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POTENTIAL STUDY OF BIOLOGICAL CONTROL AGENTS AND PHEROMONE TRAPS FOR THE CONTROL OF *EPHESTIA* SPP. IN DATE WAREHOUSES OF TWO PROVINCES IN IRAQ

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A B S T R A C T

The research carried out into two date warehouses, one in Karbala province, While the other in the Babylon province which belongs to the Iraqi company for manufacturing and marketing dates. In these two date warehouses, the biological agents were released periodically in addition to hanging pheromone traps. The results revealed that the percentage of preserving date in these two date warehouses were 97.3 and 98.1 % in comparison with 90.5 and 92.5 % into the control date warehouses in which biological agents and pheromone traps did not used. Furthermore, to prove that this method for controlling *Ephestia* spp. in date warehouse was good and efficient, we examined date from another date warehouse containing about 3250 tons of date packed in polyethylene bags and treated with Methyl Bromide to protect it from *Ephestia* spp. infestation, unfortunately the percentage of preserving dates in this warehouse was only 91.7% after six months. Furthermore, our results also showed that the mean number of *Ephestia* spp. captured by pheromone traps in the date warehouse which treated with Methyl Bromide was 18 times more than that captured in the warehouses treated with biological agents mentioned above and pheromone traps in both provinces.

Keywords: *Ephestia* spp. Biological Control, Pheromone, Dismate.

INTRODUCTION

The species *Ephestia cautella* , *Ephestia figulilella* and *Ephestia calidella* belong to genus *Ephestia* are distributed worldwide , well known to most countries because its ability to damage stored dried food stuff (Lindgren,1968; Hameed *et al* ., 2004 & 2011a). In Iraq it was noticed that *E. cautella* is the main insect pest that infested dried stored dates in comparison with the two species (Khadir, 1998; Al-Taweel & Al-Jboory, 2007). If this infestation left without any treatment the dates will seriously affected and become unsuitable for human consumption (Hameed, 2002). Furthermore, the adults of *E. cautella* can be noticed either flying around in the store near the dates or rest on the store wall. Moreover, *E. cautella* females are capable to lay 250-400 eggs during its life span (Abdul Al-Hussain, 1985) .Such high fecundity is the main reason for damaging the stored dates specifically under unsuitable conditions for storage (Muhsen, 2001; Hussain & Esmail, 2007) .During storage period methyl bromide (CH_3Br) usually applied in spite of its dangerous (Ahmed, 1998), moreover *E. cautella* is capable to develop resistance to it (Abdul Al-Hussin, 1985; Ahmed, 1998) and this fumigant appeared to be carcinogenic agent to human being and environment in addition to its ability to deplete Ozone layer (Leesch *et al*., 1992; Marcot, 1993; Ross &Vail, 1993). Therefore, it will be soon or later prevented worldwide by the end of 2015 according to Montreal Protocol (Ross & Vail, 1993). For the above reasons, several authors started to look for alternative and reported the importance of using biological control

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agents for controlling insect pest that attack post-harvest products including dried dates using insect parasitoid (Scholler *et al*.,1997; Riotberg *et al*.,2007) such as egg parasitoid *Trichogramma evanescens* (Hameed *et al*., 2004; Alrubeai *et al*., 2005 & 2008) and larval parasitoid *Bracon hebetor* (Brower & Press,1990; Rawnsley,1995, Hameed *et al*., 1999,2005 & 2008; Smith,2006), while, another researcher suggested using pheromone traps or Dismate EP which resulted in reducing males either in the orchard or in the date warehouses (Ahmed,1986; Hameed *et al*., 2012). To avoid using Methyl Bromide as a fumigant agent to control *Ephestia* spp. infestation a combination of two IPM elements in particular releasing the egg parasitoid, *Trichogramma evanescens* and the larval parasitoid, *Bracon hebetor* in addition to the pheromone traps have been proposed for this research in date's stores to be the main objective.

MATERIAL AND METHODS

Preparation of Experimental Date Stores

- Two experimental date stores (5×10×3 meter) were prepared within Babylon date dates Zahdi variety of the season 2011 were stored in each store packed by plastic boxes (25×30 ×50)cm to preserve dates texture.
- Two experimental date stores with the same measurements were also prepared but within Karbala dates warehouses belong to same company and also five tons of dried dates were stored in the same way as in 1-a.
- To record the initial infestation rate of the dates by different *Ephestia* Spp. stages , used in these four stores in Babylon and Karbala provinces , two thousand date fruits were examined carefully under dissecting microscope from each date store mentions in 1-a and 1- b above. The percentages of infestation were 2.1% and 1.6% in Babylon and Karbala date fruits, respectively.

