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Biological Activity of some Control Agents and *Trichogramma evanescence* on the Bioactive of *Batrachedra amydraula* M. (Batrachedridae:Lepidoptera) on Date Palms in Iraq

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Abstract. Field studies were conducted in each of the governorates of Basra, Maysan and Dhi Qar and Babylon and included a field survey for the presence of the bug *Batrachedra amydraula* and the sensitivity of some date palm cultivars to the infection of the mentioned insect and evaluating the efficiency of direct spraying of different concentrations of some control agents in reducing the rates of infection with the bug on immature fruits in date palm. Where nano silver (AgNPs), Alsystin, *Trichoderma viride*, and *Trichogramma evanescence* were used. Whereas, the treatment of the field survey in the province of Basra recorded the highest percentage of the *B.amydraula* on the date palm amounted to 53.79%. While the lowest percentage was recorded in the Dhi Qar, it amounted to 43.66%. The cultivar Al-Zuhdi also recorded the highest sensitivity to the infection of the mentioned insect by 51.29%, and the lowest sensitivity was recorded for Al-Halawi cultivar with a rate of 44.66%. Whereas nano silver were the most effective among all other factors. Where the infection of the bitch was reduced by 6.00% compared with the control treatment, which amounted to 55.03%, while the biological fungus *T.viride* had the least effect with a total infection rate of 18.40% compared with the control treatment, which gave a total infection rate of 55.03%. The interaction treatment between nano silver and the insect growth regulator cysteine also contributed to a higher reduction in the rates of total infection by an average of 5.60%, while the combination of interaction between the bio control fungus *T.viride* and the biological growth regulator Alsystin gave the least reduction in the total infection rates by an average of 29.70%. The egg parasitoid *Trichogramma evanescence* effectively contributed to reducing the infestation of the *B.amydraula* by influencing the percentage of eggs presence, where the treatment (3 capsules/palm) gave the highest reduction in the total infection rates at an average of 6.54% compared to the control treatment, which gave a total infection rate of 55.03%, While the treatment (1 capsule/palm) gave the least reduction in the total infection rates, with an average of 11.87%, compared with the control treatment, which gave 55.03% of the total infection rates.

Keywords. *Batrachedra amydraula* M., AgNPS, *Trichoderma viride*, *Trichogramma evanescence*.



1. Introduction

The date palm *Phoenix dactylifera* (Palmales:palmae) is one of the ancient fruit trees of great economic and social importance to farmers in Iraq and neighboring countries. The cultivation of palms and their various types is widespread in tropical and semi-tropical regions [1]. Iraq is one of the most important centers of date palm cultivation in the world, as the number of planted palm trees exceeded 30 million palm trees of various types of dates until 1980 when it was one of the main producers of dates in the world [2]. After that, the number of date palms declined. In 2006, it recorded about 8 million palm trees that produced 432,000 tons of dates [3]. The reason for the decline in palm numbers is a result of infection with many insect and fungal pests and others, as well as neglect, salinity, excessive cutting, and the country's political conditions [4]. Palm trees in Iraq are affected by many agricultural insect pests, fungal diseases, spiders, dust mites, and many others, causing heavy losses to palm trees and their products, as the number of their types in palm fields reaches 14 species [5]. An important pest that infects immature palm fruits is *Batrachedra amydraula* Meyrick, where the infestation begins early in the season and from the beginning of the fruit set and continues in the later stages of development of fruits. The larvae feed on most of the contents of the fruit, causing the fruits to dry out and then fall and turn dark red. Severe infestation causes a significant decrease in yield as a result of drying and dropping of a large percentage of the fruits, where the infestation rate of fruits reaches from 60-100% [6,7]. Several fields and laboratory studies were conducted in Iraq, in which various control methods were tested to limit its spread [8], and away from chemical pesticides and their harm to human health and pollution to the environment. This study was prepared to test some biological control agents to reduce their numbers below the critical economic limit.

