Journal of Applied Sciences Research, 9(1): 952-959, 2013
ISSN 1819-544X
This is a refereed journal and all articles are professionally screened and reviewed

ORIGINAL ARTICLES

Control of the fruit fly, *Ceratitis capitata* (Wiedemann) and the peach fly, *Bacterocera zonata* (Saunders) (Diptera: Tephritidae) on peach and grape fruits

Hamdy E.M. Hanafy and Walaa El- Sayed

Department of Plant Protection, Faculty of Agriculture, Ain Shams University, Shoubra El-Kheima , Cairo, Egypt.

ABSTRACT

Two bait traps compared with one chemical insecticide were evaluated for their efficacy in the control of the fruit fly, *Ceratitis capitata* (Wiedemann) and the peach fly, *Bacterocera zonata* (Saunders) (Diptera: Tephritidae) on peach and grape fruits. Concerve exhibited the highest toxic effect on the mean infestation percentages of *C. capitata* and *B. zonata* at 1.2 litre / 5litre water on peach and grape fruits after the termination of the 2nd application. It reduced infestations of both fruit flies from 54% before spraying to 2.5 % on peach fruits and reduced infestations of *C. capitata* on grape fruits from 59 % to 4% after the termination of the 2nd application, followed by concentration of 1 litre / 5litre water, it reduced infestations of both fruits flies from 51.5% to 6% on peach fruits and from 54 % to 5.5% on grape fruits after the termination of the 2nd application. Bait traps treatment of Buminal mixed with Malathion showed low toxic effect on the infestation percentages of *C. capitata* and *B. zonata* after the termination of the 2nd application, it reduced the infestations of both fruit flies from 53% to 39% on peach fruits and infestations of *C. capitata* from 56% to 53.5% on grape fruits. Lambadacyhalothrin reduced infestation percentages by *C. capitata and B. zonata* from 56 % to 19.5% on peach fruits and from 52% to 19.5% on grape fruits after the termination of the 2nd application.

Key words: *Ceratitis capitata, Bacterocera zonata*, Concerve and Buminal.

Introduction

Tephritid fruit flies are among the major pests of fleshy fruits throughout the world and represent the most economically important group of polyphagous dipterous pests (Robison and Hooper, 1989). The peach fruit fly, *Bactrocera zonata* (Saunders) and Mediterranean fruit fly (MFF), *Ceratitis capitata* (Wiedemann) are the most dominant and serious pests on fruit orchards in the world. They severely attack of more than 300 host fruits species such as; guava, peach, mango, citrus, apricot, fig and apple, in addition to some vegetables such as tomato, pepper and egg-plants as secondary hosts (Kapoor and Agarwal, 1982; Liquido *et al*., 1990; White and Elson-Harris, 1992; El-Minshawy *et al.*, 1999; Hashem *et al.*, 2004; Ghanim, 2009 and El-Gendy, 2012).

The damages caused by Medfly result first from oviposition in fruits followed by larvae feeding in addition to decomposition of plant tissue by invading secondary micro-organisms. Young fruits become distorted and usually drop. The larval tunnels provide entry points for bacteria and fungi that cause the fruit to rot (Weems, 1981).

Four hundred species belonging to the genus *Bactrocera* are widely distributed in tropical regions of Asia, South Pacific and Australia, but very few species of this genus were recorded in Africa (Drew and Hancock, 1994). Although, the peach fruit fly, *B. zonata* was recorded in Egypt as early as in 1924 (Efflatoun, 1924) in 1993, it caused a major attack in Egypt attacking a wide range of fruits. Female flies lay their eggs in the fruits and the maggots devour the pulp. Subsequently, secondary infections with bacterial and fungal diseases are frequent and infested fruits drop down (White and Elson-Harris, 1994). Also, it is considered as one of the most destructive fruit pests in temperate, tropical and subtropical countries due to the losses caused by fruit larvae as they feed and live in the fruits of host plants (Joomaya & Price 2000 and Hashem *et al*., 2001).

