 3.244e–05). Furthermore, rat age classes differed significantly in their *P. blanchardi* infestation levels (χ^2 = 18.246, df = 3, P = < 0.001). The Negative Binomial Mixed Model showed a significant positive effect of temperature [(generalised linear mixed-effects models (GLMM): z (estimate/standard error) = 3.13, P < 0.01)] and sex (male) (GLMM: z = 2.22, P < 0.001) on insect abundance. These findings suggest that black rats may represent a previously unknown form of phoresy for the survival of the date palm scale insect, emphasising the need for further research to investigate this novel ecological interaction and its potential implications for pest management.

Keywords: *Rattus rattus*; phoresy; date palm scale; palm grove; Algeria

Supported by the Ongoing Research Funding program, (ORF-2025-107), King Saud University, Riyadh, Saudi Arabia, for funding this research.

https://doi.org/10.17221/156/2024-PPS

The date palm tree (*Phoenix dactylifera* L.) is a vital crop in the Middle East and North Africa (MENA) region (Tirichine 2010). It has allowed for the diverse plant and animal life types necessary for population preservation and survival, serving as the primary pillar of oasis ecosystems (Dhouibi 2000; Bouguedoura et al. 2010). Algeria is a major producer of dates, accounting for 500 000 t a year, ranking first in the Maghreb and fourth in the world, with 8% of world production (FAO 2023). Similarly, the Kingdom of Saudi Arabia plays a significant role in date production, whereas 75% of its fruit production comes from 30 mil. palm trees that yield over 1.5 mil. t of dates yearly (Rahman et al. 2014; Aleid et al. 2015; Elfeky & Elfaki 2019; FAO 2022). Date palm agriculture is fraught with difficulties despite its significance. Low productivity results from a lack of farming support, which harms farmers' income (FAO/RNE 2008). Additionally, the emergence of monoculture practices has brought new pest and disease risks, necessitating sustainable management techniques (El Bouhssini & Faleiro 2018). This crop is one of the most nutritious fruits with enormous economic importance, but its growth, vigour, and productivity are decreasing due to many biotic and abiotic stresses. Biotic stresses, i.e., pests and diseases, are the major threat to date palm trees worldwide (Khan et al. 2023). Several insect pests attack date palms under field conditions. Although few of them cause serious economic losses to the crop, e.g. the red palm weevil (*Rhynchophorus ferrugineus* Olivier; Coleoptera: Dryophthoridae), which is the most dangerous and damaging palm tree pest in the world (Sutanto et al. 2023; Husain et al. 2024). Furthermore, the date fruit quality is seriously threatened by *Cadra cautella* and *Apomyelois ceratoniae* (Lepidoptera: Pyralidae), which can cause damage ranging from 10% to 30% and up to 70% in storage areas. Both orchards and storage were infested. The white cochineal (*Parlatoria blanchardi* Targ.; Hemiptera: Diaspididae) is a particularly dangerous pest of date palms that infests every part of the palm, from leaves to the fruits. Because of crusting and a yellowish look on the foliage and fruits, this infestation can weaken the tree or significantly decrease the commercial grade of the dates (Munier 1973).

Moreover, the black rat (*Rattus rattus* L.; Rodentia: Muridae) is one of the most dangerous pests, causing damage in open fields and in storage, where it attacks fruit on the tree, on the ground, and in stocks. Additionally, it is considered a reservoir for many disease-causing germs, including fungi and bacteria. Considering all this and its physical capacities, he adapted to the most rustic climatic conditions in Saharan environments (Mlik 2019).

The recently discovered association link between the black rat and the white cochineal is investigated in this experiment. Our study explores the possibility that *R. rattus* could act as a new phoresy for *P. blanchardi* and the dangers of its spread to date palm stands, enabling this pest to carry on with its life cycle in a way that has never been recorded before.