2. Materials and Methods

2.1. Field Survey and Calculation of Infection Rate

The survey was conducted for one of the palm orchards in Basra province in the district of (Shatt Al-Arab) with an area of 10 dunums and containing more than 150 palm trees of medium length (sprouts) isolated from the rest of the orchards. For the purpose of conducting plowing, turfing, and removing palm waste. During the 2018-2019 season. The sampling method was used as in Figure (1), and the percentage of infection was calculated according to the following equation [9]:

$$\text{Infection \%} = \frac{\text{The number of infected palms}}{\text{total number}} \times 100$$

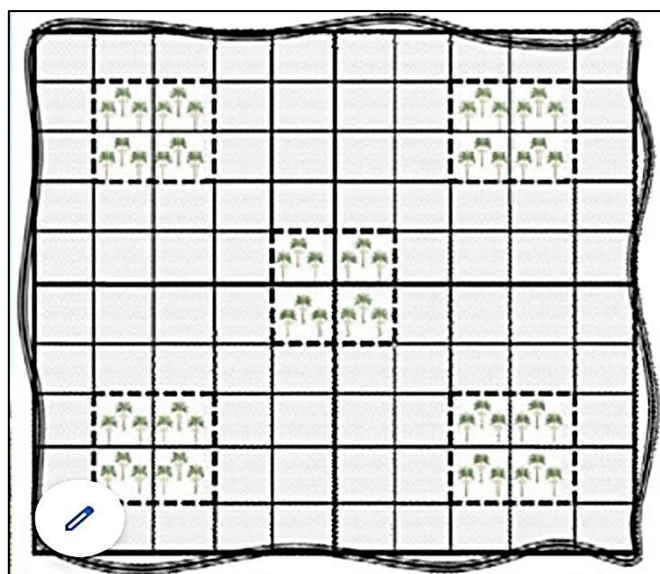


Figure 1. Represents the sampling method of *Batrachedra amydraula* Meyrick for areas of 5 - 1000 dunams [10].

2.2. Bio-Control

The control was conducted in the Jamri phase, where three treatments were selected for each control factor and three replicates for each treatment. Three palm trees were selected for each replicate and three bunches were selected from each palm. These were covered with tulle bags and a 2000ml air-pressure spraying was used. The percentage of total infection was calculated through the fruits falling in the bag and the infection in the taste, and the interaction between the control agents were used by spraying the second agent after 4-24 hours of spraying the first agent.

2.2.1. Using the Biocide of Nano Silver (AgNPs)

A box of Nano silver was obtained from Al-Bashir Chemicals Office / Bab Al-Moadham. Baghdad has a weight of 50 g and a particle size of 50 nm. The original concentration of 1000 ppm was prepared with the addition of the diffusive substance cyclic by dissolving 1 g / L, and the following dilutions were made: (200, 300, 400) ppm and kept in the refrigerator until use.

2.2.2. Alsystin Growth Regulator (ALS)

It is a concentrated suspension, a liter of which contains 480 g of the active substance Triflumerun. The following concentrations were prepared on the basis of the active substance, which are (25,50, 75) mg / L. It inhibits the synthesis of chitin and prevents the formation of the epidermis. It works by contact or through the digestive system.

2.2.3. Bio Fungi Pers *Trichoderma Viride*

The fungal isolate was obtained from the laboratories of the Agricultural Research Department in Al-Zafaraniya/Baghdad. The isolate was activated by growing it on Dextros Agar culture medium. Then the following concentrations were prepared (2×10^2 , 2×10^3 and 2×10^4) spores/ml.

2.2.4. D. *Trichogramma Evanescens*

The egg parasitoid *T.evanescens* was obtained from the laboratories of the Agricultural Research Department / Baghdad for the purpose of breeding and releasing it against the eggs of *B.amydraula* M. insect in one of the experimental orchards in the Shatt Al Arab district in Basra governorate.



Figure 2. A capsule with parasite eggs inside hanging near the taste of the palm.

2.3. Statistical Analysis

The experiment was designed according to the Random Complete Block Design (RCBD) for field experiment and according to the standard deviation between the studied parameters. The significant differences between the means of some treatments were also compared with the least significant

difference test (0.05) (Least Significant Difference - LSD) [11]. The ready-made Statistical Analysis System SPSS 22 [12], program was used in data analysis to study the effect of the studied treatments.