Parasitoid Rearing Methods

- Rearing the egg parasitoid *T. evanescens:* This parasitoid was mass reared using *E. cautella* eggs as a host after introducing it from Egypt during 2009 .This parasitoid killed its host at egg stage (Alrubeai *et al*., 2005 & 2008).
- Rearing the larval parasitoid *B. hebetor*: This parasitoid was mass reared using *E. cautella* last instar larvae as a host according to the method described earlier (Ahmed *et al.,* 1982; Baker & Fabric, 2000).
- For 2-a and 2-b above *E. cautella* was mass reared using artificial diet to get sufficient numbers of its eggs and last instar larvae (Al-Tai, 2001; Muhsen, 2001).
- Parasitoid Release: 8000 individuals of eggs parasitoid *T. evanescens* / month were released in one of the experimental date stores mentioned in 1-a and 1-b above for six months which means that 48000 eggs parasitoid were released in each store starting from 5/11/2010 to 5/5/2011. In addition to these numbers of eggs parasitoid, 500 individuals / month of larval parasitoid (*B. hebetor*) were also released in the same experimental dates stores for the same period which means that 3000 larval parasitoid were released too.

Pheromone Traps: The pheromone traps of the three species of *Ephestia* genus (*E. cautella*, *E. figulilella* and *E. calidella*) were imported from Russell /IPM Company/UK. The pheromone traps were distributed into the experimental dates stores mentioned in 1-a and 1-b above.

Examining Dates from Experimental and Control Date Stores: Date samples from experimental date stores and control date stores were collected periodically and examined carefully using lens and dissecting microscopes. The following data were reported for each store. Number of infested dates, Number and stages of insect found inside dates. These stages were kept in an incubator at 27± 2ºC till the adults emerged, then will be identified to species.

General Date Warehouse for Comparison: For comparison an agreement with Iraqi company for manufacture and packaging dates was made, according to this agreement we were able to use one of their date warehouse in Babylon province (123×20×11 meter), stored in it 3170 tons of dates Zahdi variety from season 2010-2011 and fumigated one time with methyl bromide during November /2011 as a general control. In this warehouse three pheromone traps of each *Ephestia* species (*E. cautella* , *E. figulilella* and *E. calidella*) were hanged on the store wall in equal distance to cover all warehouse, these pheromone traps were examined periodically to record the number of insect catch in each one.

RESULTS AND DISCUSSION

The results illustrated in Figure 1 and 2 showed that the average percentage of infested dates in the experimental date stores in Babylon and Karbala provinces in which both parasitoids (*Trichogramma evanescens* and *Bracon*

hebetor, eggs and larvae) were released and the pheromone traps hanged were 2.7% and 1.9% respectively, in comparison with control stores in both provinces where the average percentage of infested dates were 9.5% and 7.5% respectively. The reason of the reduction in the percentage of infested dates was due to the efficacy of *T. evanescens* and *B. hebetor* to parasitize it host *Ephestia* species eggs and larvae. These results were agreed with the results of Morrison & Strong (1980) and Thrope & Gelen (1985), who suggested that the efficacy of *Trichogramma* Spp. increased as the number of parasitoids released increased, the results also agreed with Al-Rubeai *et al*., (2008) investigation which resulted in reducing the percentage of cotton buds infestation with *Earias insulana* after one week from the third released of the parasitoid. Moreover, the results were in agreement with Grille & Basso (1995) and Hameed *et al*., (2004), who showed that the activity of *Trichogramma evanescens*, *T. minutum* and *T. semitumatum* reached to 80% at 20 ºC, while the threshold temperature for parasitism was 21-25ºC, such temperature more or less the same as in the date warehouses where this study was achieved. On the other hand, the reason of reducing the percentage of infestation could be as a result of efficacy of *Bracon hebetor* to parasitize last instar *Ephestia* Spp. larvae too, these results were agreed with previous studied using this parasitoid to control *Ephestia* Spp. (Brower & Press, 1990; Hameed *et al*., 2004 & 2009).

