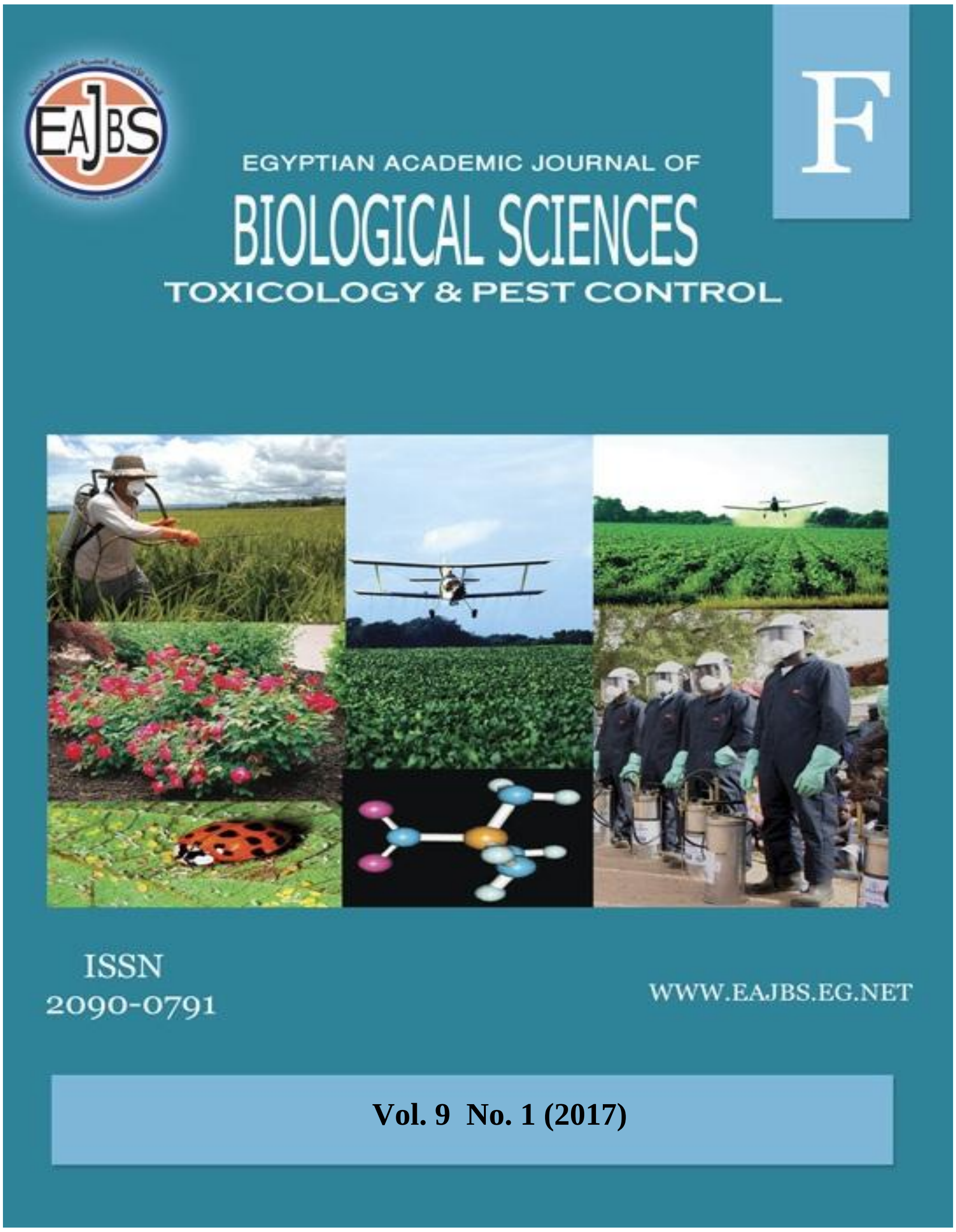


The journal of Toxicology and pest control is one of the series issued twice by the Egyptian Academic Journal of Biological Sciences, and is devoted to publication of original papers related to the interaction between insects and their environment.

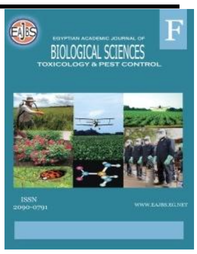
The goal of the journal is to advance the scientific understanding of mechanisms of toxicity. Emphasis will be placed on toxic effects observed at relevant exposures, which have direct impact on safety evaluation and risk assessment. The journal therefore welcomes papers on biology ranging from molecular and cell biology, biochemistry and physiology to ecology and environment, also systematics, microbiology, toxicology, hydrobiology, radiobiology and biotechnology.

www.eajbs.eg.net

Citation : *Egypt. Acad. J. Biolog. Sci. (F. Toxicology & Pest control) Vol.9(1)pp.59-72(2017)*

Egypt. Acad. J. Biolog. Sci., 9(1): 59-72(2017)

Egyptian Academic Journal of Biological Sciences
F. Toxicology & Pest control
ISSN: 2090 - 0791
www.eajbs.eg.net



Integrated Control of Some Pests Infesting Pomegranate Trees in Northern Western coast.

Ali, E. A.
Plant Protection Department, Desert Research Center, Cairo, Egypt

ARTICLE INFO

Article History
Received:25/1/2017
Accepted:10/3/2017

Key words:
Lymphoma
Jurkat cell line
Curcumin
Ceramide
Apoptosis

ABSTRACT

The pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) is an important pest in pomegranate field conditions in Egypt. The study was conducted during 2014 to 2015. Data revealed that the most effective treatment for suppressing pomegranate butterfly was Lambda as chemical insecticides followed by DiPel 2X and Tracer as bioinsecticides then bagging fruits method with reduction percentage 88.5, 59.1, 45.3 and 36.8 %, respectively for infested fruits. Data showed that the mixture of Super Nano with diatom (100%) and Super Nano with diatom (75%) caused a maximum reduction in pomegranate fruit infestation caused by *V. livia* compared to control treatment which gave reduction percentage 74.4 & 69.5 % for infested fruits. Super Nano treatment that was used only without any mixtures by diatom was the third treatment, which caused a significant reduction of the infestation which were 64.6, respectively for infested fruits of pomegranate butter fly followed by mixture Super Nano with Diatom 50 % and Super Nano with diatom 25% that gave reduction percentage 59.8 & 51.2% for infested fruits. The data clearly showed a potential effect for the mixture between diatoms 1% with Super Nano 100% followed by diatom 1% with Super Nano in different rates 75%, 50%, 25% and diatom without any mixture compared with the control treatment for infested fruits of pomegranate butterfly. Their reduction percentages were 74.9, 70.2, 66.3, 59.8 and 59.0, respectively for infested fruits of pomegranate butter fly. Data of the interaction between natural products (Super Nano & diatoms) and some rates of recommended dose (100, 75, 50 & 25 %) of Lambda insecticide were observed in plants treated by Super Nano with Lambda 100 % of recommended dose followed by diatom with Lambda 100 % of recommended dose, Super Nano with Lambda 75%, Lambda 100% (without kaolin & diatom), Super Nano with Lambda 50%, diatom with 75% lambda compared with the control treatment. The infestation level of pomegranate butterfly were reduced to 97.0, 91.3 , 84.3 and 73.7 for mixing of Super Nano with lambda rates (100, 75, 50 & 25 %) and (94.6, 82.0, 72.2 & 63.3) for diatom with lambda rates (100, 75, 50 & 25 %). The lowest effects were Lambda 25 & 50 % (without kaolin & diatom) and reduced the level of infestation to 27.2 and 37.8.

