

**BIOECOLOGY AND HARMFULNESS OF THE CALIFORNIA RED SCALE
(QUADRASPIDIOTUS PERNICIOSUS COMST.) IN WALNUT ORCHARDS****Boqieva Mariyam Bozorovna**

PhD Student, Tashkent State Agrarian University (TSAU)

ORCID: <https://orcid.org/0009-0008-3998-0727><https://doi.org/10.5281/zenodo.22252145>

Abstract. This study presents the results of investigations on the biology, distribution, seasonal development, harmfulness, reproductive capacity, and natural regulation of the California red scale, *Quadraspidotus perniciosus* Comstock (Hemiptera: Diaspididae), in walnut (*Juglans regia* L.) orchards under the conditions of Tashkent Region, Uzbekistan. During 2023–2025, the reproductive productivity of females, degree of tree infestation, seasonal population dynamics, and the role of natural parasitoids were studied. The results showed that the average reproductive productivity of first-generation females ranged from 61.3 to 64.6 crawler larvae per female, while that of second-generation females ranged from 84.6 to 92.3 larvae. The infestation level reached 1.9% in young walnut trees and up to 2.5% in mature trees, with an average infestation rate of 2.3%. Natural parasitism by parasitoid entomophages ranged from 11.2% to 13.9%. The mass emergence period of first-instar crawler larvae was identified as the most appropriate biological timing for monitoring and implementing control measures. The obtained results can be used to develop an economically and ecologically justified integrated pest management system for California red scale in walnut orchards.

Keywords: California red scale, *Quadraspidotus perniciosus*, walnut, *Juglans regia*, pest harmfulness, reproductive productivity, crawler larvae, natural parasitoids, parasitism, monitoring, economic threshold.

Introduction. The California red scale, *Quadraspidotus perniciosus* Comstock (Hemiptera: Diaspididae), is a highly polyphagous sucking pest that damages a wide range of fruit and ornamental plants. In walnut (*Juglans regia* L.) orchards, its feeding on trunks, branches, young shoots, and fruits disrupts plant physiological processes, weakens shoot growth, reduces fruit quality, and may cause partial branch dieback under severe infestation.

In the conditions of Tashkent Region, the development and population dynamics of *Q. perniciosus* are strongly influenced by temperature, relative humidity, precipitation, host-plant condition, and orchard phytosanitary status. The mobile first-instar crawler stage is particularly important because it determines pest dispersal and represents the most susceptible stage for timely control measures.



Therefore, studying the reproductive capacity, infestation level, seasonal development, natural parasitism, and economic injury level of *Q. perniciosus* in walnut orchards is of significant scientific and practical importance. Such data provide a basis for improving monitoring and developing an environmentally sound integrated pest management strategy.

The aim of the study was to determine the biological and ecological characteristics, reproductive capacity, infestation level, and natural parasitism of *Q. perniciosus* in walnut orchards of Tashkent Region and to establish appropriate monitoring and control periods.

Materials and methods

The study was conducted during 2023–2025 in walnut (*Juglans regia* L.) orchards of Tashkent Region. The distribution, seasonal development, reproductive performance, damage level, and natural parasitism of *Quadraspidotus perniciosus* Comstock were studied. For each generation, 10 females were observed and the number of crawler larvae produced was recorded. Pest infestation was assessed on trunks, branches, young shoots, and fruits. Ten model trees were selected for monitoring, with samples collected from four sides of each tree. Natural parasitism was determined by recording parasitoid emergence holes. The mass emergence of crawler larvae was used to establish the optimal timing for monitoring and control measures.

Results and discussion

The California red scale, *Quadraspidotus perniciosus* Comstock (Hemiptera: Diaspididae), is a highly polyphagous sap-sucking pest that infests a wide range of fruit and ornamental tree species. Field observations conducted in walnut (*Juglans regia* L.) orchards in Tashkent Region, Uzbekistan, confirmed the occurrence and development of the pest on tree trunks, primary and secondary branches, young shoots, and fruit surfaces.