MATERIAL AND METHODS

Study area. The present work was conducted in the region of Touggourt, located in the southeastern part of Algeria (33°02'–33°12' N, 5°59'–6°14' E) with an altitude of 75 m. It is limited to the north by Megarine palm groves, to the south and east by the great Oriental Erg, and to the west by dunes. This locality constitutes the upper part of the Oued Righ Valley.

Sampling. An exhaustive sampling was conducted throughout the year in four stations, two storage places and two palm groves, in the southeastern Algerian region (Touggourt) characterised by Deglet Nour, Degla Beida, and Ghars varieties. Captured rodents were trapped using BTS cages (Besonçon Technology System), very lightweight devices that are easy to store and transport in the field. They enable the capture of live animals, allowing for a thorough analysis of the specimens (e.g., actual live weight, parasite recovery, cytogenetic analysis, etc.). At the same time, the farmers captured all the individuals used in the present study within the control framework against these pests. The sex and age of trapped animals were distinguished according to Aplin et al. (2003). After, they were transported to the laboratory, euthanised with chloroform, placed over a white tray, and brushed to recover external arthropods. Entomological tweezers were used to carefully examine the ears. All removed arthropods were stored in ethanol (70%). Then, they were mounted following the protocol mentioned by Hastriter and Whiting (2003). This study has the approval of the ethical committee of the University of Kasdi-Merbah, Ouargla.

Ecological indices applied to *Parlatoria blanchardi*. To study these arthropods, the obtained results were studied with two principal indices:

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Prevalence estimation [Pr (%)] is the number of individuals of a host species infected with a particular parasite species/number of hosts examined (Margolis et al. 1982).

Mean intensity (MI) is the total number of individuals of a particular parasite species in a sample of a host species/number of infected individuals of the host species in the sample (Margolis et al. 1982).

Statistical analysis. For the statistical interpretation of results, comparison tests were implemented in R software (version 4.2.3). Firstly, the relationship between rats' age classes and stations was analysed using the correspondence analysis (CA) with the package FactoMineR (version 2.12) (Lê et al. 2008). In addition, generalised linear mixed-effects models (GLMM) and zero-inflated models with Poisson and negative binomial distributions were carried out with the insect number as a response variable, and precipitation, temperature, host sex (male, female), and host age (aged, adult, sub-adult, and juvenile) as explanatory variables with fixed effect, while including Station as a random effect. Meanwhile, the GLMMs are advantageous because they are well-suited for handling complex ecological data, allowing for the incorporation of fixed and random effects. The zero-inflated models are especially useful for analysing datasets with many zeros, a common feature in count data. On the other hand, several model selection criteria, such as Akaike information criterion (AIC), Bayesian information criterion (BIC), and over-dispersion ratio, were used to select the retained (well-fitted) model, where the model with the lowest value of AIC and BIC indicates the better fit compared to other models. Overdispersion was checked using the function *check_overdispersion*() from the package performance, where an overdispersion ratio greater than one indicates that the distributional assumption of the model is not met.

RESULTS

The current study allowed us to capture 484 individuals of black rats (278 individuals in palm groves and 206 individuals in hangars) during the year, with 28 individuals (27 male and one female) infested by 95 individuals of date palm scale. Knowing that these 28 rats (from 300 rats) were captured only in five months (April, May, June, July, August) (Table 1). This sampling recorded a prevalence rate of *P. blanchardi* on *R. rattus* equal to 5.79% during the year, unlike in the five months, which was 9.33%. On the other hand, the mean intensity was 3.39 during the five months.

Infestation of *R. rattus* by *P. blanchardi*. The number of black rats and the isolated date palm scales during five months are shown in Figure 1.