The use of cover insecticide sprays against fruit flies is wide spread. In order to reduce the fruit flies populations to low levels, chemical control using Malathion bait sprays has been the most common method used in most countries (Rosseler *et al* ., 2000). In conventional farming, *C. capitata* is usually controlled by intensive use of pesticides or poisoned proteinic baits (Roessler, 1989). However, in recent years, researchers have searched for new and less toxic control methods due to their plant extracts and mineral products have been considered low toxicity and low environmental impact.

The aim of the present study was to evaluate the efficiency of bait traps and some chemical insecticide for the control of *C. capitata* and *B. zonata* in peach and grape fruits orchard.

Corresponding Author: Hamdy E.M. Hanafy, Department of Plant Protection, Faculty of Agriculture, Ain Shams University, Shoubra El-Kheima, Cairo, Egypt.
E-mail: drhamdy50@yahoo.com

J. Appl. Sci. Res., 9(1): 952-959, 2013

Materials and Methods

The present study was conducted at Al Khatatbah, Al-Mounifeya Governorate to evaluate two types of bait traps compared with one chemical insecticide for the control of *C. capitata and B. zonata*.

Monitoring of fruit and peach flies:

Pheromones traps from Spain Green Universe were used for monitoring *C. capitata* and *B. zonata* in peach and grape orchards (Figs. 1 and 2) by one trap / feddan. The traps were placed near the upper half of the tree. After appearance of the first fruit and peach flies in the traps, treatments of the experiment were conducted.

Fig. 1: Pheromone traps of *C. capitata* on peach trees.

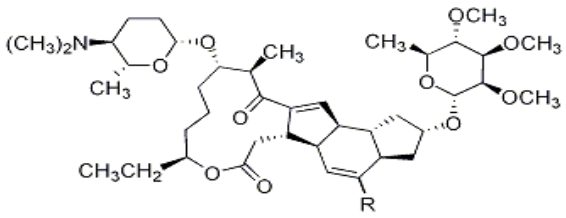
Fig. 2: Pheromone traps of *B.zonata* on peach tree.

Bait traps tested:

a- Conserve (GF-120 NF or Spinosad):

The GF-120 NF Naturalyte Fruit Fly Bait. Conserve is an organic pesticide under federal and state guideline and contains 0.020% or 200 ppm spinosad as its active ingredient.

Chemical structure:



spinosyn A, R = H-

spinosyn D, R = CH_3-

J. Appl. Sci. Res., 9(1): 952-959, 2013

Four concentrations of Conserve were used, 1 L / 5L water; 1.2 L / 5L water; 1 L / 10 L water and 1.2 L / 10 L water / feddan and conducted on third; six; nine and twelve rows, respectively. Applications were carried out by a Hydraulic Back Pack sprayer. Two sprays were conducted by use straight line on leaves of the top tree.

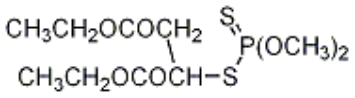
b- Buminal mixed with Malathion:

Chemical structure:

Buminal: dry matter: 56.8%; Protein: 38.69%; total Nitrogen: 6.19% and amino nitrogen: 3.35%.

One concentration of Buminal mixed with Malathion as bait traps was used and treatment was conducted on eighteen rows. Glass jar traps (12 cm in height and 8 cm in diameter) were filled by approximately 150 ml of food attractant per trap, which were hanged at a level of 2 meters height in a shadow place of the trees (Fig. 3). The distance between two adjacent traps was 8 meters. Treatment was replicated four times and each replicate contain ten traps, which were changed every 7days.