INTRODUCTION

The pomegranate (*Punica granatum* L.) crop is one of the most important crops in Egypt, constituting the main income of the farmers. Pomegranate is one of the oldest known cultivated plants, known to be native to central Asia (Kahramanoglu and Usanmaz 2013).

Pomegranate fruit has been traditionally known to beneficial to human health, confirmed by recent scientific findings (Haidari *et al*., 2009) which reported that pomegranate is a good source of antioxidants, vitamins, potassium, calcium, magnesium, iron and zinc. One of the most important problems causing yield and quality reduction in pomegranates is pests. The pomegranate trees are attacked by several insect species, which decrease the quality and quantity of its product. Pests negatively affect pomegranate production, but marketing quality of pomegranate fruits is mainly affected by Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) (Holland *et al*., 2009) and pomegranate butterfly, *Deudorix* (*Virachola*) *livia* (Klug) (Lepidoptera: Lycaenidae) (Awadallah *et al*., 1971; Holland *et al*., 2009). The pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) is the most important insect pest attacking pomegranate fruits and date palm in Egypt (Sayed & Temarek, 2007 and Abd-Ella 2015). The pomegranate butterfly is widely distributed throughout the Arabian Peninsula reaching the Mediterranean Coast in Egypt, Israel, Lebanon and Syria and Recently in Europe. (Mkaquar and Ben Jamaa 2016). The pomegranate butterfly penetrates the fruit in early stages of fruit development and causes arils rot (Awadallah *et al*. 1971; Wisam and Mazen 2002). Morton (1987) indicated that the moth lays eggs on the flower-buds and the calyx of developing fruits and they may cause loss of an entire crop unless the flowers are sprayed 2 times 30 days apart. Current management programs depend on chemical, biological insecticides and several good agricultural practices as well as beneficial insects (Sayed & Temarek, 2007 and Sharma, 2009). Chemical insecticides have been extensively used in horticultural crop production to control certain pests such as arthropods and mites. Although these chemical insecticides generally belong to different types of chemical compounds, there is still a need for an affective safe alternative demonstrated as not harmful to mammals, birds, fish, beneficial arthropods and environment. (Ali 2016). These new regulations have reduced the number of synthetic pesticides available in agriculture (Franck *et al*., 2009). One of the most important factors in leading to some insects becoming pests is their ability to evolve resistance to insecticides (Parrella and Keil, 1984). So, It is important to use natural products for controlling insect pests to avoid resistance of insect to insecticides as kaolin, diatoms, *Bacillus thuringiensis* (Bt) and actynomycites (spinosad) which are a potential alternative pest management product with improved safety and reduced environmental impact. Natural products for pest control have been used to control pests since the early beginning of agriculture circa 8000 B.C. to repel or kill biting arthropods. Throughout the years, natural products have played a direct role in controlling insects, plant pathogens and nematodes in the field, or indirectly as leads for development modern pesticides through chemical syntheses (Koivunen *et al*., 2013).

Kaolin is non-insecticidal hydrophobic mineral particle film that acts as a physical barrier protecting plants against certain insects and diseases. Kaolin particle film is frequently used to suppress or control arthropods and disease pests in many agricultural crops (Showler 2002; Gharbi and Ben Abdallah 2016). Kaolin is a white, fine-grained aluminosilicate mineral [Al4Si4O10 (OH) and has the environmental advantage of being an inert product and non-toxic to vertebrates (González-Núñez *et al*., 2008). It can easily be removed from harvested commodities.

On plants coated with hydrophobic particle films, repellence, ovipositional deterrence, and reduced survival of insects were observed (Glenn *et al*., 1999; Glenn and Puterka, 2005). The powdery film formed by Kaolin on plants may prevent insects from identifying a host crop and consequently insects do not land, feed or lay eggs on the host crop. The coating may also cause insects to deem the fruit or leaves unsuitable (Rouini (2008) and Ali (2016)). Diatomaceous earth (DE) is powdered remains of fossilized diatoms and has extremely small but sharp protrusions that severely injure insects when they crawl over it (Sarwar 2016). It absorbs and removes the protective waxy covering of insects that are exposed to it. This covering protects insects from water loss so they dehydrate when the protective layer is removed. The abrasiveness of DE elevates the mode of action by injuring the insect body with sharp edges of the diatom remains, causing further exposure to desiccation. The advantages of using DE over conventional insecticides are safety to pets and humans and proven effectiveness notwithstanding insecticide resistance. (Tsang 2016).

Microbial insecticides *Bacillus thuringiensis* (Bt) formulations are primarily applied to control lepidopteran pests on fruit and vegetable crops and to control dipteran pests (mosquitoes and blackflies) that bite humans. A highly selective insecticide with activity conferred primarily by insecticidal crystal proteins (ICPs), Bt is generally not harmful to action make it an important alternative to conventional chemical insecticides, and many integrated pest management (IPM) programs for particular fruit and vegetable crops as well as certified organic production include the use of Bt. (Walkeer *et al*., 2008).

Bagging is a physical protection technique, commonly applied to many fruit, which not only improves their visual quality by promoting peel coloration and reducing the incidence of fruit cracking, rusting, disease, mechanical damage, sunburn of the skin, agrochemical residues on the fruit and bird damage but can also change the micro-environment for fruit development, which can have multiple effects on internal fruit quality. (Benitley and Ivieros 1992; Kitagawa *et al.*1992; Hofman *et al.*, 1997; Joyce *et al*., 1997; Fan and Mattheis, 1998; Amarante *et al.*, 2002; Xu *et. al.*, 2010). In this technique, individual fruit or fruit bunches are bagged on the tree for a specific period. These may be due to differences in the type of bag used, the stage of fruit development when bagged, the duration of fruit exposure to natural light following bag removal, and/or fruit- and cultivar-specific responses. Bagging is laborious and its cost benefit ratio must be investigated in order to promote adoption of the method in much of the World (Sharma *et al*., 2014). Several studies have indicated that bagging reduced the incidence of fruit fly in guava (Pereira, 1990; Morera-Montoya *et al*., 2010), Sarker *et al*., 2009), codling moth in apple (Benitley and Ivieros, 1992), woolly aphid in apple (Teixeira *et al*., 2011), fruit borer in litchi (Debnath and Mitra, 2008), San Josescale in apple (Sharma *et al*., 2013), and fruit borer in pomegranate (Bagle, 2011).