Rats of different ages exhibit varying degrees of infestation, with adult and older rats harbouring larger *P. blanchardi* populations (Figure 1). These findings demonstrate the lack of infestation in female date palm scale rats and show that the larval *P. blanchardi* infestation in black rats was more pronounced than

Table 1. Monthly monitoring of *Rattus rattus* individuals and *Parlatoria blanchardi* were conducted on them

Months	*T* (°C)	*P* (mm)	*Rattus rattus* captured			Infested rats	*Parlatoria blanchardi* recorded		
			Palm groves	Hangars	Total		Palm groves	Hangars	Total
1	9.7	0.1	9	6	15	0	0	0	0
2	14.9	0.0	15	12	27	0	0	0	0
3	17.9	8.1	15	20	35	0	0	0	0
4	21.1	35.5	22	21	43	1	2	0	2
5	28.3	0.2	34	20	54	5	7	7	14
6	31.7	1.0	40	16	56	13	39	16	55
7	34.1	0.0	46	23	69	4	7	2	9
8	33.6	0.0	49	29	78	5	13	2	15
9	28.0	7.1	25	43	68	0	0	0	0
10	22.1	2.9	15	10	24	0	0	0	0
11	15.5	40.9	4	5	8	0	0	0	0
12	11.5	1.0	4	1	4	0	0	0	0
Total			278	206	484	28	68	27	95

https://doi.org/10.17221/156/2024-PPS

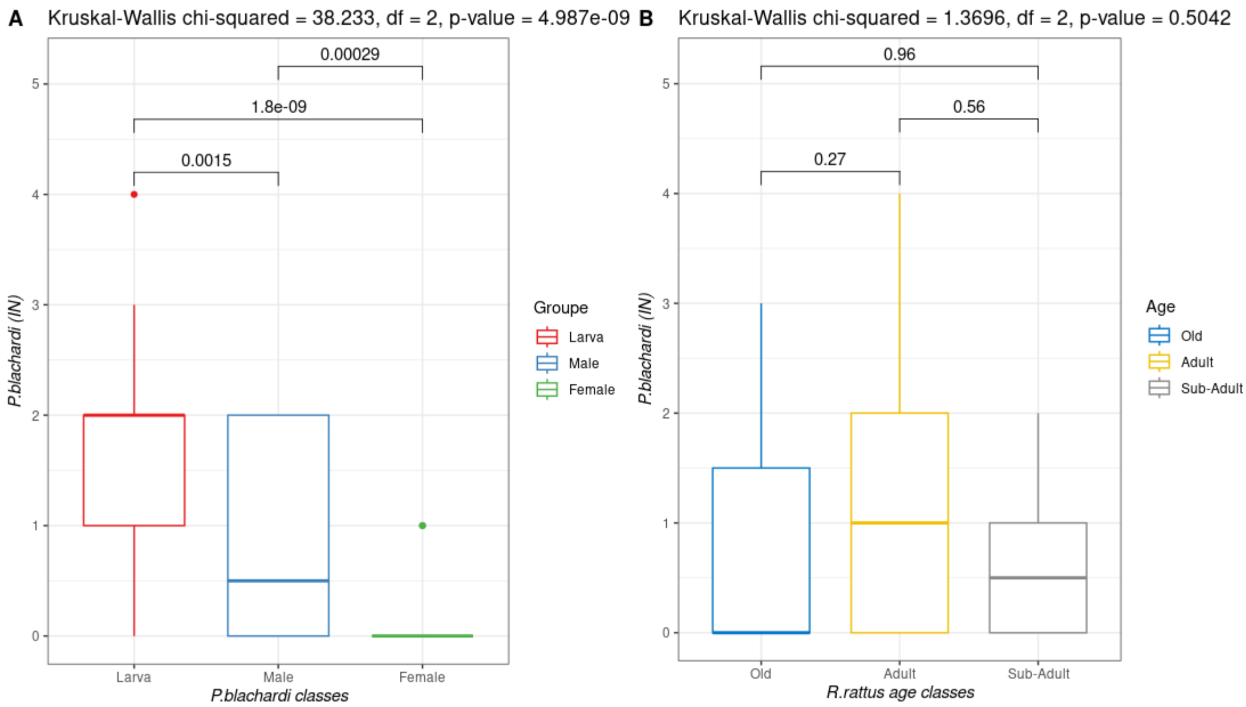

Figure 1. *Parlatoria blanchardi* evolution on *Rattus rattus* during five months

in males. Several factors may account for this difference. Male rats typically have larger home ranges and greater activity levels, which enhance their exposure to parasite-rich environments. In contrast, females often exhibit more effective grooming behaviour, which helps reduce their parasite load. Indeed, the male and larval phases of *P. blanchardi* were more frequently detected, with only one female. The structure of males, which have wings to move and fly, and larvae, which are mobile individuals, explains all this. In contrast, females are fixed on palms and covered by a shield. Moreover, the lack of infestation observed in date palm scale females with poor mobility suggests that limited movement