II-Malathion:



Rate of application:

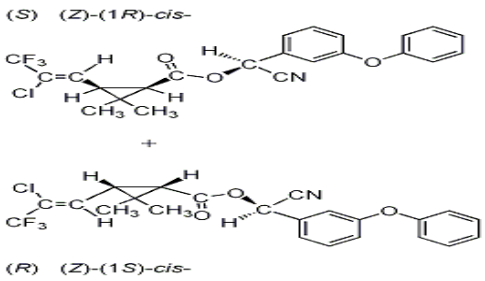
2.4litre of Buminal mixed with 0.6 litre of Malathionl / feddan.

Fig. 3: Bait traps of Buminal mixed with Malathion hanged on peach tree.

Chemical insecticide:

Lambdacyahlothrin

Chemical structure:



Rate of application:

720 ml/ feddan

J. Appl. Sci. Res., 9(1): 952-959, 2013

One concentration of Lambdacyahlothrin was used and application was conducted on fifteen rows. Treatment was replicated four times and each replicate comprised ten trees. Application was carried out by a Hydraulic Back Pack sprayer and two applications were conducted.

Field experiments:

The experiments were conducted on peach trees of 5 year old variety Early Sweeling and a 3 year old grape orchards variety Early Sweet each comprising 5 feddan. Peach or grape orchards were divided into 25 rows and each row comprised 80 – 100 trees. For each of the three control measures two applications were carried out at a biweekly interval. After 7 days following application, all peach fruits falling under the trees were collected and infestation percentages by either *C. capitata* and/or *B. zonata* were calculated. Furthermore, percentage infestation by *C. capitata* and *B. zonata* in peach fruits on the trees was also determined by randomly picking 20 fruits and examining them for infestation and percentage infestation determined. Similarly, in the grape orchard after 7 days following the 1st and the 2nd applications, 100 grape clusters were examined for each treatment to calculate the infestation percentages by *C. capitata*. Each treatment was replicated four times and each replicate contain ten trees.

Results:

1. Infestation percentages by C. capitata and B. zonata in Peach fruits:

1.1. Dropped peach fruits under the trees:

At the initiation of the experiment, in the control treatment before spraying, infestation percentage by *Ceratitis capitata* and *Bacterocera zonata* in peach fruits dropping under the trees was 67.3 & 15.4%, respectively. This percentage increased to 76.4 & 20% at the termination of the experiment, respectively (Table 1).

Mean reduction in infestation percentage by *C. capitata* was 12.1, 15.8, 17.9 and 22.6 % after 7 days following the 1st application of Conserve at concentrations of 1.2 litre /5litre water , 1.2 litre /10 litre water, 1 litre /5litre water and 1 litre /10 litre water, respectively. Meanwhile, percentage reduction of *B. zonata* infestation was 3.1, 3.6, 6.5 and 10.5 % after 7 days of the 1st application of Conserve at concentrations of 1.2 litre /5litre water , 1 litre /5litre water, 1 litre /10 litre water and1.2 litre /10 litre water, respectively. After 7 days of the 2nd application with Conserve, mean reduction by *C. capitata* infestation percentage was 9.1, 13.3, 14.3 and 14.7% at the concentrations 1.2 litre /5litre water, 1 litre /5litre water, 1 litre /10 litre water and 1.2 litre /10 litre water, respectively. Mean reduction in infestation percentage of *B. zonata* after 7 days following the 2nd application was 0, 0, 3.7 and 8.8 % at the respective mentioned concentrations, respectively.

Mean infestation percentage by *C. capitata* following 7 days of the 1st application of Lambadacyhalothrin and Buminal mixed with Malathions bait traps was 25 and 33.3 %, respectively. Meanwhile, infestation percentage by *B. zonata* at the similar period was a low of 8.3 and 12.1%, respectively. Subsequently, after 7 days following the 2nd applications of Lambadacyhalothrin and Buminal mixed with Malathion bait traps infestation percentages of *C. capitata* and *B. zonata* were 20 & 40.9% and 5 & 13.6%, respectively (Table 1). Concerve exhibited the highest toxic effect on the total infestation percentages of *C. capitata* and *B. zonata* at 1.2 litre / 5 litre water after 7 days of 1st and 2nd applications (15.2 and 9.1%, respectively) followed by concentration of 1 litre / 5litre water (21.5 and 13.3%, respectively). Meanwhile bait traps treatment of Buminal mixed with Malathion showed low toxic effect on the total infestation percentages of *C. capitata* and *B. zonata* after 1st and 2nd applications (45.4 and 54.5%, respectively) compared with the other treatments (Table 1).

