

Using egg parasitoid *Trichogramma evanescens* and pheromone traps in date palm orchards and in date warehouses to control *ephestia* spp.

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ABSTRACT

Ephestia cautella, *Ephestia figulilella* and *Ephestia calidella* belong to *Ephestia* genus caused damages to the dates during the storage period which was for about 4-6 months before manufacturing and marketing it. The infestation with *Ephestia* spp. started in Orchards with the maturation of dates and this infestation transferred to date warehouses if no treatment applied. Therefore, this article concentrated upon releasing *Trichogramma evanescens* parasitoid in three selected Orchards, the area of each was about 10-15 dunams, these Orchards were in Alrashidia/ Baghdad, Bohruz/ Diyala and Alhur/Karbala. In each Orchard 15-18 thousands parasitoids were released /dunam twice in autumn and spring. The results illustrated that the percentage of preserving dates while it were on the palm trees were 99.6, 98.5 and 99.2% respectively in the above mentioned Orchards in comparison with 97.5, 97.2 and 98.5% respectively in the control Orchards of the same provinces. To prove that egg parasitoid used was active in controlling *Ephestia* spp. in the date warehouses too, six date warehouses were selected in the same provinces belonging to date manufacturing and marketing company, in three of them 10 tons of

dates were stored in each one, these dates were taken from the Orchards which were treated already with *T. evanescens*, while in the other three warehouses 10 tons of dates were stored too in each one but the dates were taken from the control Orchards. Then 70000 parasitoids/warehouse was released in each of the first three date warehouses, then the same numbers were released after two weeks, in each of these three warehouses in addition to nine pheromone traps for each *Ephestia* spp. hanged, while the control date warehouses left without treatment with parasitoid but pheromone traps hanged too for monitoring. The results revealed that the average percentages of disinfecting dates in the first three warehouses were 99.5, 98.6 and 98.9% respectively in comparison with 84.1, 87.7 and 90.7% respectively in the control warehouses. Furthermore, the results showed that the mean number of the three *Ephestia* spp. were 0.5, 0.3 and 0.2 insect/trap/ month in the date warehouse of Baghdad and 0.3, 0.4 and 0.2 insect/trap/month in the date warehouse of Diyala and 0.6, 0.2 and 0.1 insect/trap/month in the date warehouse of Karbala in comparison with 17.0, 13.8 and 6.0 insect/trap/month for control warehouse of Baghdad. 16.3, 8.3 and 3.0 insect/trap/month for control warehouse of Diyala and

finally 13.3, 6.0 and 2.0 insect/trap/month for control warehouse of Karbala. In Conclusion these results are encouraging and using this biological control agent with pheromone traps could be essential to control *Ephestia* spp. in Orchards and date warehouses instead of chemical insecticide and methyl bromide within IPM program.

INTRODUCTION

Iraq is the oldest countries in the world in date palm plantation . the date palm plantation recognized in Mesopotemia before four thousand years (Hussain and Esmail, 2007, Abdul – Hussain, 1985 and Al – Haidari, 1979). The importance of date palm is not as dates production only but it also important for improving environment and for protecting citrus trees from high temperature in summer and low temperature in winter in middle and south of Iraq (Hameed, 2002 and AL-Taie, 2001). Till recently Iraq was determined as the main country in producing, packaging and exporting dates internationally (AL-Anbaki, 2007). The main problem facing Iraqi dates trade is its infestation with insect pest mainly *Ephestia* spp., the infestation appeared to be started in the Orchards and transferred with dates to the date warehouses because of the suitable condition in these warehouses for their reproduction (AL-Taweel and Al-Jboory, 2007 and Hameed *et al.*, 2001) The Larvae fed inside date on the flesh which resulted in date become unsuitable for human consumption (Ahmed, 1998), previously to control insect pest in dates warehouses Methyl Bromide was used as fumigant because it was effective in killing most insect stages but this fumigant (Methyl Bromide) appeared to be ozone depleting agents (Marcotte, 1993 and Leesch *et al.*, 1992), therefore, it was prevented since 2005 in developing countries and it will be prohibited by 2015 in underdeveloping countries according to Montreal Protocol (Ross and Vail, 1993). Therefore, scientist in Iraq and other countries started to look for new technology which should be acceptable nationally and internationally for date disinfection, one of these methods is using biological control agents specifically egg parasitoid *Trichogramma evanescens* and pheromone traps for dates disinfection in Orchards to minimize the percentage of dates infestation with *Ephestia* spp. larvae and using the same biological agents and pheromone traps in dates warehouses after transferring dates from these Orchards and to keep the infestation as low as possible and the manufacturing dates accepted for human consumption.