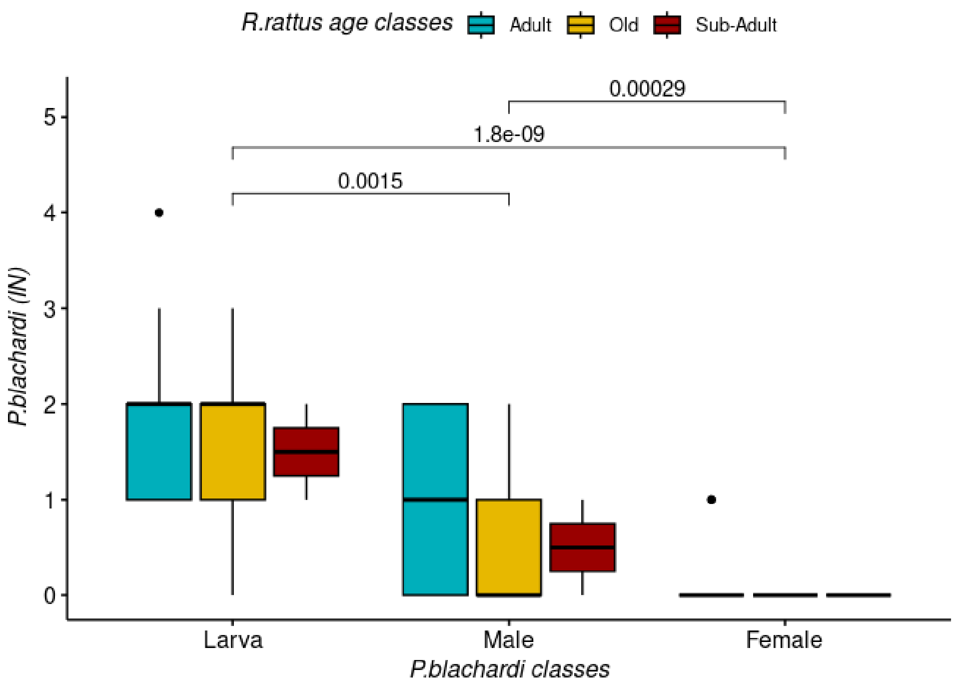

Figure 2. The relation between the number of *Parlatoria blanchardi* and its age classes, as well as *Rattus rattus*