3. Results and Discussion

3.1. Field Survey of *B.amydraula*

Figure (3) showed that date palms were infected with *B.amydraula* in all cultivated regions and governorates at varying rates. The highest total infection was recorded in the orchards of Basra Governorate, with a rate of 53.79%. While the lowest percentage of total infection was in the orchards of Dhi Qar governorate, which amounted to 43.66%, compared with the governorates of Maysan and Babylon, where each of them gave total infection rates of (51.11 and 46.49%) respectively. This is a result of the nature of the spread and feeding of *B.amydraula* Meyrick larvae on immature fruits, where they have the ability to penetrate the immature fruit wall from the carpel area, as well as the ability to withstand or resist phenolic or spicy materials contained in immature date fruits with no other hosts for feeding. As well as the ability of adults of the insect to fly and lay its eggs on all types of palms and the number of their three interaction generations during the season of its spread, as well as the environmental conditions favorable to its activity and reproduction.

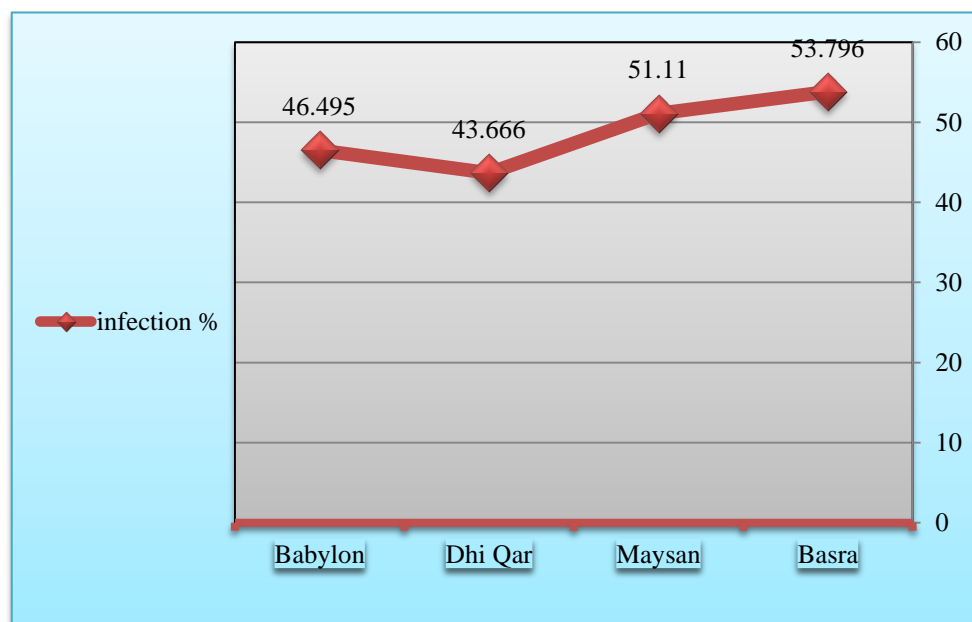


Figure 3. Percentage of total infestation of *B.amydraula* on palm orchards in pronainc central and southern Iraq.

3.2. Sensitivity of Some Palm Cultivars to *B.amydraula*

The results in Figure (4) showed the sensitivity of date palm cultivars to the infection of *B.amydraula* Meyrick insect on the immature fruits of the date palm. the cultivar Al-Zuhdi had the highest infection with *B.amydraula* Meyrick insect by 51.29%, while the lowest total infection rate recorded for the Al-Halawi cultivar was 44.66% compared to the Khastawi, Al-Sayer and Al-Barhi cultivars, which gave a total infection of (49.24, 49.66 and 46.91%), respectively. The palm fruits have an important role in feeding the larvae of the *B amydraula* Meyrick insect because they contain essential nutrients for the insect such as proteins, carbohydrates and others.