MATERIALS AND METHODS

Mass Rearing of Egg Parasitoids *Trichogramma evanescens*.

Sitotroga cerealella and *Ephestia cautella* eggs were used as host to produce sufficient numbers of the egg parasitoid (Alrubeai *et al.*, 2005)

Effect of Releasing Egg Parasitoids and Pheromone Traps on the Percentage of Date Infestation in the Orchards.

Three Orchards, each of 10 – 15 donums were selected for this study, these Orchards were located in Alrashidia / Baghdad, Bohruz / Diyala and alhur Karbala . In each Orchard 15 – 18 thousands parasitoids were released/ donum (As pupae inside their host eggs) twice in autumn and spring because at these times *Ephestia* spp. (*E. cautella*, *E. figulilella* and *E. calidella*) found at their maximum density (Hameed *et al.*., 2011). Moreover, four pheromone traps were used / donum for each *Ephestia* spp. in the Orchards treated with the egg parasitoids while one trap was used for the control Orchards for monitoring. Furthermore, about 125-150 date fruits were collected from each date palm tree selected randomly (Fifty date palm trees) from treated and control Orchards at the time of harvesting date fruits at the beginning of November 2012 . The date fruits samples kept in polyethylene bags separately and transferred to the laboratory for inspection and the percentage of infestation with different *Ephestia* spp. stages was recorded.

C) Effect of Field Treatment (in b above) on the Percentage of Infestation of Date Fruits Stored in the Date Warehouses.

Two date warehouses each of 4 x 10 x 6 meters were prepared / each province mentioned in (b) above, in the first warehouse ten tons of dates harvested from treated Orchard in (b) above was stored while in the second warehouse ten tons of dates harvested from control Orchard in (b) above was stored . Nine pheromone traps for each *Ephestia* spp. were hanged in the first warehouse of each province while one pheromone trap was hanged in the control warehouse of each province. Furthermore, seventy thousands egg parasitoids (*T. evanescens*) were released within the first week of storing dates and after weeks from the first release another seventy thousands egg parasitoids were released too in the first date warehouse of each province . while the second date warehouse of each province left without any treatment. The experiment continued for six months starting from November / 2012 till April / 2013. Moreover, to study the efficacy of *T. evanescens* (the egg parasitoid), two hundred sterilized eggs of the host with UV were placed

in petri dish and placed in each treated date warehouse monthly, the percentage of parasitism was recorded. Finally two hundred Kilograms of dates were selected randomly from each treated warehouse for each province and packed in polyethylene bags, transferred to the laboratory for inspection. The same amount of dates also inspected from control date warehouses for the same provinces.

