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Field Evaluation of Some Biological Formulations Against *Thrips tabaci* (Thysanoptera: Thripidae) in Onion

[1]*Sayeda S. Ahmed* and [2]*Mohamed M. El-Mogy*

[1]Department of Economic Entomology and Pesticides,
[2]Department of Vegetable Crops,
Faculty of Agriculture, Cairo University, Giza, Egypt

Abstract: Two biological formulations, neem (Nimbecidine) & *Beauveria bassiana* (Bio-Power) and jojoba oil were used for control onion thrips, *T. tabaci* in onion field. Also, vegetative characteristics and yield and germination of onion seeds were considerable. The evaluation was conducted in onion field at 2007/2008 season and repeated at 2008/2009 season. Two rates for each formulation, oil and a recommended rate of Malathion (reference insecticide) were sprayed three times for each season while the control was sprayed with distilled water. The first and second sprayings were carried out during the growing period while the third spray was during the flowering period. Results showed that all tested products revealed significant reduction in thrips populations on both growing and flowering periods. Bio-Power exhibited the highest effective on the growing period (2nd spray) followed by jojoba oil, Nimbecidine and Malathion at 2007/2008 season, while Malathion was the highest with the same spray on the growing period followed by jojoba oil, Nimbecidine and Bio-Power at 2008/2009 season. On the flowering period, Nimbecidine and Malathion were more effective on thrips population at 2008/2009 season as well as they gave the highest significant seed yield. Vegetative characteristics and seed germination were also improved. In conclusion, it can be use Bio-Power and Jojoba oil on growing period and Nimbecidine on flowering period in integrated pest management of onion crop.

Key words: *Beauveria bassiana* · Control · Insecticide · Neem

INTRODUCTION

The onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), is a polyphagous species which occurs world-wide [1], its population is usually high on plants from the Alliaceae family, especially on onion (*Allium cepa* L.) and leek (*Allium porrum* L.). It is a serious pest as populations may be very large particularly during hot, dry weather [2]. It also attacks cultivated crops of Brassicaceae plants like radish, cabbage and cauliflower [3]. The damage of onion thrips is caused by severe feeding activity of adults and nymphs on green plant tissues [4], whereby they puncture sub-epidermal cells and suck out the contents. Damaged areas become desiccated causing a silvery flecked appearance as well as distorted and undersized bulbs [5]. It also causes indirect damage as vector of mainly viral plant diseases [6] including Iris yellow spot virus of Tospovirus genus which has spread in many important onion-producing regions of the world and cause yield loss up to 100% [5]. Heavy infestation leads to decreased quality as well as quantitative losses in both leek and onion [7, 8]. Significant yield losses of up to 50% have been attributed to *T. tabaci* on garlic in India [9]. It is the most serious pest of onion that can reduce seed production as much as 50% [5].

Management of thrips pests is problematic due to their minute size and their cryptic habits, as they feed hidden in crevices of flowers and leaf sheaths. Their high reproductive capacity leads quickly to great numbers infesting individual plants [6]. In most target crops, use of synthetic pesticides is the most commonly used option for controlling thrips. The concealed habit and reproduction of thrips species make their management very difficult with the use of chemical method to be the most commonly adopted control option. These treatments

Corresponding Author: Sayeda S. Ahmed, Department of Economic Entomology and Pesticides, Faculty of Agriculture, Cairo University. Giza, Egypt.
Tel: +2-02-35699524, Fax: +2-02-35717355.

cause residue and insecticide resistance problems, are costly and undesirable, with regard to risks to operators, livestock and nontarget organisms [10]. Control strategies in glasshouse and field have often relied on repeated application of chemical insecticides that not only produced environmental risks, but also resulted in widespread development of resistance. This, combined with the increasing economic impact of thrips pests, put considerable urgency on the development of novel control strategies [11].

Certain plant and microbial derived products have been promoted in recent years as alternatives to traditional chemical method. They possess good efficacy and are environmentally friendly against insect pests [12]. Maniania *et al.* [10] found the entomopathogenic fungi *Metarhizium anisopliae* had potential pathogenic effect against *T. tabaci* in field trial. Essential oils extracted from plants belong to the Lamiaceae family (marjoram *Origanum majorana*, sage *Salvia officinalis*, lavender *Lavandula angustifolia*, mint oil *Mentha arvensis* and rosemary *Rosmarinus officinalis*) showed repellent and deterrent properties against *T. tabaci* [13].