Table 1: Infestation percentages of the fruit fly, *Ceratitis capitata* and the peach fly, *Bacterocera zonata* on peach fruits falling under the trees.

Treatments/ feddan	Infestation percentages after treatment								
	Pre-treatment			1st spraying			2nd spraying		
	Fruit fly	Peach fly	Total	Fruit fly	Peach fly	Total	Fruit fly	Peach fly	Total
Conserve (1.2 litre/5 litre water)	66	10	76	12.1	3.1	15.2	9.1	0	9.1
Conserve (litre/ 5 litre water)	69	14.3	83.3	17.9	3.6	21.5	13.3	0	13.3
Conserve (litre/ 10 litre water)	63.6	12.7	76.3	22.6	6.5	29.1	14.3	3.7	18
Conserve (1.2 litre/ 10 litre water)	68.3	13.3	81.6	15.8	10.5	26.3	14.7	8.8	23.5
Lambadacyhalothrin (720 ml)	64	12	76	25	8.3	33.3	20	5	25
Buminal mixed with Malathion (2.4 litre + 0.6 litre)	64.3	12.5	76.8	33.3	12.1	45.4	40.9	13.6	54.5
Control	67.3	15.4	82.7	74.1	18.5	92.6	76.4	20	96.4
F value interactions				22.7			24.2		

J. Appl. Sci. Res., 9(1): 952-959, 2013

1.2. Infestation percentages in peach fruits on the trees:

As seen in Table 2, in control plots at the initiation of the experiment before spraying, the mean of infestation percentages by *C. capitata* and *B. zonata* on peach fruits on the trees (Figs.4 and 5) were 43 and 12%, respectively. Infestation percentage gradually, increased to 57.5 and 30% at the termination of the experiment (Table, 2).

Fig. 4: Infestation of *C. capitata* on peach fruits.

Fig. 5: Mucilaginous secretion resulting from injury of *B. zonata* on peach fruits.

There was a marked gradual decrease in infestation by *C. capitata* and/or *B. zonata* on peach fruits following treatments, this effect was most evident in the plots receiving Conserve, (this effect was concentration dependant), followed by Lambadacyhalothrin. The least control measure was exhibited by bait trap of Buminal mixed with Malathion.

Spraying Conserve at 1.2 litre/ 5 litre water reduced *C. capitata* and *B. zonata* infestation from 44 and 10% at the initiation of the experiment to 7 and 1.5%, respectively after 7 days following the 1st application and 2.5 & 0% after 7 days of the 2nd application. The lower concentration of Conserve at 1.2 litre or 1 litre / 10 litre water decrease infestation by *C. capitata* and *B. zonata* to 13.5 & 4% and 17.5 & 5% infestation after 7 days from the initiation of the 1st application, respectively. This percentage was further reduced to 11.5 & 5% and 12.5 & 6% at the termination of the experiment, respectively (Table, 2). Concerve applied at1.2 litre / 5litre was led the highest toxic effect on *C. capitata* and *B. zonata* as it caused a reduction in total infestations from 54 % to 8.5 and 2.5%, respectively. Furthermore concentration at a 1 litre / 5litre water, reduced the total infestations of the respective mentioned insects from 51.5 % to 12.5 and 6%, respectively following two biweekly.

In comparison bait traps treatment of Buminal mixed with Malathion after two applications showed a low toxic effect on the total infestation percentages of *C. capitata* and *B. zonata* from 53% to 37.5 and 39%, respectively (Table , 2).