RESULTS AND DISCUSSION

The results of table (1) illustrated significant differences ($P < 0.05$) in the percentage of infested dates collected directly from the date palm tree of the Orchards treated with the egg parasitoids and pheromone traps in comparison with control Orchard. Furthermore, table (1) also showed that the average of infestation in the Orchard treated with the *T. evanescens* and pheromone traps in Baghdad, Diyala and Karbala provinces were 0.4, 0.2 and 0.8 % in comparison with 2.5, 2.8 and 1.5% for the control Orchard for the same provinces respectively. These results were agreed with Strong and Morrison (1980) results and Alrubeai *et al.* (2003) in their experiments in which they used egg parasitoid *T. evanescens* to control insect pest, Furthermore the average number of *E. cautella*, *E. figulilella* and *E. Calidella* captured by pheromone traps was reduced to 2.2, 1.7 and 1.2 in the treated Orchard in comparison with 37.7, 52.0 and 24.7 in the control Orchard respectively. This could be as a result of releasing egg parasitoid in the Orchards which act as an agents to reduce *Ephestia* spp. populations in the treated Orchards.

The results represented in tables 2, 3 and 4 showed also significant differences ($P < 0.05$) in the percentage of infested dates in the date warehouses treated with *T. evanescens* and pheromone traps in comparison with control date warehouses in Baghdad, Diyala and Karbala. The percentage of infested dates in the treated warehouses were 0.5, 1.4 and 1.1% in comparison with 15.9, 12.3 and 9.3% in control date warehouses respectively. These results agreed with Thrope and galen (1985) and with Grille and Basso (1995) who stated that the activity of egg parasitoids increased if the warehouses areas decreased, also they found that the temperature in warehouses was suitable for the egg parasitoid activity (21 – 25 °C) which was approximately equal to temperature in the date warehouses, these results also agreed with Ahmad and Ali (1989) who found the importance of pheromone traps in reducing *E. figulilella* population density in the field if the pheromone trap used as an agents to control this pest within Integrated Pest Control Program. Furthermore, the results of the same tables (2, 3 and 4) showed that the average number of *Ephestia* spp. (*E. cautella*, *E. figulilella* and *E. calidella*) in the treated date warehouses were 0.5, 0.3 and 0.2 insect / trap / month for Baghdad; 0.3, 0.4 and 0.2 for Diyala and 0.6, 0.2 and 0.1 for Karbala in comparison with control date

warehouses were 17.0, 13.8 and 6.0 insect / trap / month for Baghdad; 16.3, 8.3 and 3.0 insect / trap / month for Diyala and 13.3, 6.0 and 2.0 insect / trap / month for Karbala. These results are very encouraging and showed the importance of primary treatment of the Orchard with egg parasitoid and pheromone trap in reducing the infestation rate of dates and average number of insect / trap / month. On the other hand the results showed that 85% of host eggs which placed in the treated date warehouse was parasitized by the egg parasitoid *T. evanescens* which mean that the egg parasitoids were capable to find its host egg in the date warehouse and these result support the above results which showed reduction in the average number of insect captured per trap per month.

In conclusion, the results of this investigation showed the possibility to disinfect dates in the date warehouses before preparing it for manufacturing and packaging it for exportation instead of Methyl Bromide using the biological control agents and the pheromone traps.

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Tables

Table 1. Number of Date Fruits Inspected (Which Directly Collected from Date Palm Trees) from the Orchards Treated by the Parasitoid *Trichogramma evanescens*, Percentage of Infested Date and Average Number of *Ephestia* spp. captured by Pheromone Traps in the Date Orchards of Baghdad, Diyala and Kabala Provinces.

Orchard Location	Nos.of Date Fruits Inspected	%Non infested and infested Dates*		Average Nos.of <i>Ephestia</i> spp. Captured by Pheromone Traps**•		
		Infested	Non-infes ted	<i>E. cautella</i>	<i>E.figulilella</i>	<i>E.calidella</i>
Baghdad AlRashidia						
Treated	6300	0.4	99.6	3.2	2.1	1.2
Non-treated	6800	2.5	97.5	62	87	23
Diyala/Buh-ruz						
Treated	7250	0.2	99.8	1.2	1.7	1.8
Non-treated	8200	2.8	97.2	28	41	19
Karbala/Alhur						
Treated	7300	0.8	99.2	2.1	1.2	0.7
Non-treated	6900	1.5	98.5	23	28	32