Many laboratory and field trials were conducted to evaluate neem products against various thrips species; *Frankliniella occidentalis* [14, 15], *Dichromothrips nakahari* [17], *Panchaetothrips indicus* [18], *Ceratothripoides claratris* [16], *Scirtothrips dorsalis* [19].

Fungal products derived from *Beauveria bassiana* were evaluated against *T. tabaci*, *Frankliniella occidentalis*, *F. intonsa, T. colorants* and *T. hawaiiensis* [20]. Some botanical products extracted from the plant jojoba revealed, insecticidal, fungicidal, acaricidal, nematicidal and antimicrobial properties [21-24]. Therefore, the aim of this study was to evaluate the efficacy of some biological formulations Nimbecidine, Bio-Power and jojoba oil against onion thrips *T. tabaci* in onion field with special consideration for vegetating characteristics, seed yield and seed germination.

MATERIALS AND METHODS

This study was conducted at the Experimental Station of the Faculty of Agricultural, Cairo University, in Giza, Egypt during two successive seasons of 2007/2008 and 2008/2009.

The Host Plant: The bulbs of onion, *Allium cepa* variety Giza 20 was purshased from Seed Production Unit, Agriculture Research Center, Giza.

The Formulations Used: Two commercial liquid formulation Bio-Power contains spores and mycelia fragments of *Beauveria bassiana* (1 x 10^9 CFUs/ml), Nimbecidine contains 0.03% azadirachtin as active ingredient and jojoba oil (*Simmondsia chinensis*) were used. These products were obtained from T. Stanes Company Limited, India.

Two rates 5 and 10 ml per liter of water for each product were sprayed on onion plants infested by *T. tabaci* in the early morning. The rates were prepared by diluting the compounds in distilled water. A recommended rate of Malathion (1ml/L) was used as insecticidal reference. The control treatment was sprayed with distilled water.

Expeimental Design: The experimental area of about 288 $m.^2$ was divided into 8 equal blocks each comprising of 3 equal plots (12 m^2). Each plot consisted of 4 rows, 4 m. long and 70 cm wide with 12 hills/ row separated by 30 cm. distance. Then, the area was divided into 24 plots totally each measuring 3 × 4 m. (0.2/100 feddan). Eight treatments, with 3 replicates each, were distributed in the experimental area as follows: blocks 1 and 2 were sprayed with two rates of Nimbecidine, blocks 3 and 4 were sprayed with two rates of Bio-Power, blocks 5 and 6 were sprayed with two rates of jojopa oil, block 7 was sprayed with Malathion using recommended rate by the manufacturer and block 8 was sprayed with distilled water as a control. The bulbs of onion were sterilised by immersing in fungicidal reagent and sown on December 17, 2007/2008 season and December 23, 2008/2009 season. All experimental plots received regular agricultural practices. The spraying was carried out three times for each season. The first spraying was conducted two months post planting onion bulbs. The second spraying was done two weeks post the first spray. Both the first and second sprayings were carried out during the growing phase of onion. The third spraying was carried out after 36 days from the second spraying during the mid flowering phase of onion. Thrips samples were taken on 3^{rd}, 7^{th} and 10^{th} day after each spraying. The sample included four plants which were randomly selected from each plot and investigated for alive adults and nymphs of *T. tabaci*. Thrips specimens on the plants were indvidually counted in the field during growing phase (1^{st} and 2^{nd} sprayings). During the flowering phase (3^{rd} spraying), flowers of onion were gently cut, placed in plastic bags and transmitted to the laboratory to thrips counts. The reduction in the number of thrips individual was calculated by using Henderson and Tillton equation [25].

Vegetative Characteristics: The number of umbel, flower stalk length and diameter of umbel per plant were determined for four plants per plot after four months of sowing date.

Yield and Germination of Seeds: Weight of 100 seeds (g), seed germination percentage and seed yield were calculated for each treatment during the two seasons. Seed yield was assessed by weighing 10 flowers per sample. Germination percentage was determined by cultivating 100 seeds in Petri dish and counting the number of germinated seeds.

Data Analysis: Data were analysed using a linear model accounting for treatments combinations. Treatment values, vegetative and yield characteristics were subjected to an analysis of varience (ANOVA), with the means separated using Duncan's Multiple Range criterion ($P<0.05$).