Lambadacyhalothrin reduced infestation percentage by *C. capitata and B. zonata* from 46 & 10 % before application to 18 & 8 % after 7 days following the 1st application and to 15.5 & 4 % after 7 days of the 2nd application, respectively.

Table (2): Infestation percentages of the fruit fly, *Ceratitis capitata* and the peach fly, *Bacterocera zonata* on peach fruits on the trees.

Treatments/ feddan	Infestation percentages after treatment								
	Pre-treatment			1st spraying			2nd spraying		
	Fruit fly	Peach fly	Total	Fruit fly	Peach fly	Total	Fruit fly	Peach fly	Total
Conserve (1.2 litre/5 litre water)	44	10	54	7	1.5	8.5	2.5	0	2.5
Conserve (litre/ 5 litre water)	42.5	9	51.5	10	2.5	12.5	5	1	6
Conserve (1.2litre/ 10 litre water)	45	11	56	13.5	4	17.5	11.5	5	16.5
Conserve (litre/ 10 litre water)	43	9	52	17.5	5	22.5	12.5	6	18.5
Lambadacyhalothrin (720 ml)	46	10	56	18	8	26	15.5	4	19.5
Buminal mixed with Malathion (2.4 litre + 0.6 litre)	42	11	53	27.5	10	37.5	26.5	12.5	39
Control	43	12	55	55	11	66	57.5	30	87.5
F value interactions				15.5			18.3		

2. Infestation percentages of C. capitata on grape fruits on the trees:

As seen in Table 3, at the initiation of the experiment, the infestation percentages of *C. capitata* on grape fruits on the trees (Fig.6) was 53 % in the control plots before application. This percentage gradually increased to 81 % at the termination of the experiment.

Fig. 6: Infestation of *C. capitata* on grape fruits.

Application of Concerve at 1.2 litre/ 5litre water reduced the infestation percentages of *C. capitata* from 59% at the initiation of the experiment to 7 and 9% after 7 and 14 days, respectively following the 1st application and 3 & 5% after 7 and 14 days from the initiation of the 2nd application, respectively. Conserve at 1 litre/5litre water reduced infestation percentages from 54% to 9 & 11% after 7 and 14 days of the 1st application and 4 & 7% after 7 and 14 days of the 2nd application, respectively. The lower concentrations of Conserve at 1.2 litre or 1 litre / 10 litre water also caused a marked decrease in infestation percentages in a range of 8.5- 10.5% following 2 applications compared with 78% infestation percentage of *C. capitata* in control plots (Table, 3).

Lambadacyhalothrin reduced *C. capitata* infestation from 52% to 22 and 30 % after 7 and 14 days following 1st application and 18 & 21 % after 7 and 14 days of the 2nd application, respectively.

Buminal bait traps exhibited a relative very low effect in reducing infestation by *C. capitata* on grape fruits, as infestation percentages were only reduced to between 42 and 48% following the 1st application and 52 and 55% after the 2nd application, respectively.

Table 3: Infestation percentages of the fruit fly, *Ceratitis capitata* on the grape fruits.

Treatments/ feddan	Infestation percentages after treatment						
	Pre-treatment	1st spraying			2nd spraying		
		7 days	14 days	Mean±Sd	7 days	14 days	Mean±Sd
Conserve (1.2 litre/5 litre water)	59	7	9	8±1.4	3	5	4±1.1
Conserve (litre/ 5 litre water)	54	9	11	10±1.6	4	7	5.5±1.3
Conserve (1.2 / 10 litre water)	57	12	15	13.5±1.9	7	10	8.5±1.0
Conserve (litre/ 10 litre water)	58	14	16	15±2.2	9	12	10.5±1.1
Lambadacyhalothrin (720 ml)	52	22	30	26±3.3	18	21	19.5±2.2
Buminal mixed with Malathion (2.4 litre + 0.6 litre)	56	42	48	45±2.9	52	55	53.5±3.6
Control	53	61	65	63±4.4	75	81	78±3.1
F value interactions		20.8			23.1		