Orchard Location	Nos. of Date Fruits Inspected	% Non infested and infested Dates*		Average Nos. of <i>Ephestia</i> spp. Captured by Pheromone Traps**		
		Infested	Non-infested	<i>E. cautella</i>	<i>E. figulilella</i>	<i>E. calidella</i>
Average for Treated	6950	0.5	99.5	2.2	1.7	1.2
Average for Non-treated	7300	2.3	97.7	37.7	52	24.7

- * T-test showed significant differences between infested and noninfested dates ($P < 0.05$) collected from treated Orchard and nontreated Orchard. Calculated T value=3.666 and Tabulated T value= 3.182
- ** T-test showed significant differences ($P < 0.05$) between average number of *Ephestia* spp. captured by pheromone traps in treated Orchard and nontreated Orchard with the Egg parasitoid .. Calculated T value=4.451 and Tabulated T value= 3.182.
- Four pheromone traps/donum for each *Ephestia* spp. for treated Orchard and one pheromone trap/donum for control Orchard.

Table 2: Controlling *Ephestia* spp. in Date Warehouse Using Egg Parasitoid. *T. evanescens* and Pheromone Traps in Baghdad Province / Alshaljiya .

Date of Inspection	No. of Kg. of Date Fruits Inspected		% Non infested and infested Dates •				Average No. of <i>Ephestia</i> spp. Captured by Phoromone Trap**					
			Treated warehouse		Control warehouse		Treated ** warehouse			Control*** warehouse		
	Treated warehouse	Control warehouse	Non infested	Infested	Non infested	infested	(1)	(2)	(3)	(1)	(2)	(3)
Nov./2012	200	200	99.6	0.4	97.8	2.2	0.2	0.3	0.5	4	8	4
Dec./2012	200	200	99.7	0.3	94.2	5.8	0.3	0.1	0.3	8	12	7
Jan./2013	200	200	99.3	0.7	87.5	12.5	0.5	0.3	0.2	13	14	6
Feb./2013	200	200	99.8	0.2	81.4	18.6	0.3	0.6	0.0	17	10	5
Mar./2013	200	200	99.2	0.8	73.8	26.2	0.9	0.4	0.1	28	18	8
April/2013	200	200	99.4	0.6	70.0	30.0	0.8	0.0	0.0	32	21	6
Total	1200	1200	597	3.0	504.7	95.3	3.0	1.7	1.1	102	83	36
Average	200	200	99.5	0.5	84.1	15.9	0.5	0.3	0.2	17.0	13.8	6.0

- * *Ephestia* spp. : (1) *E. cautella*; (2) *E. figulilella* and (3) *E. calidella* .
- ** Nine pheromone traps for each *Ephestia* spp. were hanged in the treated date warehouse (Mass trapping).
- *** One pheromone trap for each *Ephestia* spp. was hanged in the control date warehouse (Monitoring)
- T-test showed significant differences ($P < 0.05$) between the average percentage of infested dates in the treated date warehouse in comparison with control date warehouse, Calculated T value= 3.402, Tabulated T value = 2.441.
- T-test showed significant differences ($P < 0.05$) between the average nos. of captured *Ephestia* spp. by pheromone traps in the treated date warehouse in comparison with the Control date warehouse, Calculated T value= 12.590, Tabulated T value = 2.441.

Table 3: Controlling *Ephestia* spp. in Date Warehouse Using Egg Tarasitoid . *T. evanescens* and Pheromone Traps in Diyala Province/Buhraz.