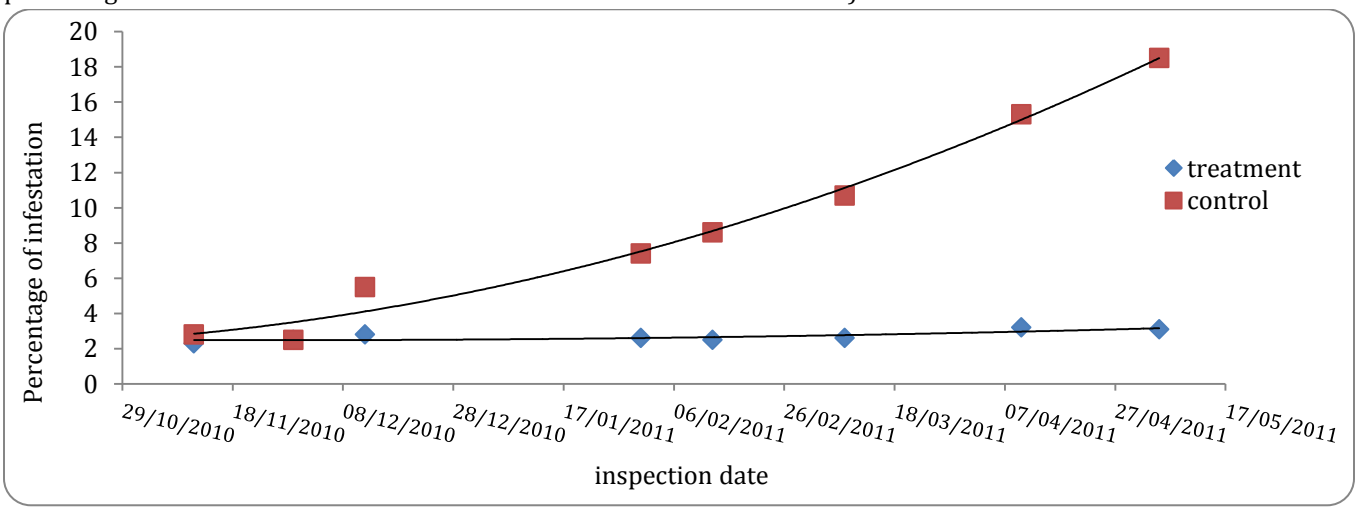

Figure 1. Efficacy of *Trichogramma evanescens*, *Bracon hebetor* and pheromone traps in controlling *Ephestia* spp. in Experimental date store in Babylon province.

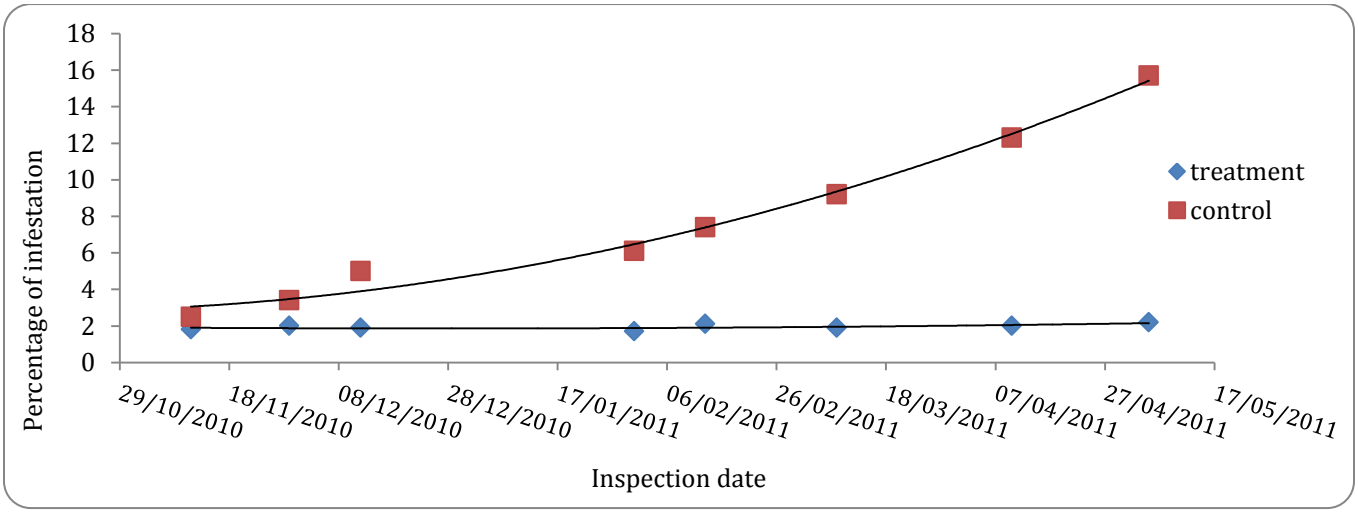

Figure 2. Efficacy of *Trichogramma evanescens*, *Bracon hebetor* and pheromone traps in controlling *Ephestia* spp. in Experimental date store in Karbalaa province.