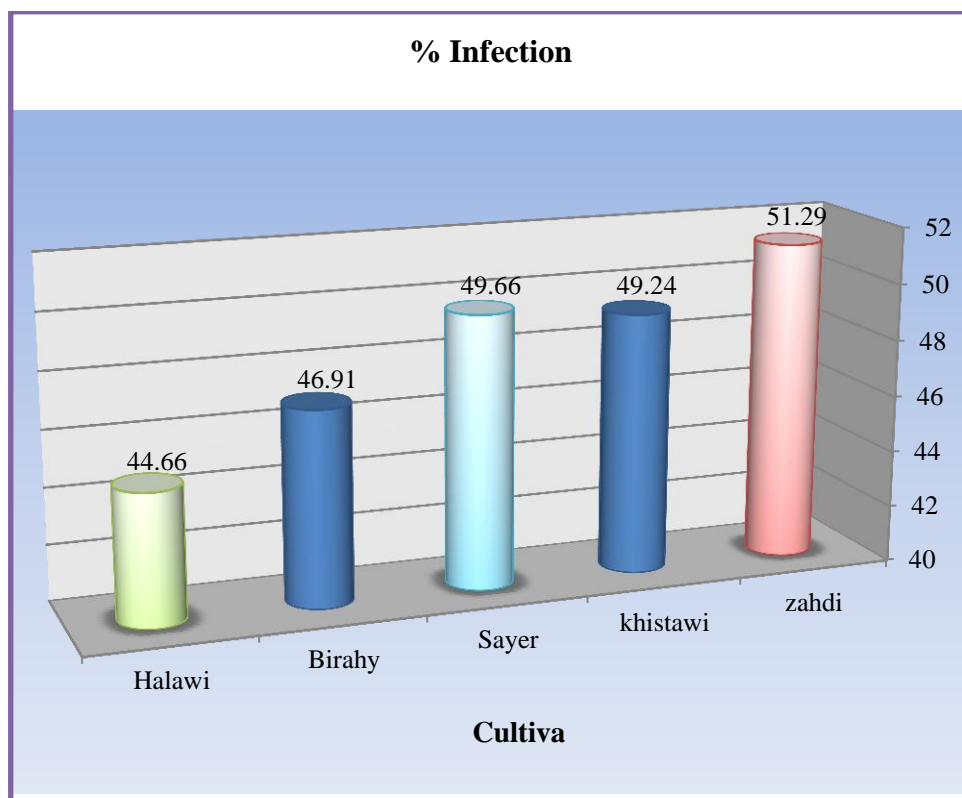


Figure 4. Sensitivity of some palm cultivars to *B. amydracula* In some governorates of central and southern Iraq.

3.3. Effect of Control Agents on the Biological Activity of *B. amydracula*

The results of Table (1) showed the contribution of the control factors to reducing the total infestation rate of the *B. amydracula* Meyrick insect on immature fruits in varying proportions. The silver nanoparticle treatment had the best effect in reducing the total infection rates of immature fruits with a total infection rate of 6.00%. Compared with the control treatment, which gave a total infection rate of 55.03%, while the bio-fungus *T. viride* had the least effect in reducing the total infection rates by an average of 18.40% compared with the control treatment, which also gave 55.03%. nano Silver have an effective role in affecting the target organisms because of their ability to penetrate the cell wall, causing cell swelling and then death. Silver nanoparticles also induce tissue changes that vary according to the concentration and duration of time, as they work to deposit the amyloid proteins inside the vessels [13]. The results of the study also agree with what was mentioned [14], that silver nanoparticles induced the highest killing rates in mealybug adults when using concentrations (4250, 510) ppm on the one hand, and on the other hand, the study agreed with what was mentioned [15], that different concentrations of silver nanoparticles showed effectiveness in reducing the level of growth of the feeding phases of the amoebae parasite, and what was mentioned [16], that silver particles Bti-AgNPs It was excelled in its ability to kill the fourth instar larvae of *Culex quinquefasciatus* say mosquitoes compared to native floating discs. The importance of growth regulators in integrated control, even if it was less efficient than nano silver in affecting the target insects, came from here. These results are consistent with what was mentioned [17], when treating the eggs of the measured worm and cotton leaf worm with the insect growth regulator ALsystemin, which led to the larvae depleted the lethal dose of the growth regulator from the eggshell treated during the hatching process. The larvae are the first to start feeding on the outer membrane of the eggshell. The results of the research also agree with what was mentioned [18], when using the suspension of the fungus *T. viride* against the nymphs and adults of the Dubas palm bug, as it achieved killing rates of 64.2% after 10 days of treatment.

Table 1. Efficacy of some control agents on the bio activity of *B.amydraula* on palm.