Date of Inspection	No. of Kg. of Date Fruits Inspected		% Non infested and infested dates •				Average No. of <i>Ephestia</i> spp. Captured by Phoromone Trap*••					
			Treated warehouse		Control warehouse		Treated ** warehouse			Control*** warehouse		
	Treated warehouse	Control warehouse	Non infested	infested	Non infested	infested	(1)	(2)	(3)	(1)	(2)	(3)
Nov./2012	200	200	98.7	1.3	98.6	1.4	0.3	0.8	0.5	6	8	2
Dec./2012	200	200	97.4	2.6	93.8	6.2	0.2	0.9	0.3	10	6	5
Jan./2013	200	200	98.9	1.1	92.2	7.8	0.4	0.1	0.0	12	8	2
Feb./2013	200	200	98.8	1.2	88.3	11.7	0.5	0.1	0.0	16	6	3
Mar./2013	200	200	99.0	1.0	81.8	18.2	0.3	0.4	0.2	26	13	2
April/2013	200	200	98.9	1.1	71.5	28.5	0.2	0.1	0.0	28	9	4
Total	1200	1200	591.7	8.3	526.2	73.8	1.9	2.4	1.0	98	50	18
Average	200	200	98.6	1.4	87.7	12.3	0.3	0.4	0.2	1.3	8.3	3.0

- * *Ephestia* spp. : (1) *E. cautella*; (2) *E. figulilella* and (3) *E. calidella* .
- ** Nine pheromone traps for each *Ephestia* spp. were hanged in the treated date warehouse (Mass trapping).
- *** One pheromone trap for each *Ephestia* spp. was hanged in the control date warehouse (Monitoring)
- T-test showed significant differences ($P < 0.05$) between the average percentage of infested dates in the treated date warehouse in comparison with control date warehouse, Calculated T value= 3.402, Tabulated T value = 2.441.
- •• T-test showed significant differences ($P < 0.05$) between the average nos. of captured *Ephestia* spp. by pheromone traps in the treated date warehouse in comparison with the Control date warehouse, Calculated T value= 12.590, Tabulated T value = 2.441.

Table 4: Controlling *Ephestia* spp. in Date Warehouse Using Egg Parasitoid. *T. evanescens* and Pheromone Traps in Karbala Province/Al hur.

Date of Inspection	No. of Kg. of Date Fruits Inspected		% Non infested and infested Dates •				Average No. of <i>Ephestia</i> spp. Captured by Phoromone Trap*••					
			Treated warehouse		Control warehouse		Treated **			Control***		
	Treated warehouse	Control warehouse	Non infested	infested	Non infested	infested	(1)	(2)	(3)	(1)	(2)	(3)
Nov./2012	200	200	98.9	1.1	98.3	1.7	0.4	0.5	0.1	5	3	1
Dec./2012	200	200	98.6	1.4	96.5	3.5	1.2	0.3	0.2	6	8	2
Jan./2013	200	200	98.5	1.5	92.8	7.2	0.6	0.1	0.5	10	7	3
Feb./2013	200	200	98.8	1.2	88.2	11.8	0.7	0.0	0.0	15	8	1
Mar./2013	200	200	99.2	0.8	86.8	13.2	0.4	0.0	0.0	18	2	2
April/2013	200	200	98.5	1.5	81.8	18.2	0.2	0.0	0.0	26	8	3
Total	1200	1200	592.5	7.5	544.4	55.6	3.5	0.9	0.8	80	36	12
Average	200	200	98.9	1.1	90.7	9.3	0.6	0.2	0.1	13.3	6.0	2.0

- * *Ephestia* spp.: (1) *E. cautella*; (2) *E. figulilella* and (3) *E. calidella* .
- ** Nine pheromone traps for each *Ephestia* spp. were hanged in the treated date warehouse (Mass trapping).
- *** One pheromone trap for each *Ephestia* spp. was hanged in the control datewarehouse (Monitoring)
- T-test showed significant differences ($P < 0.05$) between the average percentage of infested dates in the treated date warehouse in comparison with control date warehouse, Calculated T value= 3.402, Tabulated T value = 2.441.
- •• T-test showed significant differences ($P < 0.05$) between the average nos. of captured *Ephestia* spp. by pheromone traps in the treated date warehouse in comparison with the Control date warehouse, Calculated T value= 12.590, Tabulated T value = 2.441.

