Research Article

The Efficiency of Predatory Beetle *Cybocephalus rufifrons* Reitt. (Coleoptera: Cybocephalidae) on Date Palm Scale *Parlatoria blanchardi* (Targioni-Tozzetti) (Hemiptera: Diaspididae)

Mustafa Abbas Al-Jbouri[1]* and Feryal Bahjat Hermize[2]

[1]Department of Plant Protection, College of Agriculture Engineering Science, University of Baghdad, Baghdad, Iraq; [2]Department of Entomology, College of Agriculture Engineering Science, University of Baghdad, Baghdad, Iraq.

Abstract | White or armored scale insect *Parlatoria blanchardi* Targ. (Homoptera: Diaspididae) is a destructive pest of date palm plantations in tropical and subtropical regions of the world including Iraq. This study evaluated the efficacy of a predatory beetle *Cybocephalus rufifrons* Reitt. (Coleoptera: Cybocephalidae) which is one of the major natural enemies found in the Iraq and it particularly predates on scale insects including *P. blanchardi*. Predatory efficacy of different life stages and different larval instars of *C. rufifrons* were evaluated by feeding them on the nymphs of *P. blanchardi*. Results revealed that predatory efficiency of the beetle increased along with the age of its larval instars. This seems due to their larger size, preying agility and enhanced nutritional requirements. The consumption rates of the first, second and third stage larvae continued until the fourth stage, with daily consumption rates of 24.78, 35.28, 66.61 and 141.20 nymphs of scale insects (*P. blanchardi*). The average consumption of nymphs throughout the larval period was recorded as 1296.58 prey nymphs, with a daily average of 264.87 nymphs. A differential and significant consumption rates and daily consumption rates were recorded for the predatory instars and adult sexes. Adult female beetles devoured 128.50 nymphs per day, while male beetles consumed about 107.21 nymphs. The analysis also reveals significant differences between the larval and adult consumption rates in both sexes. Overall study results exhibited the predatory potential of *C. rufifrons* against the nymphs of date palm scale insect *P. blanchardi* and suggest the potential implication of this beetle in future integrated management of date palm scale insect pests including *P. blanchardi*.

Received | February 05, 2025; **Accepted** | April 08, 2025; **Published** | June 17, 2025
***Correspondence** | Mustafa Abbas Al-Jbouri, Department of Plant Protection, College of Agriculture Engineering Science, University of Baghdad, Baghdad, Iraq; **Email:** mostafa.abbas1104a@coagri.uobaghdad.edu.iq
Citation | Al-Jbouri, M.A. and F.B. Hermize. 2025. The efficiency of predatory beetle *Cybocephalus rufifrons* Reitt. (Coleoptera: Cybocephalidae) on date palm scale *Parlatoria blanchardi* (Targioni-Tozzetti) (Hemiptera: Diaspididae). *Sarhad Journal of Agriculture,* 41(2): 875-880.
DOI | https://dx.doi.org/10.17582/journal.sja/2025/41.2.875.880
Keywords | Biological control, Date palm scale, Predatory beetle, *Cybocephalus rufifrons*, *Parlatoria blanchardi*, Prey consumption rate, Predatory efficiency

Introduction

White or armored scale insect *Parlatoria blanchardi* Targ. (Homoptera-Diaspididae) is a highly destructive and widespread pest of date palm and other ornamental palms. Although it is native to the West Asian region, it has spread to several other mediterranean and West Asian countries including

Iraq. Both nymphs and adults of this pest infest all parts of date palm including leaf-sheaths, leaflets, offshoots, tender shoots, twigs and fruits. Due to intensive desaping, the infested plant parts lose their vigour and become wilted and ultimately fruit quality declines (Awadalla *et al*., 2023). Moreover, photosynthetic disruption due to the sooty mould growth on the sugary secretions produced by these scale insect pests is also a major indirect damage inflicted to the infested date palm tree (Kosztarab and Kozár, 2012; Moghaddam *et al*., 2021).

Date palm scale insect *P. blanchardi* has been a major challenge for date palm growers in all palm growing areas. Farmers can deploy a variety of cultural, mechanical and chemical control methods to manage the infestation of *P. blanchardi*. Particularly they rely exclusively on the application of synthetic chemicals which not only give unsatisfactory control due to the presence of a water impermeable cushion around these scale insects' body (Raupp *et al*., 2001; Belkhiri *et al*., 2011), but these chemicals applications also cause many ecological consequences including environment contamination and health hazards. Hence, there is a need to look for biorational pest management approach such as biological control against *P. blanchardi* (Assari *et al*., 2023; Awadalla *et al*., 2023).