Furthermore, the results of Figure 3. showed that Methyl Bromide is not capable to kill all stages of the three species of genus *Ephestia* after six months from fumigation with Methyl Bromide. Moreover, the results of this Figure also showed that *E. figulilella* and *E. calidella* are either highly sensitive to this fumigant in comparison with *E. cautella* or that the environmental condition in the date warehouses did not suitable for their development. This is really clear from this figure too when the average number of these two species (*E. figulilella* and *E. calidella*) captured /trap/ month were 6.0 and 0.0 respectively, in comparison with 31.0 for *E. cautella*. These results are in agreement with the results of other authors (Abdul Al- Hussain, 1985; Leesch *et al.*1992 and Khadir, 1998) who stated that the method of applying Methyl Bromide is not sufficient in killing all stages of *Ephestia* Spp. under warehouses conditions. Finally, Figure 4 illustrate the percentage of infestation of dates in the three date warehouses ((without any treatment, fumigated with Methyl Bromide for one time during the storage period and in the warehouse treated with both parasitoid (*T. evenescens* and *B. hebetor*) and the pheromone traps)). It is clearly seen from this Figure that the percentage of date infestation is gradually increased as the storage period increased in both date warehouses (the control, which left without any treatment and that fumigated with Methyl Bromide), while in the date warehouse treated with both parasitoid and pheromone traps when the percentage of date infestation kept more or less in the range of 2.3–3.1 % (in average 2.7%) for date warehouse of Babylon province and it was in range of 1.7–2.2% (in average 1.9%) for date warehouse of Karbala province. These results are in agreement with other studies (Pinneger and Chamber, 1989; Al-Taweel *et al.*, 1990a and 1990b; Brower and Press, 1990; Hameed *et al.*, 1999 and Hameed *et al.*, 2011a and 2011b) who stated in their studies the possibility of using these biological agents within IPM program with either pheromone traps or gamma radiation to keep the percentage of infestation never exceed the initial percentage which occurred in the orchard. In conclusion, it is possible to preserve dates in warehouses for a period did not exceed six months with average percentage of infestation never exceed 1.9 - 2.7%.