https://doi.org/10.17221/156/2024-PPS

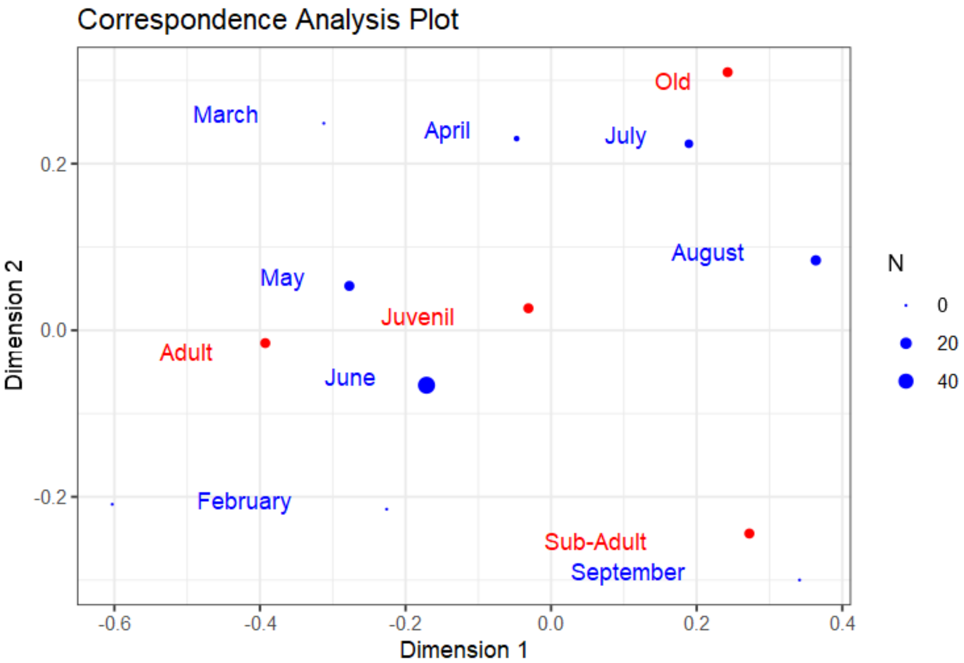

Figure 3. Correspondence analysis of black rats' age categories according to sampling months

may reduce the likelihood of parasite transfer. Conversely, *P. blanchardi* populations increased in lockstep with rising black rat populations. Moreover, *P. blanchardi* was more commonly detected in adult and older black rats, indicating that the latter group was more mobile. The statistical results showed that the three *P. blanchardi* age classes reported in the various *R. rattus* age groups differed in a very highly significant way (Figure 2). There were significant differences in *P. blanchardi* abundance among its three classes ($\chi^2 = 62.067$, df = 24, $P = 3.244e{-}05$), with most of this insect being found in the male and larval stages, respectively. In contrast, there is a substantial difference in *P. blanchardi* counts between the age groups of rats ($\chi^2 = 18.246$, df = 3, $P < 0.001$) (Figure 2).

Ecological relation between *P. blanchardi* and *R. rattus*. This experiment showed that, depending on ecological conditions, black rat individuals caught in the palm groves had a higher abundance of date palm scale than those captured in the hangars. This difference is due to habitat differences that influence both rat behaviour and insect populations. In palm groves, the presence of date palms creates an ideal environment for *P. blanchardi* to thrive, increasing the likelihood of contact between the insects and the rats. Additionally, rats in palm groves may roam over larger areas and engage in behaviours that elevate their exposure to the insects. In contrast, hangars provide less suitable conditions for the insect population, leading to a lower infestation rate among rats captured in those settings. However, the temperature and precipitation have an impact on the insect population. Figure 3 indicates that, based on the sampling months, June had the most significant number of *P. blanchardi* recorded; May, August, and July were the next highest numbers (Figure 3). All these ascertained that the temperature had a significant positive effect on insect abundance, suggesting that higher temperatures may facilitate the proliferation of *P. blanchardi*. At the same time, sub-adult rats showed lower infestation rates, potentially due to differences in mobility or behaviour.

Table 2. Model selection depending on AIC, BIC and overdispersion ratio

	AIC	BIC	Dispersion ratio
Poisson mixed models	478.0167	511.4734	2.473
Negative binomial mixed models	305.6898	343.3286	0.821
Zero-inflated poisson mixed models	317.6349	355.2736	1.115
Zero-inflated negative binomial mixed models	289.1245	330.9453	2.254

AIC – Akaike information criterion; BIC – Bayesian information criterion

Table 3. Negative binomial mixed models

	Estimate	Std. error	*z* value	*Pr* (> |*z*|)
(Intercept)	3.82	6.89E–01	–5.549	2.88e–08
P (mm)	–9.04E–02	4.83E–01	–0.187	0.851407
T (°C)	1.67	5.32E–01	3.139	0.001694**
Sex male	2.22	6.35E–01	3.489	0.000485***
Age old	6.98E–01	5.75E–01	1.214	0.224913
Age juvenile	–2.82E+01	2.82E+05	0.000	0.99992
Age sub-adult	–2.41	7.79E–01	–3.096	0.001964**

Based on the AIC, BIC, and overdispersion ratio (Table 2), the Negative Binomial Mixed Model was retained as the most appropriate model, since it has the lowest AIC and BIC values and an overdispersion ratio that does not exceed 1.