Discussion:

In the experiments of the present work, Conserve (Spinosad) proved to be the most effective insecticide at all considered concentrations in reducing infestation of peach and grape fruits by *C. capitata* and *B. zonata*. Results show a significant difference in infestation percentages of *C. capitata* and *B. zonata* as affected by the different control treatments under field conditions. The differences can be attributed to different modes of action of the products and also the number of sprays .The mode of action of Spinosad was activated the nicotinic acetylcholine receptor, but at a site distinct from that of nicotine or the neonicotinoids. Conserve (Spinosad) is a low toxicity to mammals and other non-target organisms.

The second effective insecticide was Lambadacyhalothrin, this chemical is Pyrethroid, non-systemic insecticide with contact and stomach action and gives rapid knockdown and long residual. However, reduction by this insecticide was relatively comparable to both *C. capitata* and *B. zonata*. Mosleh, *et al*. (2011), found that Diazinon was the most toxic followed by Malathion, Lufenuron and Methoxyfenozide to *Bactrocera zonata* at 24 h post treatment. At 48 h post treatment Diazinon was the most toxic followed by Malathion, Methoxyfenozide and Lufenuron to *Bactrocera zonata*. At 72 h post treatment Diazinon was the most toxic followed by Malathion, Lufenuron and Methoxyfenozide to *Bactrocera zonata.* Gabriella,*et al*. (2011) tested The effectiveness of processed kaolin (Surround WP) for control of *C. capitata* damage in field trials on two early ripening citrus species. The percentage of damaged fruit varied greatly from almost 0% to more than 60% .Nevertheless, the application of processed kaolin significantly reduced damage caused by *C. capitata* on both citrus species on preharvest fruit on some dates and on harvested fruits in both years.

The least effective method for reducing infestation of two considered fruits,*C.capitata* and *B. zonata* , was the Buminal bait traps. Buminal bait traps are a hydrolyzate of raw plant material. It attracts fruit fly and peach fly; this action is due mainly to its content of protein and the well- balanced quantitative ratio of amino acides. Malathion is Cholinesterase inhibitor; proinsecticide, activated by metabolic oxidative stomach, and respiratory action. Results show that this method was ineffective traps. However, this bait and other similar baits (e.g. lufenuron bait; lure Tri-pack®; Cera Trap bait and Ferag CC D TM) were very effective in the control of *C. capitata* on several citrus trees. It was reported by Bachrouch, *et al*.(2008) Mediouni, *et al*. (2010) ; El-Gendy (2012) and Martinez-Ferrer, *et al*., (2012).

References

Bachrouch, O., B.J. Mediouni, J.E. Alimi, S. Skillman, T. Kabadou and E. Kerber, 2008. Efficacy of the Lufenuron Bait Station Technique to Control Mediterranean Fruit Fly (Medfly) *Ceratitis capitata* in Citrus Orchards in Northern Tunisia. Tunisian Journal of Plant Protection, 3: 35-45.

Drew, R.A.I. and D.L. Hancock, 1994. The *Bactrocera dorsalis*, complexes of fruit flies (Diptera: Dacinae) in Asia. Bulletin of Entomology Research, 2: 1- 68.

Efflatoun, H.C., 1924. A Monograph of Egyptian Diptera. Part II, Family Trypaneidae. Mémoires de la société entomologique de l'Egypte. Fortin Masson & Ci, Paris.

El-Gendy, I.R., 2012. Evaluating Attractency of Some Protein Derivatives for the Mediterranean Fruit Fly, *Ceratitis capitata* (Wiedmann) and the Peach Fruit Fly, *Bactrocera zonata* (Saunders).International Journal of Agricultural Research, 7(4):185-194.