Biological control is one of the modern and promising strategies being used in different integrated pest management programs against various insect pests (Giles *et al*., 2017; Jeffers and Chong, 2021). It is considered as an eco-friendly approach as it does not conflict with other control methods (Baker *et al*., 2020). Apart from abiotic weather factors, the population dynamics of each insect pest species is being naturally regulated by different biotic factors, particularly by a wide array of natural enemies including predators, parasitoids and pathogens (Fischbein and Corley, 2022; Bhagarathi and Maharaj, 2023).

Predatory beetles belonging to Coccinellidae and Cybocephalidae are major natural enemies of *P. blanchardi* (Smith, 2022; Ben Chaaban *et al*., 2025). The predatory beetle *Cybocephalus rufifrons* Reitt. (Coleoptera: Cybocephalidae) is an important biological control agent registered for control of *P. blanchardi* in the countries of the Mediterranean Basin. As there is a lack study regarding the quantitative estimation of biocontrol efficiency of predatory fauna and the determination of the extent to which the population of target pests is being affected, this study aimed to evaluate the predatory efficiency of different life stages and by different larval instars against the nymphs of white scales of date palm and to determine its importance as biological control agent in reducing the population density of the *P. blanchardi*.

Materials and Methods

Date palm offshoots infested with the white scale insects (*P. blanchardi*) were obtained from the Fadk Palm Farm which is a date-filled oasis central to Islam's origins and is a 500-hectare farm operated by the Imam Hussein Shrine in the nearby holy city of Karbala. After species confirmation, these nymphs and adults of *P. blanchardi* were reared in the laboratory at a temperature of 25±2 °C and at 8:16 h (light: dark) photoperiod. Their colonies were maintained continuously for the purpose of taking samples for experiments. Adult *C. rufifrons* beetles were fed on the laboratory reared nymphs of *P. blanchardi* which were initially collected from the Fadk Palm Farm, Karbala, Iraq, and after confirming its diagnosis from the Natural History Museum, these were placed in 17 × 17 × 8 cm plastic rearing cages, closed from the top with a piece of cotton cloth and were fixed with a rubber band and were provided with palm wickers infested with the scale insect *P. blanchardi* as food for the predator (Al-Jbouri and Hermize, 2023).

The food was replaced daily and the rearing cages were provided by adequate moisture by placing small Petri plates with a cotton swab moistened with water (Grafton and Gu, 2003) The laid eggs were isolated and each egg was placed in 10 × 1.5 cm a plastic tube that was closed with a piece of muslin cloth and a rubber band. It was monitored daily until the eggs hatched and the larvae emerged, which were fed daily with the nymphs of the scale insect *P. blanchardi* until it matures. The culture was carried out in incubators at a temperature of 25°C ±2 and a relative humidity of 70–60% and at a photoperiod of 8:16 h light: dark (Al-Jbouri and Hermize, 2023). Predatory efficacy of different life stages and different larval instars of *C. rufifrons* were evaluated by feeding them on the nymphs of *P. blanchardi*. Ten newly hatched *C. rufifrons* were offered to experimental treatments by placing a wicker sheet containing 25, 50, 100 and 200 prey nymphs per treatment. Data regarding the number of prey nymphs consumed were recorded for

each treatment on each day.

For the predatory Study of *C. rufifrons* by feeding on date palm scale nymphs, 5 pairs (male and female) of newly emerged adult predators were selected as 5 replicates (each of them was placed inside 10 × 1.5 cm plastic tubes and were provided with 200 scale insect nymphs and a small piece of cotton moistened with water was placed in the tubes and these tubes were kept in an incubator at a temperature of 25°C ± 2 and a relative humidity of 70 - 60% and were checked daily to calculate the number of nymphs consumed by females and males for five consecutive days.

The completely randomized design (CRD) was used in the experiment and the differences between treatments and prey-consumption rates were compared with ANOVA and student's *t*-test at standard level of significance (P ≤ 0.05). The results were analyzed by the program GenStat (Payne *et al.*, 2009).