Successful management of pomegranate fruit damaging pests is important for the production of marketable fruits. Therefore, this study aimed to determine successful management strategies for the main fruit damaging pests of pomegranates, including pomegranate butterfly. By testing the effectiveness of chemical insecticide (Lambda), bio rational insecticides (Tracer and DiPel 2X), fruit bagging, Kaolin (Super Nano), diatoms and their mixture and also reducing the concentration of chemical insecticide (lambda) by mixing lambda in 100, 75, 50 & 25% from recommended dose with kaolin and diatom in controlling pomegranate butterfly.

MATERIALS AND METHODS

Location and Illustration of the studied pomegranate orchard:

The current study was conducted in pomegranate field in El Matarih, Marsa Matrouh in Matrouh Governorate, Egypt that has a typical Mediterranean climate during the years 2014 to 2015. During the experimental months, the weather was characterized by moderate to high temperature (23 – 31ºC average daily), moderate humidity, slight to moderate winds and lack of rainfall, so the orchard is watered from an artesian well. Orchard was cultivated for 12-years old "Manfalouty" cultivar pomegranate trees spaced by 3 × 3 m. The trees of the orchards were of uniform vigor and size.

Sampling of fruit infestation for pomegranate butterfly:

The pomegranate infestation for pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) was initiated after fruit-set on May and terminated in October (at harvest). Ten sampling dates at two week‟s intervals were taken during the study time. The evaluation of the tested compounds carried out during fruit infestation levels to assess fruit damage comparing with the control up to the harvest during the experimental period. Pomegranate fruits were examined for the two presences of the number of infested fruits and larval tunnels. Total levels of infestation were calculated. Treatments with four replicates were arranged in a completely randomized block design. Each replicate consisted of three trees. Samples from each tree representing different levels and directions of the trees were randomly collected to investigate pomegranate butter fly attacking fruits. For all treatments, samples of infested fruits were collected immediately before spraying as index of pretreatment count, and every 15 days after the successive sprays to determine the level of infestation. Samples were collected and examined in the laboratory by using stereoscope microscope. The percentage of reduction in infestation was calculated according to the formula Topps and Wain (1957).

$$\% R = \left(\frac{C - T}{C}\right) \times 100$$

Where:

C: number of insects recorded in the check samples.

T: number of insects recorded in treatment samples.

Treatment Methods:

Effect of fruit bagging, bioinsecticides, chemical insecticide against pomegranate butter fly, *Virachola livia*.

Fruit bagging method:

Fruit bagging was applied to all fruits on the tree one week after hand thinning using paper bags 15 x 20 cm (Samra and Shalan 2013). Each pomegranate fruit was wrapped with paper bag. Fruits of 2 cm diameter were bagged individually (from May to October month after fruit setting). Bags were tied at the fruit peduncle with a jute string. The bags were removed only after harvesting of the fruits. The control treatment was without wrapping or any insecticides.

Insecticides:

Chemical insecticide (Lambda)

Lambda cyhalothrin is an insecticide registered by the U.S. Environmental Protection Agency (EPA) in 1988. Lambda cyhalothrin belongs to a group of chemicals called pyrethroids. Pyrethroids are manmade chemicals that are similar to the natural insecticides pyrethrins. Scientists developed pyrethroid insecticides to have properties better than those of the pyrethrins. Lambda cyhalothrin is similar to the pyrethroid cyhalothrin.

Bioinsecticides:

Tracer 24% SC

Spinosad is the first active ingredient proposed for a new class of insect control products, the Naturates. Spinosad is derived from the metabolites of the naturally occuring bacteria, *Saccharopolyspora spinosa*. Spinosad is an emulsifiable concentrate, formulated by Dow Agro Sciences Limited containing a mixture of Spinosyn A and Spinosyn D (Ali 2016).

DiPel 2X

DiPel 2x is a biological insecticide that active ingredient is *Bacillus thuringiensis, subsp. Kurstaki*. 32,000 International Units per mg of product or 14.52 billion International Units per pound of product.

The insecticide concentrations applied in field experiments were calculated according to the recommendations of Egyptian Ministry of Agriculture as follows:

Pesticide name	Rate of using
Lambda	150 ml / 100 L
Tracer 24% SC	20 ml / 100 L
DiPel 2X	300 g\fed.

Effect of mixture of kaolin and diatom against pomegranate butterfly, *Virachola livia*.

In this experiment, two natural products were used. Kaolin (Super Nano) and diatoms were tested to control pomegranate butterfly. Kaolin and diatom were used separately and in a mixture with each other in four different rates (100, 75, 50 and 25) as follow:

1- Super Nano only in 3 % concentration.
2- Diatom only in 1 % concentration.
3- Super Nano 3% with 100 % diatom.
4- Super Nano 3% with 75 % diatom.
5- Super Nano 3% with 50 % diatom.
6- Super Nano 3% with 25 % diatom.
7- Diatom 1% with 100 % Super Nano.
8- Diatom 1% with 75 % Super Nano.
9- Diatom 1% with 50 % Super Nano.
10- Diatom 1% with 25 % Super Nano.

Reducing of Lambada insecticide concentration by kaolin and diatom against pomegranate butterfly, *Virachola livia*.

Kaolin and diatoms were used to reduce the concentration of insecticide (lambda) and to increase its potentiality. The insecticide (Lambda) was tested with four concentrations in 100, 75, 50 and 25 % from the recommended dose separately, with Super Nano (3%) and with diatoms (1%) as follow:

1- Lambda only in 100 % concentration from recommended dose.
2- Lambda only in 75 % concentration from recommended dose.
3- Lambda only in 50 % concentration from recommended dose.
4- Lambda only in 25 % concentration from recommended dose.
5- Lambda in 100 % concentration from recommended dose with Super Nano3%.
6- Lambda in 75 % concentration from recommended dose with Super Nano 3%
7- Lambda in 50 % concentration from recommended dose with Super Nano 3%
8- Lambda in 25 % concentration from recommended dose with Super Nano 3%
9- Lambda in 100 % concentration from recommended dose with diatom 1%.
10- Lambda in 75 % concentration from recommended dose with diatom 1%
11- Lambda in 50 % concentration from recommended dose with diatom 1%
12- Lambda in 25 % concentration from recommended dose with diatom 1%

Statistical Analysis:

Pooled data were subjected to the combined statistical analysis after passing the homogeneity test using M-STAT C, (Russell, 1991), while Duncan's multiple range test was used to verify the significant differences between treatments means as described by Duncan, (1955).

RESULTS

Effect of fruit bagging, bioinsecticides, chemical insecticide against pomegranate butter fly, *Virachola livia*.