The study investigated the distribution, seasonal development, reproductive performance of females, natural parasitism, and economic injury threshold of *Q. perniciosus* within the walnut agrobiocenosis. Particular attention was given to the biological characteristics of the pest and the factors determining its population dynamics under local environmental conditions.

The California red scale exhibits pronounced sexual dimorphism. Females are wingless, relatively immobile, and have a rounded body protected by a circular, grayish-brown scale approximately 1.5–2.0 mm in diameter. Males are considerably smaller, winged, and short-lived, with their primary biological function being the fertilization of females.



First-instar larvae, commonly referred to as “crawlers,” are initially highly mobile and actively disperse over the surfaces of trunks, branches, young shoots, and fruits. After locating a suitable feeding site, the crawler inserts its stylet into the plant tissue and begins feeding. It subsequently becomes sessile and gradually develops a protective scale cover, which enables the pest to remain attached to the host plant during subsequent developmental stages.

The development and population dynamics of *Q. perniciosus* are closely associated with environmental and host-plant factors, including air temperature, relative humidity, precipitation, physiological condition of the trees, and the phytosanitary status of the orchard. Under warm and relatively dry conditions, accelerated development of the crawler stage was observed, whereas cooler periods accompanied by increased precipitation were associated with a relative reduction in population density.

Reproductive Performance of California Red Scale Females

During 2023–2025, the reproductive performance of female *Q. perniciosus* was investigated on walnut trees under the conditions of Tashkent Region. For each generation, 10 female individuals were selected for observation, and the number of first-instar crawler larvae produced by each female was recorded.

The results demonstrated that, throughout all study years, females of the second generation exhibited substantially higher reproductive performance than those of the first generation. The mean reproductive output of first-generation females ranged from 61.3 to 64.6 crawler larvae per female, whereas second-generation females produced an average of 84.6–92.3 crawler larvae per female. The increased reproductive performance of the second generation was associated with the more favorable temperature and nutritional conditions prevailing during the summer period of the growing season, which promoted enhanced development and reproduction of the pest (Table 1).

Table 1.

Reproductive performance of female California red scale (*Quadraspidotus perniciosus* Comstock) on walnut trees during 2023–2025

Year	Generation	Number of females observed	Mean reproductive output per female, larvae
2023	First generation	10	64,6
2023	Second generation	10	92,3

2024	First generation	10	61,3
2024	Second generation	10	84,6
2025	First generation	10	62,3
2025	Second generation	10	87,3

Damage Caused by the California Red Scale to Walnut Trees

The larvae and adult females of the California red scale feed by sucking plant sap from the trunks, branches, young shoots, and fruits of walnut trees. Infested tissues exhibited physiological disturbances, reduced shoot growth, localized bark damage, and the formation of reddish-brown spots on fruit surfaces.

Table 2.

Symptoms observed in walnut trees depending on the level of infestation by the California red scale

Infestation level	Main symptoms observed in walnut trees
1-2%	Individual scale insects occur on shoots; damage is low.
3-5%	Growth of young shoots is reduced; fruit quality begins to decline.
5-10%	The physiological condition of trees deteriorates; yield decreases.
>10%	Branch dieback and severe weakening of trees are observed.

Under severe infestation, the shape and external appearance of walnut fruits were adversely affected, resulting in reduced market quality. Prolonged infestation weakened the overall physiological condition of trees and, in some cases, led to the dieback of individual branches.

In the surveyed orchards, the infestation rate of young walnut trees was 1.9%, whereas that of mature trees reached 2.5%, with an average infestation rate of 2.3% (Table 2).

Role of Natural Entomophages

Parasitoid entomophages were found to play an important role in the natural regulation of *Q. perniciosus* populations. Natural parasitism was assessed by recording parasitoid emergence holes on the scale covers of infested individuals.



Table 3.