Transac.	Concent.	% for infection after treatment/day					% of total infected fruits falling into the bag	% of the total fruits infected in bunches	Total infection %	
		3		7						
		Infected fruits falling into the bag	Infected fruits in bunches	total infection	Infected fruits falling into the bag	Infected fruits in bunches	total infection			
Control	0.00	2.82 ± 11.20	13.4 ± 6.46	24.6 ± 2.38	15.6 ± 9.22	14.68 ± 2.10	30.37 ± 2.15	± 26.89	± 28.14	±55.03
AgNPs	400ppm	1.25 ± 4.00	1.00 ± 0.11	5.00 ± 0.44	1.00 ± 0.21	0.00 ± 0.00	1.00 ± 0.10	5.00 ± 0.48	1.00 ± 0.04	6.00 ± 0.23
Alsystin	75 mg/L	7.20 ± 0.00	1.60 ± 0.31	8.80 ± 0.18	2.40 ± 0.36	0.00 ± 0.53	2.40 ± 0.41	9.60 ± 0.29	1.60 ± 0.37	± 11.20
T.viride	2 × 10 ⁴ spore /ml	7.20 ± 1.56	3.20 ± 2.05	10.4 ± 1.65	4.80 ± 1.63	3.20 ± 1.90	8.00 ± 1.89	12.00 ± 1.81	6.40 ± 1.69	± 18.40

*Numbers represent average of three replicates + standard deviation.

3.4. The Effect of Interaction Between Control Agents on the Biological Activity of *B.amydraula*

Table (2) showed that the interaction between the control factors had a clear effect in reducing the rates of infection with the *B.amydraula* M..The combination between the growth regulator and the nano silver gave the highest reduction in the total infection rates, at an average of 5.60%, compared to the control treatment, which amounted to 55.03%. Whereas, the combination between silver nano AgNPs and *T.viride* filtrate gave a reduction in the total infection rates by an average of 12.00% compared to the control treatment, which gave the total infection rate by 55.03% as well. Whereas, the combination of *T.viride* and the insect growth regulator Al-systin decreased in the effect, which gave the least reduction in the total infection with a rate of 29.70% compared with the control treatment with an average of 55.03%.

Table 2. Effectiveness of the interaction between some control agents on the biological activity of *B.amydraula* on palm.

Transac.	Concentra.	% for infection after treatment/day					% of total infected fruits falling into the bag	% of the total fruits infected in bunches	Total infection %	
		3		7						
		Infected fruits falling into the bag	Infected fruits in bunches	total infection	Infected fruits falling into the bag	Infected fruits in bunches	total infection			
Control	0.00	11.20 ± 0.65	13.4 ± 2.28	24.66 ± 1.30	15.69 ± 2.93	14.68 ± 2.43	14.68 ± 2.43	± 26.89	28.14 ± 2.43	± 55.03
<i>T.viride</i>	10 ⁴ × 2 spore/ ml	7.20 ± 0.78	4.80 ± 0.50	12.00 ± 0.74	0.00 ± 0.00	0.00 ± 0.13	0.00 ± 0.13	7.20 ± 0.42	4.80 ± 0.14	12.00 ± 0.28
AgNPs	400Ppm	2.40 ± 2.36	2.40 ± 1.01	4.80 ± 1.99	0.00 ± 0.37	0.80 ± 0.33	0.80 ± 0.33	2.40 ± 1.53	3.20 ± 0.60	5.60 ± 1.08
Alsystin	75 mg/L	2.40 ± 16.90	2.40 ± 7.20	4.80 ± 24.10	0.00 ± 2.80	0.80 ± 2.80	0.80 ± 2.80	2.40 ± 19.70	3.20 ± 10.00	5.60 ± 29.70
<i>T.virid</i>	10 ⁴ × 2 spore/ ml	0.92 ± 1.31	0.92 ± 1.31	1.84 ± 2.62	1.84 ± 3.94	1.84 ± 3.94	1.84 ± 3.94	0.92 ± 1.31	1.84 ± 2.62	3.68 ± 5.24
Alsystin	75 mg/L	0.92 ± 1.31	0.92 ± 1.31	1.84 ± 2.62	1.84 ± 3.94	1.84 ± 3.94	1.84 ± 3.94	0.92 ± 1.31	1.84 ± 2.62	3.68 ± 5.24

*Numbers represent average of three replicates + standard deviation.