Results for the efficacy of fruit bagging, bioinsecticides (DiPel 2X and Tracer), chemical insecticide (Lambda) on pomegranate butterfly, *Virachola livia* are given in Table 1. Significant differences were found for the average number of infested fruits and larvae infestations among the treatments. Data revealed that the most effective treatment for suppressing pomegranate butterfly was Lambda as chemical insecticides followed by DiPel 2X and Tracer as bioinsecticides then bagging fruits method, respectively for infested fruits and larvae infestations of pomegranate butterfly,. According to the results, highest damage of *Virachola livia* on the fruits was recorded for the untreated control. The average number of damage fruits by pomegranate butter fly reached up to 43.5 and 50.3 for infested fruits and larvae infestations in control treatment. Among the treatments, Lambda insecticide gave the least effect on the damages fruits and larvae infestation (5.0 & 6.3) of *V. livia* and reduced the infested fruits and larvae infestation by 88.5 & 87.5 %. DiPel 2X as bioinsecticide treatment reduced the pomegranate butterfly damage 59.1 and 75.2 % for infested fruits and larvae infestation and the average number of infested fruits and larva infection were 17.8 and 23.8. Tracer treatment reduced the infested fruits and larvae infestations by 45.3 and 46.3% with average number of infestation 23.8 and 27.0. Bagging fruit infestation method gave the least effect among the treatments and reduced the percentage of damaged fruits to 36.8 and 32.8 % for infested fruits and larva infections. The damage fruits and larvae infestations were 27.5 and 33.8. Results indicated that all treatments had at least 36% to 59% reduction of damaged fruits as nature control and 88% reduction of damaged fruits as chemical control when comparing with the untreated control.

Table 1: Effects of fruit bagging, bioinsecticides and chemical insecticide on pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) through combinations of two seasons 2014 & 2015

Treatments	Infested Fruits		Larvae	
	Mean	R %	Mean	R %
Lambada	5.0e	88.5	6.3e	87.5
DiPel 2X	17.8d	59.1	23.8 d	75.2
Tracer	23.8c	45.3	27.0c	46.3
Bagging fruits	27.5b	36.8	33.8b	32.8
Control	43.5a		50.3a	
LSD	1.9		2.0	

Effect of kaolin, diatom and their mixtures against pomegranate butterfly, *Virachola livia.*

The result as depicted in Table 2 clearly shows that all the treatments as kaolin (Super Nano) and diatom as well as their mixtures with different rates (Super Nano 3% with diatom 100, 75, 50 & 25%) and (diatom 1% with Super Nano 100, 75, 50 & 25%) effectively reduced the pomegranate butterfly infestations. Data presented in Table 2 show that mixture of Super Nano with diatom (100%) and Super Nano with diatom (75%) caused a maximum reduction in pomegranate fruit infestation caused by *V. livia* compared to control from May to October which gave reduction percentage 74.4 & 69.5 for infested fruits and 72.9 & 63.7 % for larvae infestations. Super Nano treatment that was used only without any mixtures by diatom was the third treatment, which caused a significant reduction of the infestation which were 64.6 and 64.7, respectively for infested fruits and larvae infestation of pomegranate butter fly followed by mixture Super Nano with Diatom 50 % and Super Nano with diatom 25% that gave reduction percentage 59.8 & 56.3 % for infested fruits and 51.2 & 47.1% for larvae infestation. The average number of infestations in Super Nano with diatom 100%, 75%, 50%, 25% and Super Nano only were (10.5 & 13.8), (12.5 & 18.5), (16.5 & 22.3), (20.0 & 27.0) and (14.5 & 18.0) compared with the control treatment 41.0 & 51.0, respectively for infested fruits and larvae infestation of pomegranate butter fly.

The data clearly show in table 1 that diatom 1% alone or mixing with Super Nano in different rates 100, 75, 50 and 25%) gave significantly reduction of infestation in *Virachola livia*. Data revealed that the most effective treatment for suppressing pomegranate butter fly was the mixture between diatom 1% with Super Nano 100% followed by diatom 1% with Super Nano in different rates 75%, 50%, 25% and diatom without any mixture compared with the control treatment for infested fruits and larvae infestations of pomegranate butterfly. Their reduction percentage were (74.9 & 73.5), (70.2 & 66.9), (66.3 & 64.0), (59.8 & 54.0) and (59.0 & 62.2), respectively for infested fruits and larvae infestations of pomegranate butter fly. The average number of infestations level of diatom only and with Super Nano in different rates (100, 75, 50 and 25 %) were ((10.3 & 14.0), (12.2 & 17.5), (13.8 & 19.0), (16.5 & 24.3) & (16.8 & 20.5) compared with control treatment (41.0 & 52.8), respectively for infested fruits and larvae infestations of pomegranate butter fly.

Table 2: Effects of Kaolin, diatoms and their mixtures on pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) through combinations of two seasons 2014 & 2015

Treatments	Infested Fruits		Larvae	
	Mean	R %	Mean	R %
Control	41.0		51.0	
Super Nano only 3%	14.5	64.6	18.0	64.7
Super Nano + Diatom 100 %	10.5	74.4	13.8	72.9
Super Nano + Diatom 75 %	12.5	69.5	18.5	63.7
Super Nano + Diatom 50 %	16.5	59.8	22.3	56.3
Super Nano + Diatom 25 %	20.0	51.2	27.0	47.1
Control	41.0		52.8	
Diatom only 1%	16.8	59.0	20.5	62.2
Diatom + Super Nano 100%	10.3	74.9	14.0	73.5
Diatom + Super Nano 75%	12.2	70.2	17.5	66.9
Diatom + Super Nano 50%	13.8	66.3	19.0	64.0
Diatom + Super Nano 25%	16.5	59.8	24.3	54.0
LSD	1.9		2.0	

Reducing of Lambada insecticide concentration by kaolin and diatom materials against pomegranate butterfly, *Virachola livia*.

Obtained data concerned with the effect of foliar spraying with kaolin and diatoms separately and with mixtures of different rates of Lambda insecticides (100, 75, 50 & 25% of recommended dose) on pomegranate butterfly, *Virachola livia* expressed as mean number of infested fruits and larvae of pomegranate butterfly were presented in Table 3.

Data of the interaction between natural products (Super Nano & diatoms) and some rates of recommended dose (100, 75, 50 & 25 %) of Lambda insecticide to reduce the concentration of use of the chemical insecticide presented in tables 3 revealed that the highest effect on pomegranate butterfly were observed in plants treated by the mixture of kaolin with Lambda 100 % of recommended dose followed by diatom with Lambda 100 % of recommended dose, kaolin with Lambda 75% , Lambda 100% (without kaolin & diatom), kaolin with Lambda 50%, diatom with 75% lambda compared with the control treatment. Their average number were (1.4 & 3.9), (2.5 & 5.0), (4.0 & 8.5), (5.6 & 7.9), (7.2 & 14.2), (8.3 & 11.7) respectively compared with the control treatment (46.0 & 64.6) for infested fruits and larvae infestation on pomegranate butterfly. The lowest effect were Lambda 25 & 50 % (without kaolin & diatom) followed by diatom with Lambda 25 % which gave average number (33.5 & 43.3), (28.6 & 35.6) and (16.9 & 21.7), respectively of infested fruits and larva of pomegranate butterfly infestation. Kaolin, diatom and lambda treatments were used separately without any mixing gave (14.4 & 17.4) ,(16.5 & 20.1) and (5.6 & 7.9) as average number of infestation for infested fruits and larvae infestation level of pomegranate butterfly and reduced the level of infestation to 68.7, 64.1 & 87.8 while mixing kaolin and diatom with lambda insecticide with different rates ,the infestation level of pomegranate butterfly were reduced to (97.0 & 94.0%), (91.3 & 86.8%) , (84.3 & 78.0%) and (73.7 & 71.1) for mixing of kaolin with lambda rates (100, 75, 50 & 25 %) and (94.6 & 92.2 %), (82.0 & 81.9%), (72.2 & 73.5%) & (63.3 & 66.4%) for diatom with lambda rates (100, 75, 50 & 25 %). Lambda insecticides were used separately with 100, 75, 50, 25 % of recommended dose reduced the infestation level to (87.8 & 87.8%), (70.7 & 77.7%), (37.8 & 44.9%) & (27.2 & 33.0%), respectively for infested fruits and larva of pomegranate butterfly infestation.