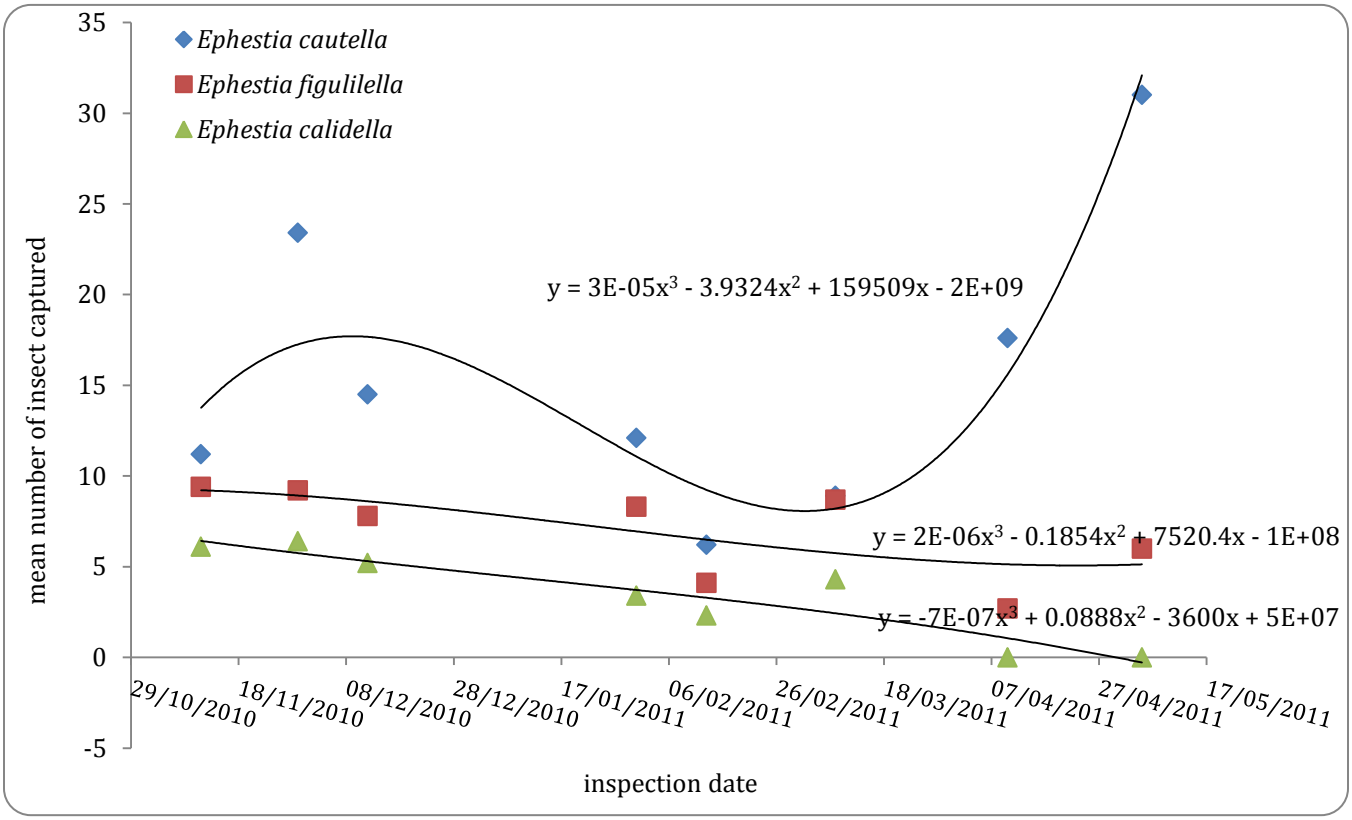

Figure 3. Mean number of *Ephestia* spp. captured in pheromone traps in date warehouse fumigated with methyl bromide for one time in Babylon province.

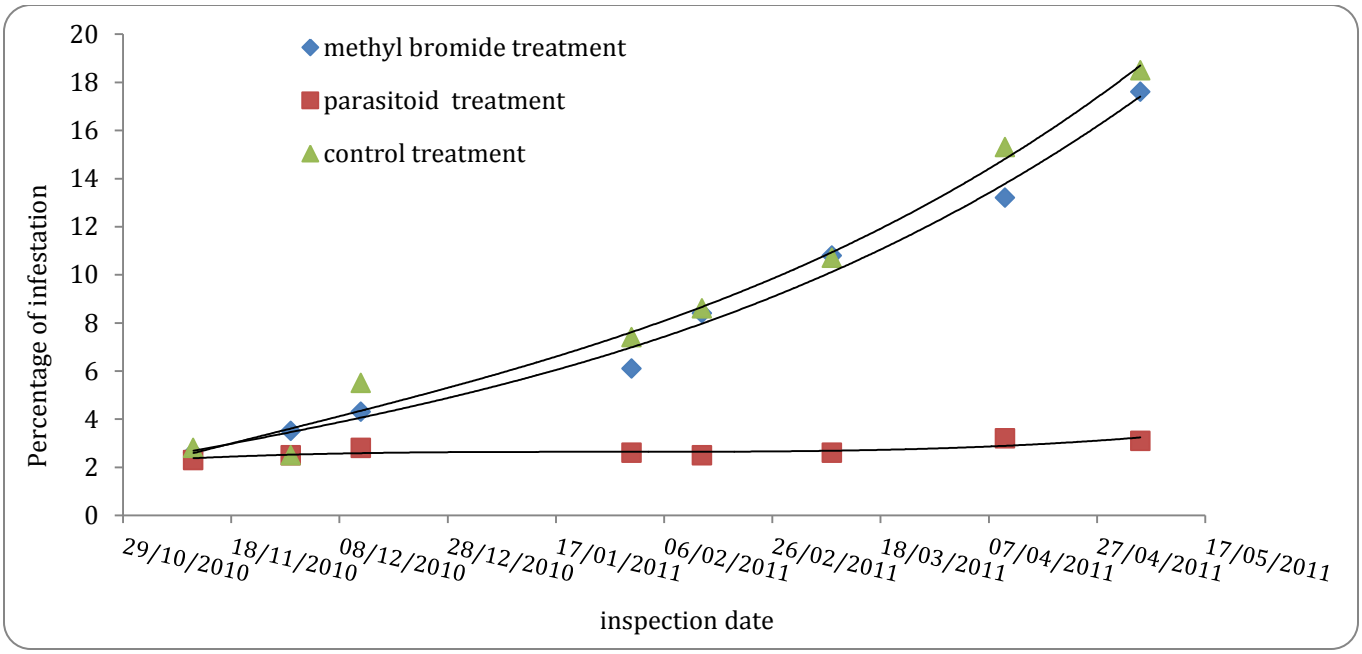

Figure 4. Comparison between different methods (methyl bromid alone, parasitoides with pheromone traps) in controlling *Ephestia* spp. in date warehouse.

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