3.5. Efficacy of the Egg Parasitoid *T. evanescence* in Reducing the Presence of *B. amydracula* Eggs on Palms

The results in Table (3) showed the efficiency of the egg parasitoid *T. evanescence* in reducing the rates of infection with the *Batrachedra amydracula* Meyrick insect on date palms. The treatment (3 capsules/palm) gave the highest reduction in the infection rate, with an average of 54.6% compared to the control treatment, which gave a total infection rate. amounted to 37.93%, While the treatment (1 capsule/palm) gave the least reduction in infection rates, with an average of 11.87%. This on one hand, and on the other hand, the period of 3 days after the control had a clear effect in reducing the infection rates, which gave the highest reduction in the infection rates, with an overall rate of 10.94% compared to the duration. 7 days after the treatment, which gave a total infection rate and an overall rate of 11.63%. From here comes the role of the egg intruder in influencing the reduction of the infection of the *Batrachedra amydracula* M. bug on the date palm through the biological instinct to lay the eggs of the parasite inside the eggs of the *Batrachedra amydracula* M. bug and nesting inside them and feeding on their internal contents, which leads to the end of its role in maturation and development. The results of the research were to some extent compatible with what was reached [19], that the use of the egg parasite *T. evanescence* led to a reduction in the rates of infection with the *Batrachedra amydracula* M. insect from 7.22% to 2.00% after four years of the parasite's release. This is consistent with what was mentioned [8], that the use of the egg parasite *T. evanescens* W. reduced the overall infection rates by an average of 25.2% after two weeks of inoculation.

Table 3. The effectiveness of the egg parasitoid *T. evanescence* in reducing the rates of infection with the insect *Batrachedra amydracula* M. on palm.

Transactions capsule /palm	% for infection after treatment/day						% of total infected fruits \pm falling into the bag	% of the total \pm fruits infected in bunches	Total infection %
	3			7					
	Infected fruits falling into the bag	Infected fruits in bunches	total infection	Infected fruits falling into the bag	Infected fruits in bunches	total infection			
Control	17.43 \pm 2.19	10.56 \pm 1.92	27.99 \pm 2.10	15.69 \pm 1.92	14.68 \pm 2.09	30.37 \pm 2.04	16.25 \pm 1.95	2.13 21.69 \pm	37.94 \pm 2.08
1 capsule	4.38 \pm 0.63	3.14 \pm 0.56	7.52 \pm 0.19	4.34 \pm 0.21	2.95 \pm 0.17	7.29 \pm 0.19	7.14 \pm 0.04	4.73 \pm 0.27	11.87 \pm 0.15
2 capsules	4.63 \pm 0.45	0.96 \pm 0.13	5.59 \pm 0.16	3.13 \pm 0.36	1.98 \pm 0.23	5.11 \pm 0.30	7.37 \pm 0.79	2.56 \pm 0.04	9.93 \pm 0.27
3 capsules	2.50 \pm 0.74	1.48 \pm 2.45	3.98 \pm 0.46	1.06 \pm 2.57	0.64 \pm 2.50	1.70 \pm 0.87	3.66 \pm 1.06	2.88 \pm 0.63	6.54 \pm 0.80
Average	6.93 \pm 1.76	4.01 \pm 0.65	10.94 \pm 1.75	6.12 \pm 1.68	5.51 \pm 1.63	11.63 \pm 1.65	8.60 \pm 1.64	7.96 \pm 1.72	16.56 \pm 1.71

* Numbers represent average of three replicates + standard deviation.

Conclusion

- *B. amydracula* is found in all palm-growing areas.
- The insect *B. amydracula* infects all palm cultivars in varying ratio.
- Bio-control agent (silver AgNPs, AL-Systin insect growth regulator and bio-control fungus *T. viride*) contributed to reducing the rates of infection with *B. amydracula* below the level of economic damage.
- The egg parasitoid *Trichogramma evanescence* contributed to reducing the presence of *B. amydracula* on date palms.

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