Table 3: Effects of interactions of kaolin and diatoms with lambda on pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) through combinations of two seasons 2014 & 2015

	Infested Fruits		**Larvae**	
	Mean	**R %**	**Mean**	**R %**
Super Nano 3%	14.4 e	68.7	17.6 g	72.8
Lambada 100% + Super Nano 3%	1.4 m	97.0	3.9 l	94.0
Lambada 75% + Super Nano 3%	4.0 k	91.3	8.5 j	86.8
Lambada 50% + Super Nano 3%	7.2 i	84.3	14.2 h	78.0
Lambada 25% + Super Nano 3%	12.1 g	73.7	18.7 f	71.1
Diatom 1%	16.5 d	64.1	20.1 e	68.9
Lambada 100 % + diatom 1%	2.5	94.6	5.0 k	92.2
Lambada 100 % + diatom 1%	8.3 n	82.0	11.7 i	81.9
Lambada 100 % + diatom 1%	12.8 fg	72.2	17.1 g	73.5
Lambada 100 % + diatom 1%	16.9 d	63.3	21.7 d	66.4
Control	46.0 a		64.6 a	
Lambada 100 %	5.6 j	87.8	7.9 j	87.8
Lambada 75 %	13.5 f	70.7	14.4 h	77.7
Lambada 50 %	28.6 c	37.8	35.6 c	44.9
Lambada 25 %	33.5 b	27.2	43.3	33.0
LSD	0.8		0.9	

DISCUSSION AND CONCLUSSION

Insecticides play a critical role in the management of pomegranate butterfly, *V. livia*, their frequent use has prompted the development of resistance (Abd-Ella 2015). Recently, alternative control strategies are becoming important for the producers with increasing concerns of consumers and health organizations about the pesticide residues (Kahramanoglu and Usanmaz 2013). Within this study, the pomegranate butterfly was caused 40-50% as average number of fruit damage in the untreated control treatments. This results was agreed with Ksentini *et al*. (2011) who reported that the damage caused by *V. livia* in pomegranate varieties was between 5.2 and 52%. So, it is necessary to find alternative methods for chemical insecticides to suppress the infestation level of pomegranate butterfly with low environmental pollution. In current study, bagging fruits, biopesticides (actinomycites (Tracer) & *Bacillus thuringiensis* (DiPel 2X)), kaolin (Super Nano) and diatoms were used to suppress pomegranate butter fly, *V. livia* as natural methods. In addition to reducing the recommended dose of Lambda insecticide with mixing it with different rates (100, 75, 50 & 25% of recommended dose) by Super Nano and diatom. The results, revealed that the most effective treatment for suppressing pomegranate butterfly was Lambda as chemical insecticide followed by DiPel 2X (Bt) and Tracer (Spinosad) as biorational insecticides then bagging fruits method for infested fruits infestations of pomegranate butterfly, *Virachola livia*. Their reduction percentage of infested fruits were 88.5, 59.1, 45.3 and 36.8, respectively. This results was in agreement with obatained by Khan *et al*., (2017) who mentioned that Lambda-Cyhalothin was most effective which reduced the infestation level of pomegranate fruit borer. Obeidat and Mazen (2002) studied the effect of four pesticides on the *V. livia* and they reported that lambda-cyhalothrin gave 97% clean fruits. It is worthy to indicate that the data obtained are in harmony with recommendation by Kahramanoglu and Usanmaz (2013) that *B. thuringiensis* reduced the damage from 15% to below 5% The birational insecticide, spinosad, also gave similar effect with the *B. thuringiensis*. Similarly Singh and Singh (2000) reported that *B. thuringiensis* is an effective control agent for the *V. livia*. The effects of spinosad and *B. thuringiensis* can be increased by increasing the number of applications. The bagging of pomegranate fruits with paper bags reduced pomegranate butterfly with lower than 50% reduction of infested fruits so, bagging fruits should be used as a part of IPM programs to control *V. livia* . Mhi-ud-din in 2014 designed a successful IPM program including bagging fruits to control *Virachola isocrates*. Similar finding for the efficiency of the bagging of pomegranate fruits with muslin cloth or paper bags have been advocated by many earlier workers to combat this pest (Narayanan, 1954 ; Shevale and Khaire, 1998). Bagging of fruits, spraying with insecticides, collection and destruction of infested as well as dropped fruits were recommended by Mohankumar *et al*. (1991) and Vijaya A. (1993) to minimize the damage by *V. isocrates*. Wisam and Mazen (2002) reported that the bagging of fruits at the end of June or, the first week of July completely prevented fruits from borer infestation in Northern Jordan. From the previous results, it can be concluded that all treatments should be participated in integrated pest management strategy to suppress or prevent pomegranate butterfly on pomegranate trees. This results are suitable for Mhi-ud-din in 2014 who designed a successful IPM programs to control V. *isocrates*. The IPM module that had bagging with muslin cloth after fruit set (25% of fruits), spray of castor oil (3%) starting with noticing of butterfly activity, release of *Trichogramma chilonis* 7 days after castor oil spray, spray of *Bacillus thuringiensis* 7 days after *T. chilonis* release, spray of NSKE (5%) 30 days after *Bt* spray, spray of quinalphos 25 EC (0.035%) 30 days after NSKE spray was the most effective module. Kumawat *et al.* (2001) said that while investigating the efficacy of bagging with wax-coated paper, carbaryl 50 WP (0.20%) and endosulfan 35 EC (0.07%) in combination with *Bacillus thuringiensis* (1.0 x 108) and azadirachtin 0.03 EC (0.00015%) against *V. isocrates* on pomegranate revealed the lowest infestation rates were observed on trees treated with four alternate sprays of carbaryl 50 WP (2.70%), which was statistically at par with four alternate sprays of azadirachtin 0.03 EC and carbaryl 50 WP (2.98%), and with bagging (3.17%).