The results of the Negative Binomial Mixed Model (Table 3) indicated a significant positive effect of temperature [GLMM: z (estimate/standard error) = 3.13, $P < 0.01$] and sex (male) (GLMM: $z = 2.22$, $P < 0.001$) on the insect abundance. Contrariwise, the GLMM result demonstrated a significant negative relationship between the sub-adult class and the number of insects (GLMM: $z = -2.41$, $P < 0.01$).

The findings of this experiment allowed us to conclude that temperature, sex, and age have statistically significant effects on the recording of the white scale cochineal of date palm trees.

DISCUSSION

The date palm scale, *P. blanchardi* (Targ.), is considered one of the most destructive pests of date palm trees (Latifian & Rad 2017). This pest species injures date palm tree leaflets, leaves, and fruits by sucking out plant sap with its mouth parts, subsequently causing deformations, defoliation, and death of fronds because date palm scales have toxic saliva, resulting in yield reduction (Al Antary et al. 2015; Haldhar et al. 2017). The findings of this experiment allowed us to conclude that temperature, sex, and age have statistically significant effects on the recording of the white scale cochineal of date palm trees. Prior research supports our findings, and according to Chebaani et al. (2020a), biotic factors, particularly predators and abiotic ones like wind and high temperatures, impact the white cochineal's development. Furthermore, Smirnoff (1957) reported that mortality from the white scale begins at 38 °C. Belkhiri (2010) also declared that the highest adult mortality rate from the white scale was recorded in June (39.80%). On the other hand, the date palm scale attacks the varieties of Deglet Nour and Ghars that are rich in sucrose (no dietary preference regarding the nature of sugar), with 49.45% and reducing sugars with 80.42% (Allam 2010). Additionally, the same author recorded a more significant infestation of *P. blanchardi* on the leaves of the Deglet Nour variety, with a rate of 68% followed by the Ghars variety with 26.74%. This means that the variety Deglet Nour is the most targeted species to be attacked by this pest. Ditto was responsible for the attack of *R. rattus*, whereas Mlik (2019) found that this variety is considered the best habitat for black rats. This factor could lead the date palm scale to change the host and settle on black rats. On the other hand, several studies have demonstrated that environmental factors of a given habitat influence the level of insect abundance, the number of generations, seasonal phenology of insect numbers, and life-history traits (Chafaa et al. 2013; Salman et al. 2013). According to Laudeho & Bénassy (1969), temperature is a primordial factor that influences the duration of the date palm scale biological cycle. In addition, population abundance was significantly correlated with temperature and relative humidity (Latifian & Zaerae 2009). The cycle of *P. blanchardi* takes place almost continuously throughout the year. Chebaani et al. (2020b) declared that the number of white scale larvae reached their peak from July (546 larvae) to September (570 larvae). As well as Boussaid & Maache (2001) in the region of Ouargla, indicated that this species evolves in three annual generations. Whereas the first (spring generation) begins from March 15 until June 09 (lasts 86 days), the 2nd (summer generation) from June 9 to September 2, lasts 85 days, and the last (autumn generation) ex-

https://doi.org/10.17221/156/2024-PPS

tends from September 2 to March 15, i.e. 194 days. This means that the high number of *P. blanchardi*, especially the larvae, coincides with the beginning of the 2nd generation (Tourneur & Lecoustre 1975). All these assertions are consistent with our findings. At the same time, the increase in *P. blanchardi* numbers coincides with an increase in *R. rattus* numbers, which in turn leads to increased movement of this animal between palm trees, which contributes to facilitating the movement and settlement of the white scales on the black rats.

CONCLUSION

R. rattus may have emerged as the date palm scale's new phoresy, possibly spreading to date palm stands. However, *P. blanchardi* chooses to settle on these animals because the high temperatures coincide with their expansion, increasing their reproduction rate and protecting them from insecticidal treatments.