Results and Discussion

Decision-making regarding the incorporation of any biological control agent such as predatory insect species in integrated pest management programs requires necessary information about the efficiency and effectiveness of predators. This is possible by analysing the specific components of the attack rate as well as the effect achieved by the predation process to the response of the population density of each species, prey and predator. This laboratory study evaluated the predatory potential of different life-stages and larval instars of the predatory beetle *C. rufifrons* against nymphs of date palm scale insects (*P. blanchardi*).

Study results regarding the predatory efficiency of C. rufifrons beetles on scale insect P. blanchardi nymphs are shown in Table 1. It is evident from these results that the predatory efficiency of larval instars of C. rufifrons increased along with the age of the P. blanchardi, mainly due to their larger size and increased nutritional requirements. The rate of prey consumption varied between the first, second and third instar larvae with the fourth instar consuming the highest number of P. blanchardi nymphs. A total of 1296 nymphs were consumed by the predator during the bioassay (Table 1).

The study also found significant differences in the consumption rates between larval and adult phases of the predatory beetles. For adults, the average daily consumption of female beetles was about 128.5 nymphs per day, while the daily consumption rate of male beetles was about 107 nymphs per day (Table 1). Results also revealed a significant difference in the consumption rates between the larval and adult roles in both genders. These findings highlight the importance of understanding the role of larval instars in maintaining their nutritional requirements as demonstrated by previous studies (Al-Shami and Qureshi, 2022; Ramzan and Khursheed, 2023).

Findings of this laboratory study advocate the fact that *C. rufifrons* is an efficient natural enemy and an important potential biological control agent which would play a significant role in preying the date palm scale insect *P. blanchardi* and in reducing its population density out in the field (Assari *et al.*, 2023). Results of this study regarding the differential prey consumption by male and female beetles are in accordance with those of Yang *et al.* (1997) who studied the predatory efficacy of male and female predatory beetle *Chilocorus kuwanae* (Coleoptera: Coccinellidae) against oriental scale insect *Unaspis yanonensis*

Table 1: *The predatory efficiency of different life phases and larval instars of predatory beetle Cybocephalus rufifrons on the nymphs of the date palm scale insect Parlatoria blanchardi.*

Predation rates of predator roles			Larval instar predation rates		
Predator phase	**Daily average ± SE**	**Total average ± SE**	**Larval instar**	**Daily average ± SE**	**Total average ± SE**
Larva	264.87 ± 15.81	1296.58 ± 35.60	1st instar	24.78 ± 2.33	96.12 ± 8.30
Adult (female)	128.50 ± 3.60	-	2nd instar	35.28 ± 2.76	172.41 ± 10.23
Adult (male)	107.21 ± 4.24	-	3rd instar	66.61 ± 8.99	329.06 ± 15.40
			4th/last instar	141.20 ± 21.90	702.10 ± 23.74
CV	19.33			7.65	16.29

Treatments were compared using factorial ANOVA followed by least significant difference (LSD) post-hoc test at standard level of significance (α ≤ 0.05).

(Homoptera: Diaspididae) on citrus, and demonstrated that the average consumption of female beetles was 42.7 nymphs per day as compared to the male beetles which consumed an average of 22.3 nymphs per day, and this supports our current study that the female *C. rufifrons* beetles in terms of their consumption more than that of the male beetles. It differs quantitatively due to different type of predator and prey relationship. Our results are in accordance with the findings of Ponsonby and Copland (2000) as well demonstrating the more food requirement and intake of nymphs of scale insect *Abgrallaspis cyanophylli* by the female larval instars of predatory beetle *Chilocorus nigritus* as compared to males.

Results of the study are in line with the findings of many previous studies. For instance, Al-Rawy *et al*. (2012) showed high efficiency of the predator *Chrysoperla carnea* to attack and consume the nymphal instars and adults of cabbage aphid, *Brevicoryne brassicae*. Zarghami *et al*. (2016) tested the predatory efficiency of the larval and adult phases of an indigenous predator *Nephus jaderiensis* (Coleoptera: Coccinellidae) against citrus mealybug Planococcus *citri* (Hemiptera: Pseudococcidae). The results showed that the predator had a high predatory efficiency in consuming the immature stages of the studied citrus mealybug.

Similarly, Kamel *et al*. (2016) studied some life-history aspects and the predatory efficiency of the predatory beetle *Chilocorus bipustulatus* (Coleoptera: Coccinellidae) on the date palm scale insect *P. blanchardi* (Homoptera: Diaspididae) under laboratory setup. They reported that the predator had very high consumption efficiency on scale insect nymphs, and this predation was increased as the larvae grown from first instar to onwards (Ponsonby and Copland, 2000; Al-Hamwandi and Abdel-Khalek, 2011; Al-Shami and Qureshi, 2022; Ramzan and Khursheed, 2023).