This study indicated that kaolin and diatom separately or mixed with each other protect pomegranate against infestations of butterfly. Super Nano 3% and diatom 3% are used separately to reduce the butter fly infestation with reduction percentage 64.6% and 59 % for infested fruit level but their efficiency increased to 10 - 15% when they were used as a mixture (Super Nano 3% with diatom 100 % and diatom 3% with kaolin 100%). Their reduction percentage became 74.4 and 74.9% for infested fruit level. The efficacy of reduction percentage of infested fruits was increased to 5-10 % in mixing Super Nano 3% and diatom 1% with 75% diatom and 75% kaolin to become 69.5 and 70.2 %, respectively. This data was acceptance with Valizaderh *et al.* (2013) who found that kaolin plus diatom suppresses the vine cicada egg laying activity (50% reduction in comparison to untreated). In the otherwise, the efficacy of reduction percentage of infested fruits was decreased in mixing kaolin with diatom 50 and 25 % to 5 & 10% to become 59.8 & 51.2 %. Mixing diatom 1% with kaolin 50 increased to 6% to be 66.3% reduction percentage of infested fruits and as it is in diatom 1% with kaolin 25 % to become 59.8 %. The potentiality of kaolin and diatom against pomegranate butter fly was may see for that Kaolin is a physical barrier to repel insects, prevent disease spread and reduce the incidence of fruit sunburn on the trees ((Valizadeh *et al.* 2013). Kaolin mineral powder could prevent damages of insects on fruit trees and makes them unable to find a suitable place for oviposition (Showler 2002). The diatom dust gets trapped on the insect and damages the cuticle (waxy outer layer of the exoskeleton), causing them to dehydrate and die. Natural amorphous diatom does not produce toxic chemical residues, and is considered to be reasonably harmless. Given its highly porous nature, Ingestion of this lethal powder by the insect will cause them to dehydrate from the inside out, as well as shredding their inside. This process happens quickly, usually within a few minutes (Subramanyam and Roesli 2015). Diatom and kaolin formulations hold significant promise to increase the effectiveness and broaden the adoption of IPM strategies, thereby reducing the need for synthetic pesticides (Korunić 2013). Mahdi and Khalequzzaman 2012 tested effectiveness of diatom and other inert dusts (kaolin powder, paddy husk ash, coal ash, alluvial soil, china clay) and a dust formulation insecticide carbaryl on the pulse beetles *Callosobruchus chinensis* L. and *C. maculatus* (F.). The bioassay of the dusts was done on adult beetles by mixing them with normal food (lentil and black gram seeds). The LD_{50} of the combined doses of mixtures for *C. chinensis* have been calculated as 12703.6 and 859.4 ppm for DE+ kaolin powder; 2432.8 and 274.0 ppm for DE+ paddy hush ash; 3430.0 and 426.2 ppm for DE+ coal ash; 12563.5 and 652.3 ppm for DE+ alluvial soil; 2242.8 and 325.8 ppm for DE+ china clay; and 21.3 and 14.5 ppm for DE+ carbaryl after 24 and 48 h after treatment respectively.

Chemical insecticides have been extensively used in horticultural crop production to control certain pests such as arthropods and mites. Although these chemical insecticides generally belong to different types of chemical compounds, there is still a need for an affective safe alternative demonstrated as not harmful to mammals, birds, fish, beneficial arthropods and environment (Ali 2016). So we must reduce of pesticides use by reducing the concentrations of using pesticides or make a good choice of the type of pesticide and time of application or all previous must be in our mind to apply pesticide. It was also found that some natural products to decrease or prevent the insect populations on plants to be used separately or can be added to chemical insecticides to increase their potential and can also reduce their concentrations with keeping their properties against insects. Kaolin and diatoms are suitable natural products to reduce insect populations and reduce the concentrations of pesticides use with highly efficacy from use some insecticide alone. Mixing Lambda as chemical insecticide with kaolin and diatom for reducing the recommended dose of lambda and reducing the pollution of chemical insecticides were success. Spraying lambda separately with different rates (100, 75, 50 & 25%) of recommended dose reduced the level of pomegranate butterfly infestation to 27.2- 87.8 while mixing it with kaolin reduced the infestation level to 73.7 - 97.0 and to 36.3 - 94.6 of diatom for infested fruits. Storm *et al*., 2016 proved that addition of kaolin to *Beauveria bassiana* increased control *Oryzaephilus surinamensis* adults from 46% to 88% at day 7 and from 81% to 99% at day 14 post-treatment. Ali 2016 consider kaolin particularly for controlling the olive fruit fly also in organic farms give a new opportunity for controlling the olive fruit fly also in organic farms for table olives productions. The data showed that kaolin, diatoms, lambda insecticide, mixture of kaolin and lambda and mixture of diatom with lambda can be effective in controlling infested fruits and preadult populations of pomegranate butterfly. These materials can be used also as a new tactic for IPM programs of pomegranate butterfly in pomegranate fields.

REFRENCES

Abd-Ella A. A. (2015). Efficacy of emamectin benzoate, pyridalyl and methoxyfenozide on pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) in cultivated and reclaimed lands. Journal of Phytopathology and Pest Management 2 (3): 32-42.

Ali, E. A. (2016). Effectiveness of Particle Film Technology and Copper Products in the Control of Olive Fruit Fly. J. Plant Prot. and Path., Mansoura Univ., 7(7): 439 – 444.

Amarante C., Banks, N. H. and Max, S. (2002). Effect of pre-harvest bagging on fruit quality and postharvest physiology of pears (*Pyrus communis*). New Zealand Journal of Crop and Horticultural Science, 30: 99–107

Awadallah A. M., Azab A, K., and El-Nahal A. K. M. (1971). Studies on the pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera-Rhopalocera: Lycaenidae). Bul. Soc. Entomol. Egypte 54:545–567.

Bagle B. G. (2011). Studies on varietal reaction, extent of damage and management of anar butterfly, Deudorix Isocrates in pome-granate. Acta Horticulturae, 890:557–559

Benitley J. and Iveros, V. M. (1992). Brown-bagging ‘Granny Smith’ apples on trees stops codling moth damage. California Agriculture, 46:30–32

Debnath, S. and Mitra, S. K. (2008) Panicle bagging for maturity regulation, quality improvement and fruit borer management in litchi (*Litchi chinensis*). Acta Horticul-turae, 773: 201-208.

Duncan, D. B. (1955). Multiple range and multiple F-test biometrics, 11:1-24.

Fan, X. and Mattheis, J. P. (1998). Bagging ‘Fuji’ apples during fruit development affects color development and storage quality. Hort. Science, 33: 1235–1238.

Franck E. D., Charles L. C., Stephen O. D. (2009). Natural products in crop protection. Bioorganic & Medicinal Chemistry 17: 4022–4034.

Gharbi, N. and Ben Abdallah, S. (2016). Effectiveness of kaolin treatment for the control of the olive fruit fly *Bactrocera oleae* in Tunisian olive groves. Tunisian J. Plant Protection, 11 (1): 73-81.