The need for more research to examine this novel ecological interaction and its possible implications for pest management is thus highlighted by these findings, which imply that black rats may represent a previously unidentified phoresy for the survival of the date palm scale insect and possible risks for its spread to the date palm stands.

REFERENCES

Al Antary T.M., Al-Khawaldeh M.M., Ateyyat M.A. (2015): Economic importance of date palm *Phoenix dactylifera* L. (Liliopsida: Arecales: Arecaceae) pests in Jordan Valley. Brazilian Journal of Biological Sciences, 2: 121–134.

Aleid S.M., Al-Khayri J.M., Al-Bahrany A.M. (2015): Date palm status and perspective in Saudi Arabia: In: Al-Khayri J.M., Jain S.M., Johnson D.V. (eds): Date Palm Genetic Resources and Utilisation, Springer, Dordrecht: 49–95.

Allam A. (2010): Etude de L'évolution des Infestations du Palmier Dattier (*Phoenix dactylifera* Linné, 1793) par *Parlatoria blanchardi* Targ. (Homoptera, Diaspididae Targ. 1892) dans Quelques Biotopes de la Région de Touggourt [PhD. Thesis]. Algiers, ENSA, Algeria. (In French)

Aplin K.P., Brown P.R., Jacob J., Krebs C.J., Singleton G.R. (2003): Field Methods for Rodent Studies in Asia and the Indo-Pacific. ACIAR Monograph, Canberra.

Belkhiri D. (2010): Effect of a new systemic insecticide (Spirotetramate) on the ovogenesis of the white cochineal of the date palm *Parlatoria blanchardi* Targ, 1868 (Homoptera, Diaspididae) in the region of Biskra. Memory of Magister. University of Biskr, Algeria.

Bouguedoura N., Benkhalifa A., Bennaceur M. (2010): Le Palmier Dattier en Algérie: Situation, Contraintes et Apports de la Recherche. Institut de Recherche pour le Développement, Montpellier. (In French)

Boussaid L., Maache L. (2001): Données sur la Bio-écologie et la Dynamique des Populations de *Parlatoria blanchardi* Targ dans la Cuvette d'Ouargla [PhD. Thesis.]. University of Kasdi Merbah, Ouargla. (In French)

Chafaa S., Biche M., Chenchouni H., Sellami M., Si Bachir A. (2013): Effet du climat et de l'exposition sur la dynamique des populations de la cochenille violette, *Parlatoria oleae* Colvée (Hemiptera: Diaspididae), en conditions arides. Annales de la Société Entomologique de France, 49: 291–297. (In French)

Chebaani H., Tarai N., Nia B., AL-Hussainawy K.J., Mohsen Hasan S. (2020a): Study of the natural and parasitic mortality of the white scale *Parlatoria blanchardi* targ., 1868 of the date palm in the region of Biskra. International Journal of Entomology Research, 6: 11–15.

Chebaani H., Tarai N., Souilah N., Nia B. (2020b): Study of population dynamics of the white scale (*Parlatoria blanchardi* targ, 1868) in the date palm of the Biskra region. International Journal of Entomology Research, 6: 10–13.

Dhouibi M.H. (2000): Lutte Intégrée pour la Protection du Palmier Dattier en Tunisie. Centre de publication universitaire, Tunisie. (In French)

El Bouhssini M., Faleiro J.R. (2018): Date Palm Pests and Diseases Integrated Management Guide. International Center for Agricultural Research in the Dry Areas, Beirut.

Elfeky A., Elfaki J. (2019): A review: Date palm irrigation methods and water resources in the Kingdom of Saudi Arabia. Journal of Engineering Research and Reports, 9: 1–11.

FAO (2022): https://www.fao.org/faostat/ar/#data/QCL

FAO (2023): Value Chain Study Date Palm in the Arab Region. Cairo.

FAO/RNE (2008): Workshop on "Irrigation of Date Palm and Associated Crops". Damascus, Rome, May 27–30, 2007.