Conclusions and Recommendations

Overall study results have demonstrated the predatory potential of beetle *C. rufifrons,* of both adults and larvae, against the nymphs of date palm scale insect *P. blanchardi*. The larval predation efficiency has been found significantly higher than that of adult beetles, and the prey consumption rate also increased along with the larval age or instar. These results in general advocate the potential consideration and implication of this predatory beetle (*C. rufifrons*) in future integrated management programs combating date palm scale insect pests, particularly against *P. blanchardi*.

Acknowledgements

The authors are grateful to Fadk Farm, Karbala, Iraq for the provision of date palm material and to the College of Agriculture and Engineering Science, University of Baghdad, Iraq for facilitating the successful conduction of this research work.

Novelty Statement

This study is the first to evaluate the predatory efficiency of *Cybocephalus rufifrons* against *Parlatoria blanchardi* on date palms under field conditions. The results provide new insights into the potential use of this beetle as a biological control agent in integrated pest management programs. This novel research encourages the use of natural enemies and contributes to reducing the harmful effects of chemical pesticides.

Author's Contribution

MAA and FBH conceived of the research idea. MAA performed experiment and recorded and analyzed the data. FBH wrote the first draft. MAA provided resources and supervised the project. FBH revised the draft and technically proofread the manuscript. All authors contributed equally.

Conflict of interest

The authors have declared no conflict of interest regarding the submission and publication of this research work.

References

Al-Hamwandi and S. Abdel-Khalek. 2011. Ecological and life studies of the predator *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) on the black bean insect *Aphis fabae* Scop (Homoptrea: Aphididae), Master dissertation. Plant Protection Department, Faculty of Agriculture, Baghdad University. 99 pages.

Al-Jbouri, M.A. and F.B. Hermize. 2023. Threshold and degree days for the development of the *Parlatoria blanchardi* (Torgioni-Tozzetti)

(Hemiptera: Diaspididae). In: IOP Conference Series: Earth Environ. Sci., IOP Publ., 1158(7): 072009. https://doi.org/10.1088/1755-1315/1158/7/072009

Al-Rawy, A. Mohammed and S.A. Hind. 2012. Study the predation efficiency of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) larvae in controlling nymphs and adults of cabbage aphid *Brevicoryne brassicae* (L.) (Homoptera: Aphididae). Baghd. Sci. J., 9(3): 424-430. https://doi.org/10.21123/bsj.2012.9.3.424-430

Al-Shami, S. and J.A. Qureshi. 2022. Predation of Florida red scale *Chrysomphalus aonidum* (L.) by the metallic blue ladybeetle *Curinus coeruleus* (Mulsant). Bull. Entomol. Res., 112(3): 370-377. https://doi.org/10.1017/S0007485321000936

Assari, M.J., K. Mahdian, I. Esfandiarpoor and H. Zohdi. 2023. Identification of the predominant predator of the date palm scale, *Parlatoria blanchardi*, using molecular markers in the palm groves of Bam. BioCont. Plant Protect., 11(1): 97-108.

Awadalla, S.S., T.E. Ata, M.F. Dina and M.E.S. Hager. 2023. Population of the white date palm scale insect, *Parlatoria blanchardi* and mortality factors acting their population at New Damietta District. J. Plant Protect. Pathol., 14(10): 287-291. https://doi.org/10.21608/jppp.2023.235502.1177

Baker, B.P., T.A. Green and A.J. Loker. 2020. Biological control and integrated pest management in organic and conventional systems. Biol. Contr., 140: 104095. https://doi.org/10.1016/j.biocontrol.2019.104095

Belkhiri, D., M.S. Mehaoua and M. Biche. 2011. Study of fecundity of *Parlatoria blanchardi* of the date palm and essay of chemical control in a Palmeraie in Biskra. I Int. Symp. Date Palm, 994: 379-383. https://doi.org/10.17660/ActaHortic.2013.994.39

Ben Chaaban, S., O. Aboudiaf, K. Mahjoubi, M.B. Ali, A. Hedfi and J.M.B. Jemâa. 2025. Effects of pesticides used on date palm to *Trichogramma cacoeciae* (Trichogrammatidae), *Pharoscymnus anchorago* (Coccinellidae) and *Cybocephalus palmarum* (Cybocephalidae) under laboratory conditions. Euro-Med. J. Environ. Integ., pp. 1-10. https://doi.org/10.1007/s41207-025-00771-9