Glenn D. M and Puterka G. J. (2005). Particle films: A new technology for agriculture.- Horticultural Reviews, 31: 1-44.

Glenn D. M., Puterka G. J., Vanderzwet T., Byers R. E. and Feldhake C. (1999). Hydrophobic particle films: a new paradigm for suppression of arthropod pests and plant diseases.-Journal of Economic Entomology, 92: 759-771.

González-Núñez, M., Pascual, S., Seris, E., Esteban-Durán, J. R., Medina, P., Budia, F., Adán, A., and Viñuela, E. (2008). Effects of different control measures against the olive fruit fly (*Bactrocera oleae* (Gmelin)) on beneficial arthropofauna. Methodology and first results of field assays. IOBC/WPRS Bull. 35: 26-31.

Haidari M., Ali M., Casscells S. W. and Madjid M (2009). Pomegranate (*Punica granatum*) purified polyphenol extract inhibits influenza virus and has a synergistic effect with oseltamivir. Phytomedicine 16(12):1127-36.

Hofman, P. J., Smith, L. G., Joyce, D. C., Johnson, G. L. and Meiburg, G. F. (1997). Bagging of mango (*Mangifera in- dica* cv. "Keitt") fruit influences fruit quality and mineral composition. Postharvest Biology and Technology, 12: 83-91.

Holland D., Hatib K., and Bar-Ya'akov I. (2009). Pomegranate: Botany, Horticulture, Breeding. Horticultural Reviews, 35 Copyright John Wiley & Sons, Inc.

Joyce, D. C., Beasley, D. R. and Shorter, A. J. (1997). Effect of pre-harvest bagging on fruit calcium levels, and stor- age and ripening characteristics of "Sensation" mangoes. Australian Journal of Experimental Agriculture, 37: 383- 389.

Kahramanoglu I. and Usanmaz S. (2013). Management strategies of fruit damaging pests of pomegranates: *Planococcus citri*, *Ceratitis capitata* and *Deudorix* (*Virachola*) *livia*. African Journal of Agricultural Research 8(49): 6563-6568.

Khan I., Khan S. A. , Hussain S., Maula F., Shah H. A. , Iqbal T. and Khan A. (2017). To study the infestation level and effective chemical control of pomegranate fruit borer (*Virachola isocrates*). J. of Entomology and zoology studies, 5(1): 282 – 284.

Kitagawa, H., Manabe, K. and Esguerra, E. B. (1992). Bagging of fruit on the tree to control disease. Acta Horticulturae, 321:871-875.

Koivunen M. S., Joel C. C., and John J. B. (2013). Pest Management with Natural Products. Chapter 1© American Chemical Society Downloaded by USDA NATIONAL AGRICULTURAL LIB on September 26, 2013 | http://pubs.acs.org Publication Date (Web): September 25, 2013 | doi: 10.1021/bk-2013-1141.ch001

Korunić K. (2013) Diatomaceous Earths – Natural Insecticides. Pestic. Phytomed. (Belgrade), 28(2): 77–95.

Ksentini I., Jardak T. and Zeghal N (2011). First report on *Virachola livia* Klug. (Lepidoptera: Lycaenidae) and its effects on different pomegranate varieties in Tunisia. EPPO Bull. 41(2):178-182.

Kumawat, K. C., Jheeba, S. S and Soni, A. K. (2001). Eco-friendly management of Anar butterfly, *Virachola isocrates* (Fabricius). Advances in Horticulture and Forestry 8: 47-51.

Mahdi S. H. and Khalequzzaman M. (2012). The efficacy of diatomaceous earth in mixed formulation with other dusts and an insecticide against the pulse beetles, *Callosobruchus chinensis* L. and *Callosobruchus maculatus* (F.) University Journal of Zoology, Rajshahi University, 31.

Mkaquar R. and Ben Jamaa M. L. (2016) Study on Biology of Pomegranate Playboy *Deudorix Livia*, (Klug, 1834) in Acacia Farnesiana Science 6(8).

Mohankumar, S., Arumugam, T. and Rangarajan, A. V. (1991). Pomegraante a valuable arid zone fruit crop. Spice India 4 (5): 7-9.

Mohi-ud-din S. (2014). Current Status, Life Cycle and Development of IPM Module of Fruit Borer, *Deudorix epijarbas* (Moore) on Pomegranate. Ph.D. thesis, The Faculty of Postgraduate Studies Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, India, 1-198.

Morera-Montoya R., Lanco-Etzler B. H. and Luis-Loria C. R. (2010). Evaluation of different bagging materials for the control of the fruit fly Anastrephasp (Diptera, Tephritidae) and fruit pathogens in Taiwanese guava fruits (Psidium guajava L.). Acta Horticulturae, 849: 283–292.

Morton J (1987). Pomegranate. In: Fruits of warm climates. Miami, FL. pp. 352–355.

Narayanan, E. S. (1954). Seasonal pests of crops: The anar-Butterfly, *Virachola isocrates*, FABR. Indian Farming 4 (1): 8-9.

Obeidat W. and Mazen A. (2002). Bionomics and control of pomegranate butterfly *Virachola livia* in Northern Jordan. Dirasat: Agric. Sci. 29 (1):1-12.

Parrella M.P. and Keil C.B. (1984). Insect pest management: the lesson of Liriomyza. Bulletin of the Entomological Society of America 30: 22-25.

Pereira F.M. (1990). Factors affecting guava production and quality with special reference to Sao Paulo, Brazil. Acta Horticulturae, 275: 103–109.

Rouini, I. (2008). Olive fly management with allowed formulations in organic agriculture. Thesis requise pour submitted Master of Science in “Mediterranean Organic Agriculture”

Russell, D. F. (1991). MSTAT C, Directory crop soil science Dept. Michigan Univ. USA.

Samra, B. N. and Shalan A. M. (2013). Studies on thinning, bagging and aluminum silicate spraying on yield and quality of wanderfull pomegranate. J. Plant Production, Mansoura Univ., 4 (2): 219 – 227.

Sarker D., Rahman M. M. and Barman J. C. (2009). Efficacy of different bagging materials for the control of mango fruit fly Bangladesh Journal of Agricultural Research, 34:165–168.

Sarwar M. (2016). Inorganic insecticides used in landscape settings and insect pests. Chemistry Res. J. 1(1):50-57.

Sayed A. A. and Temerak S. A. (2007). Alternate two green chemicals: spinosad and methoxyfenozidz to combat *Viracola livia* on dates in Dakhla Oasis, New Valley, Egypt. The Fourth Symposium on Date Palm in Saudi Arabia, King Faisal University, Alahsa, 5-8 (5): 1495–1501.

Sharma R. R. (2009). Fruit production problems and solutions .International Book Distributing Company, Lucknow, India. 649.

Sharma R. R., Pal R. K., Sreyr S. V. R., Himan M. R. and Rana M. R. (2013). Pre-harvest fruit bagging influences fruit color and quality of apple cv. Delicious. Agricult. Sci., 443–448.