**Natural parasitism of the California red scale in walnut orchards,
2024–2025**

Year	Location	Individuals examined, n	Parasitoid emergence holes, n	Parasitized individuals, %
2024	Bo'stonliq	508	57	11.2
2024	Qibray	225	28	12.4
2025	Bo'stonliq	152	21	13.8
2025	Qibray	122	17	13.9

The results showed that natural parasitism of the California red scale ranged from 11.2–12.4% in 2024 and from 13.8–13.9% in 2025. These findings indicate that conserving natural entomophages in walnut agrobiocenoses may contribute to the biological suppression of *Q. perniciosus* populations (Table 3).

Economic Injury Threshold of the California Red Scale

To determine the economically justified timing of control measures against *Q. perniciosus*, pest population density, tree infestation level, and the period of mass emergence of crawler larvae were taken into account.

During monitoring, 10 model trees were selected in each study area. Ten-centimeter shoot sections were sampled from four sides of each tree, and the number of scale insects, the proportion of infested shoots and fruits, and the timing of mass emergence of first-instar crawler larvae were recorded. The results confirmed the importance of considering critical pest density when determining control measures in walnut orchards. In particular, the period of mass crawler emergence was identified as the most appropriate biological timing for chemical treatments.

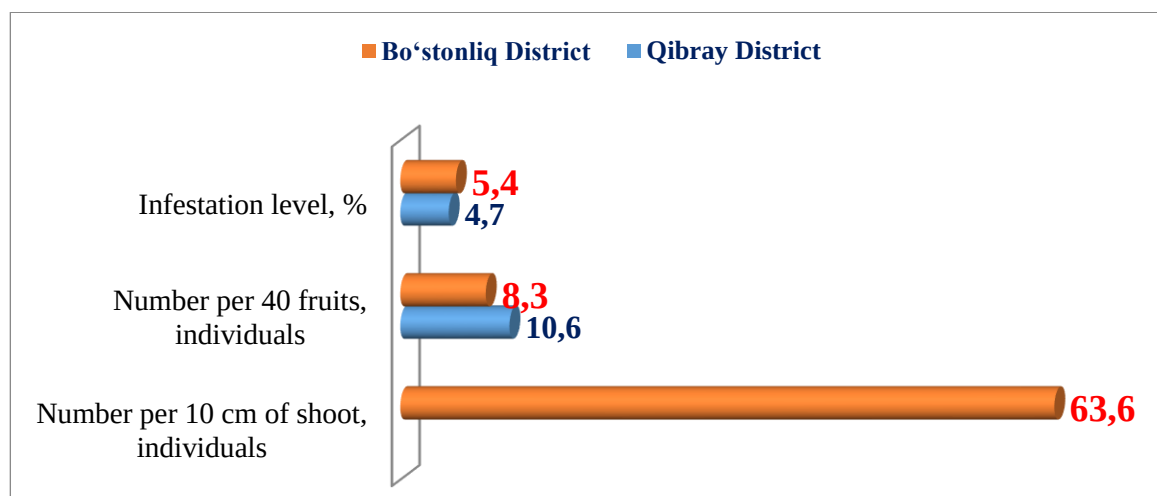


Figure 1. Symptoms of California red scale infestation on walnut shoots and

fruits

Conclusion

The study established the biological and ecological characteristics of the California red scale, *Quadraspidiotus perniciosus* Comstock, in walnut (*Juglans regia* L.) orchards of Tashkent Region during 2023–2025. The reproductive capacity of females was higher in the second generation (84.6–92.3 crawlers) than in the first generation (61.3–64.6 crawlers). The average infestation level of walnut trees was 2.3%, reaching 2.5% in mature trees.

Natural parasitism ranged from 11.2% to 13.9%, indicating a significant role of parasitoids in regulating pest populations. The mass emergence of first-instar crawler larvae was identified as the most critical period for monitoring and timely control measures.

Overall, the results demonstrate that systematic monitoring of pest density, reproductive dynamics, natural parasitism, and crawler emergence is essential for developing an effective and environmentally sustainable integrated pest management system against *Q. perniciosus* in walnut orchards.

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