Haldhar S.M., Maheshwari S.K., Muralidharan C.M. (2017): Pest status of date palm (*Phoenix dactylifera*) in arid regions of India. Journal of Agriculture and Ecology, 3: 1–11.

Hastriter M.W., Whiting M.F. (2003): *Siphonaptera* (Fleas). In: Resh V.H., Carde R. (eds): Encyclopedia of Insects. Academic Press, San Diego: 1040–1044.

Husain M., Rasool K.G., Sutanto K.D., Omer A.O., Tufail M., Aldawood A.S. (2024): Laboratory evaluation of indigenous and commercial entomopathogenic Nematodes against red palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). Insects, 15: 290.

https://doi.org/10.17221/156/2024-PPS

Khan R.R., Ul Haq I., Naqvi S.A. (2023): Pest and disease management in date palm. In: Date Palm, CABI Digital Library: 297–338.

Latifian M., Rad B. (2017): Efficacy of cultural control for date palm borer management. Indian Journal of Plant Protection, 45: 7–11.

Latifian M., Zaerae M. (2009): The effects of climatic conditions on seasonal population fluctuation of date palm scale *Parlatoria blanchardi* Targ. (Hem.: Diaspididae). Plant Protection Journal, 1: 277–286.

Laudeho Y., Bénassy C. (1969): Contribution à l'étude de l'écologie de *Parlatoria blanchardi* Targ. en Adrar mauritanien. Fruits, 22: 273–287. (In French)

Lê S., Josse J., Husson F. (2008): FactoMineR: An R package for multivariate analysis. Journal of Statistical Software, 25: 1–18.

Margolis L., Esch G.W., Holmes J.C., Kuris A.M., Schad J.A. (1982): The use of ecological terms in parasitology: report of an ad hoc committee of the American society of Parasitologists. Journal of Parasitology, 68: 131–133.

Mlik R. (2019): Diversité et importance des rongeurs dans les milieux urbains et phœnicicoles du Sahara septentrional d'Algérie [PhD. Thesis.]. University of Kadi Merbah, Ouargla. (In French)

Munier P. (1973): Le palmier dattier. Ed. Georges-Paul Maisonneuve et Larousse. Paris.

Rahman S., Begum I.A., Alam, M.J. (2014): Livestock in Bangladesh: distribution, growth, performance and Potential. Livestock Research for Rural Development, 26: 233–238.

Salman A.M.A., Moussa S.F.M., Barky M.M.S. (2013): Seasonal activity of the white date palm scale insect, *Parlatoria blanchardii* (Targioni Tozzetti) infesting date palm trees at Esna district, Luxor Governorate, Egypt. Nature Science, 11: 32–40.

Smirnoff W.A. (1957): The date palm cochineal (*Parlatoria blanchardi* Targ) in North Africa. Behavior, economic importance, predators and biological control. Entomophaga, Tome II., 1: 98.

Sutanto K.D., Husain M., Rasool K.G., Mankin R.W., Omer A.O., Aldawood A.S. (2023): Acoustic comparisons of red palm weevil (*Rhynchophorus ferrugineus*) mortality in naturally infested date palms after injection with entomopathogenic fungi or Nematodes, *Aluminum phosphide* fumigation, or insecticidal spray treatments. Insects, 14: 339.

Tirichine A. (2010): L'état phytosanitaire des palmeraies algériennes, principaux axes de recherche/développement à prendre en charge. Workshop sur l'Agriculture Saharienne: Enjeux et Perspectives, May 3, 2010, Université Kasdi Merbah, Ouargla. (In French)

Tourneur J.C., Lecoustre R. (1975): Cycle de développement et tables de vie de *Parlatoria blanchardi* Targ. (Homoptera-Diaspididae) et de son prédateur exotique en Mauritanie, *Chilocorus bipustulatus* L. var. *iraniensis* (Coleoptera-Coccinellidae). Fruits, 7: 481–497. (In French)

Received: September 3, 2024
Accepted: June 3, 2025
Published online: November 4, 2025