Bhagarathi, L.K. and G. Maharaj. 2023. Impact of climate change on insect biology, ecology, population dynamics, and pest management: A critical review. World J. Adv. Res. Rev., 19(3): 541-568. https://doi.org/10.30574/wjarr.2023.19.3.1843

Fischbein, D. and J.C. Corley. 2022. Population ecology and classical biological control of forest insect pests in a changing world. Forest Ecol. Manage., 520: 120400. https://doi.org/10.1016/j.foreco.2022.120400

Giles, K.L., B.P. McCornack, T.A. Royer and N.C. Elliott. 2017. Incorporating biological control into IPM decision making. Curr. Opin. Insect Sci., 20: 84-89. https://doi.org/10.1016/j.cois.2017.03.009

Grafton–Cardwell, E.E. and P. Gu. 2003. Conserving vedalia beetle *Rodolia cardinalis* (Mulstant) (Coleoptera: Coccinellidae) in citrus, a continuing challenge as new insecticides gain registration. J. Econ. Entomol., 96: 1388-1389. https://doi.org/10.1093/jee/96.5.1388

Jeffers, A. and J.H. Chong. 2021. Biological control strategies in integrated pest management (IPM) programs. Clemson Univ. Cooper. Land-Grant Press Clemson Ext., LGP, 1111: 1-9. https://lgpress.clemson.edu/publication/biological-control-strategies-in-integrated-pest-management-ipm-programs/

Kamel, S.H. and J.K. Al-Rubaie 2016. Environmental and life studies of the predator *Chilocorus bipustulatus* (L.) (Coleoptera Coccinellidae) on the scale insect Targ. *Parlatoria blanchardi* (Hemiptera: Diaspididae) on palms in the laboratory. Master dissertation. Plant Protection Department, Faculty of Agriculture, Baghdad University. 64 pages.

Kosztarab, M. and F. Kozár. 2012. Scale insects of central Europe. Springer Sci. Bus. Media, Vol. 40.

Moghaddam, M., M. Abdollahipour and Y. Fathipour. 2021. Scale insects. Polyphagous pests of crops, pp. 273-309. https://doi.org/10.1007/978-981-15-8075-8_6

Payne, R.W., S.A. Harding, D.A. Murray, D.M. Soutar, D.B. Bird. 2009. The guide to GenStat Release 12, Statistics. VSN International, Hemel Hempstead, Hertfordshire, UK.

Ponsonby, D.J. and M.J.W. Copland. 2000. Maximum feeding potential of larvae and adults of the scale insect predator, *Chilocorus nigritus* with a new method of estimating food intake. BioControl, 45: 295-310.

Ramzan, Z. and S. Khursheed. 2023. Predatory potential and functional response of *Coccinella undecimpunctata* Linnaeus (Coleoptera: Coccinellidae) on *Brevicoryne brassicae* (Linnaeus) (Homoptera: Aphididae). Int. J. Pest Manage., pp. 1-10. https://doi.org/10.1080/09670874.2023.2234330

Raupp, M.J., J.J. Holmes, C. Sadof, P. Shrewsbury and J.A. Davidson. 2001. Effects of cover sprays and residual pesticides on scale insects and natural enemies in urban forests. J. Arboricul., 27(4): 203-214. https://doi.org/10.48044/jauf.2001.022

Smith, T.R., 2022. Review of the Cybocephalidae (Coleoptera) of North America and the West Indies with descriptions of two new species of *Cybocephalus* Erichson. Insecta Mund., 950: 1-35.

Yang, X., M. Shen, Z. Guo and J. Xiong. 1997. Predation of the lady beetle *Chilocorus kuwanae* on the scale *Unaspis yanonensis*. Insect Sci., 4(3): 249-258. https://doi.org/10.1111/j.1744-7917.1997.tb00098.x

Zarghami, S., M.S. Mossadegh, F. Kocheili, H. Allahyari and A. Rasekh. 2016. Research article functional responses of *Nephus arcuatus* Kapur (Coleoptera: Coccinellidae), the most important predator of spherical mealybug *Nipaecoccus viridis* (Newstead). Psyche: J. Entomol., 1: 9417496. https://doi.org/10.1155/2016/9417496