Sharma, R. R., Reddy S.V.R. and Hjhalegar M. J. (2014). Pre-harvest fruit bagging a useful approach for plant protection and improved post-harvest fruit quality. J. Horticul. Sci. Biotech., 89(2): 101–113.

Shevale, B. S. and Khaire, V. M. 1998. Relative performance of fruit-bagging against pomegranate butterfly. J. Maharashtra Univ., 23(3): 276-279.

Showler, A.T. (2002). Effects of kaolin-based particle film application on boll weevil (Coleoptera: Curculionidae) injury to cotton. J. Econ. Entomol., 95: 754-762.

Singh S. B. and Singh H. M. (2000). Bioefficacy and economics of different pesticides against pomegranate butterfly, *Deudorix livia* (Fabricious) (Lycaenidae: Lepidoptera) infesting a onla. Indian J. Plant Prot. 28(2):173-175.

Storm C., Freya S., Adam N., Olivier P. and Aoife D. (2016). Improving Efficacy of *Beauveria bassiana* against stored grain beetles with a synergistic Co-Formulant. Insects, 7(42):1-14.

Subramanyam B. and Roesli R. (2015). “Inert Dusts”, Kansas State University pg.325-331 http://www. saferbrand. com/store/insect-control/51702

Teixeira R., Amarante C. V., Boff, M. I. C. and Ribeiro, L. G. (2011). Control of insect pests and diseases, maturity and quality of ‘Imperial Gala’ apples submitted to bagging. Brazilian Magazine of Fruit Culture, 33: 394–401.

Topps, J. H. and Wain R. L. (1957). Investigation on Fungicides III the fungi toxicity of 3 and 5-alkyl-salicyl-anilides and P-chloroanilines. Ann. Appl. Biol., 45 (3): 506 – 511. (C.F. El-Shazlyal Zein, 1983).

Tsang C. Y. (2016). Diatomaceous Earth as Insecticide. Pest control Newsletter (3) July pp 1-2.

Valizaderh H., Abbasipour H., Faradzmand H. and Askaranzadeh A. (2013). Evaluation of kaolin application on oviposition control of the vine cicada, *Paslmocharias alhageos* in vineyards (Homoptera: Cicasidae). Entomol Gener, 34(4): 279-286.

Vijaya A. (1993). Control of Anar butterfly. Spice India, 6(4): 12

Xu, H. X., Chen, J. W. and Xie, M. (2010). Effect of different light transmittance paper bags on fruit quality and anti-oxidant capacity in loquat. Journal of the Science of Food and Agriculture, 90:1783–1788.

Walker K., Mendelsohn M., Matten S., Alphin M. and Ave D. 31-51 | Published online: 12 Oct (2008). http://dx.doi.org/10.1300/J153v05n01_03.

Wisam, O. and Mazen. A. (2002). Bionomics and control of pomegranate butterfly *Virachola livia* (Klug) (Lepidoptera: Lycanidae) in Northern Jordan. Dirasat Agr. Sci., 29:1–12.

ARABIC SUMMERY

المكافحة المتكاملة لبعض الافات التى تصيب أشجار الرمان فى الساحل الشمالى الغربى

عصام احمد على
قسم وقاية النبات - مركز بحوث الصحراء – القاهرة – مصر

تعتبر حشرة فراشة الرمان (*Virachola livia* (Klug) (Lepidoptera: Lycanidae) من الافات الهامة بمزارع الرمان بمصر . ولقد تم اجراء الدراسة فى خلال موسمي ٢٠١٤ و ٢٠١٥ . واوضحت النتائج ان المعاملة بمبيد اللمبادا كمبيد كيميائى من اكثر المعاملات تاثيرا فى خفض نسبة الاصابة بحشرة فراشة ثمار الرمان ثم يلية مبيد الدايبل ٢ X ثم مبيد التريسر كأحدى المبيدات الحيوية ثم بعد ذلك استخدام طريقة تكيس ثمار الرمان وادت تلك المعاملات الى خفض نسبة اصابة ثمار الرمان الى ٨٨,٥ , ٥٩,١ , ٤٥,٣ , ٣٦,٨ % بالترتيب. واظهرت النتائج انة عند خلط السوبر نانو مع الدياتومات (١٠٠%) وا لسوبر نانو مع الدياتومات (٧٥%) الى خفض اصابة الثمار وذلك بالمقارنة بتجربة الكنترول الى ٧٤,٤ و ٦٩,٥%. انة عند استخدام السوبر نانو منفردا بدون خلطة مع الدياتومات ادى ذلك الى خفض تعداد الثمار المصابة الى ٦٤,٦ ثم يلية مخلوط السوبر نانو مع الدياتومات ٥٠ % ثم السوبر نانو مع الدياتومات٢٥ % الى ٥٩,٨ و ٥١,٢ %. واوضحت النتائج ايضا ان معاملة الثمار بمخلوط الدياتومات ١ % مع السوبر نانو ١٠٠ % ثم يلية مخلوط الدياتومات ١ % مع السوبر نانو بالمعدلات ٧٥ و ٥٠ و ٢٥ % ثم الدياتومات منفردا بدون اى اضافات الى خفض تعداد الثمار المصابة الى ٧٤,٩و ٧٠,٢ و ٦٦,٣ و ٥٩,٨ و و ٥٩,٠ % بالترتيب وذلك بالمقارنة بتجربة الكنترول. واوضحت النتائج ان تجربة التداخل بين المعاملات بأستخدام المنتجات الطبيعية (الكاولين و الدياتومات) مع المعدلات المختلفة من مبيد اللمبادا بنسب ١٠٠ , ٧٥ , ٥٠ , ٢٥ % من تركيز المبيد الموصي بة ان عند استخدام مبيد اللمبادا بنركيز ١٠٠% ثم يلية مخلوط المبيد ١٠٠ % مع الدياتومات ثم المبيد ٧٥% مع السوبر نانو ثم المبيد ١٠٠% منفردا بدون خلط مع السوبر نانو والدياتومات ثم المبيد ٥٠% مع السوبر نانو ثم المبيد ٧٥% مع الدياتومات الى خفض تعداد الثمار المصابة بحشرة فراشة ثمار الرمان . وادت تلك المعاملات الى خفض نسبة الاصابة الى ٩٧,٥, ٩١,٣, ٨٤,٣, ٧٣,٧ وذلك عند خلط مبيد اللمبادا بالمعدلات ١٠٠ , ٧٥ , ٥٠ , ٢٥ % من التركيز الموصي بة مع السوبر نانو. اما عند خلط المبيد بنفس المعدلات مع الدياتومات ١ % ادى الى خفض الاصابة الى ٩٤,٦ , ٨٢,٥ , ٧٢,٢ و ٦٣,٣ % بالترتيب. اما عند استخدام مبيد اللمبادا بمعدلات ٢٥ و ٥٠ % بدون اضافة السوبر نانو والدياتومات انخفض كفاءة المبيد الى ٢٧,٢ و ٣٧,٨.
.