El-Minshawy, A.M., M.A. El-Eryan and A.I. Awad, 1999. Biological and morphological studies on the guava fruit fly, *Bactrocera zonata* Saunders) (Diptera: Tephritidae) found recently in Egypt. 8th Nat. Conf. Pests & Dis. of Veg. & Fruits in Ismailia, Egypt, 71-82.

Gabriella, V., V. Caleca and V. Verde, 2011. The use of kaolin to control Ceratitis capitata in organic citrus groves. Bulletin of Insectology, 64(1): 127-134.

Ghanim, N.M., 2009. Studies on the peach fruit fly, *Bactrocera zonata* (Saunders) (Tephritidae, Diptera). Ph. D. Thesis, Fac. Agric. Mansoura Univ.

Hashem, A.G., M.F. El-Wakad and N.A. Soliman, 2004. The fruit flies. Egyptian Agric. Ministry, The Agricultural Guidance Division, 859: 1-35.

Hashem, A.G., S.M.A. Mohamed and M.F. EI-Wakkad, 2001. Diversity and abundance of Mediterranean and peach fruit flies (Diptera: Tephritidae) in different horticultural orchards. Egyptian Journal of Applied Science, 16: 303-314.

Joomaye, A. and N.S. Price, 2000. Pest risk analysis and quarantine of fruit flies. In: Proceedings of the Indian Ocean Commission Regional Fruit Fly Symposium, June 5-9, 2000, Mauritius: 3-16.

Kapoor, V.C. and M.L. Agarwal, 1982. Fruit flies and their increasing host plants in India. Proc. CEC/IOBC Intern. Symp. Athens/Greece,16-19, pp: 252-257.

Liquido, N.J., R.T. Cunningham and S. Nakagawa, 1990. Host plants of Mediterranean fruit fly (Diptera: Tephritidae) on the Island of Hawaii (1949-1985 Survey). Journal of Economic Entomology, 83: 1863-1878.

Martinez-Ferrer, M.T., J.M. Campos and J.M. Fiblo, 2012. Field efficacy of *Ceratitis capitata* (Diptera: Tephritidae) mass trapping technique on clementine groves in Spain. Journal of Applied Entomology, 136(3): 181-190.

Mediouni, J.B.J., O. Bachrouch, E. Allimi and M.H. Dhouibi, 2010. Field evaluation of Mediterranean fruit fly mass trapping with Tripack® as alternative to malathion bait-spraying in citrus orchards. Spanish Journal of Agricultural Research, 8(2): 400-408.

Mosleh, Y.Y., S.F.M. Moussa, L.H.Y. Mohamed, 2011. Comparative toxicity of certain pesticides to peach fruit fly, *Bactrocera zonata* Saunders (Diptera: Tephritidae) under laboratory conditions. Plant Protect. Sci., 47: 115-120.

Robison, A. and G. Hooper, 1989. Fruit Flies, their Biology, Natural Enemies and Control. World Crop Pests. Elsevier, Amsterdam.

Roessler, Y., 1989. Insecticidal bait and cover sprays, pp: 329-336. In: Fruit flies: their biology, natural enemies and control (Robinson, A. S. and Hooper, G., Eds). Elsevier, Amsterdam, the Netherlands.

Rosseler, Y., E. Ravins and P.J.G. Gomes, 2000. Sterile insect technique (SIT) in the near east, a transboundary bridge for development and peace. Crop Protection, 19: 733-738.

Weems, H.V.J., 1981. Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae). Entomology Circular No 230. Florida Department of Agriculture & Consumer Services. Division of Plant Industry, Florida, USA., pp: 12.

White, I.M. and M.M. Elson-Harris, 1992. Fruit Flies of Economic Significance: Their Identification and Bionomics. Cab International, Wallingford. UK., pp: 601.

White, I.M. and M.M. Elson-Harris, 1994. Fruit Flies of Economic Significant; their Identification and Bionomics. CAB International and Aciar., Wallingford.