RESULTS

Effect of Treatments Against *T. tabaci* During the Growing Period: Field treatments of the infested onion plants by *T. tabaci* revealed that all the tested compounds reduced significantly the alive number of thrips comparison with the control one during all investigated days (3, 7 and 10 day) in both the first and second spray. The highest rate (10ml/L) was more effective than the lower (5ml/L) for all tested compounds in the first and second spray. The number of alive thrips increased in the control through the successive days for each spray in both the two seasons, while it decreased with the most tested compounds. The number of alive thrips through the second spray of both the two seasons was lower than the first spray.

The monitoring of thrips population on the 3rd, 7th and 10th day after the first field application and reduction percentages revealed that jojoba oil was the highest

Table 1: Efficiency of some biological formulations against *Thrips tabaci* in onion field at 2007/2008 season

		(Mean of alive thrips±SE)					
			Day post spray				
Formulation	Rate ml/l	Before spray	3	7	10	Grand Mean	Reduction (%)
1st spray (growing period)							
Nimbecidine	5	56.53	19.4±1.7cd	23.1±1.1b	27.7±1.1b	23.3	70.7
	10	56.53	12.3±1.2de	11.1±0.6d	11.5±0.9d	11.6	85.5
Bio-Power	5	56.53	36.4±2.1b	24.7±1.0b	13.9±1.4d	25.0	68.7
	10	56.53	19.3±1.3cd	17.6±1.7c	11.4±1.2d	16.1	79.8
Jojoba	5	56.53	37.1±1.7b	22.7±1.7b	6.8±1.5e	22.2	72.2
	10	56.53	10.1±1.7e	9.5±1.3d	6.2±0.8e	8.6	89.2
Malathion	1	56.53	27.3±2.1c	22.4±3.1b	19.9±2.2c	23.2	70.9
Control	0	56.53	72.7±6.2a	81.3±1.3a	84.7±1.7a	79.43	-
F value	-	-	54.65	188.97	336.78	-	-
P value	-	-	0.000	0.000	0.000	-	-
2nd spray (growing period)							
Nimbecidine	5	19.2±1.6bc	7.1±0.6bc	2.5±0.7bc	5.8±0.5b	5.13	78.7
	10	13.3±0.6d	2.8±0.7d	1.9±0.6c	5.2±3.3bc	3.3	80.2
Bio-Power	5	19.7±1.7bc	3.6±0.6d	2.7±0.7bc	1.4±0.6c	2.6	42.3
	10	24.6 ±.9b	4.5±0.8cd	3.1±0.8bc	2.0±0.7bc	3.2	89.6
Jojoba	5	20.1±1.5bc	3.3±0.6d	4.8±0.4b	3.8±0.4bc	3.96	84.3
	10	21.1±1.7bc	3.7 ±0.7d	2.6±0.6bc	2.0±0.5bc	2.8	89.4
Malathion	1	18.2±1.9cd	9.2±1.3b	4.6±0.8b	5.6±0.5b	6.5	71.5
Control	0	59.6±2.6a	65.1±1.9a	74.0±1.0a	83.1±0.9a	74.1	-
F value	-	67.6	165.9	1215.5	470.5	-	-
P value	-	0.000	0.000	0.000	0.000	-	-
3rd spray (flowering period)							
Nimbecidine	5	131.1±3.9e	62.5±2.7c	18.8±1.6c	51.1±2.7c	44.13	73.5
	10	135.2±4.9d	38.1±3.2d	15.1±2.7c	24.7±3.3e	25.96	84.9
Bio-Power	5	162.0±3.8bc	55.3±4.7c	24.9±2.5c	38.2±3.0d	39.5	80.8
	10	143.5±2.6d	53.3±4.9c	32.0±4.3c	29.0±3.2cd	38.1	79.1
Jojoba	5	168.2±3.6abc	63.4±1.1c	50.2±1.7b	49.2±2.1c	54.3	74.5
	10	170.1±2.6ab	55.7±2.8c	18.0±1.0c	31.9±2.5cd	35.2	83.7
Malathion	1	158.5±2.7c	99.9±6.8b	20.0±1.8	80.9±3.1b	66.93	66.7
Control	0	176.0±2.5a	199.0±4.9a	221.0±4.5a	245.9±7.1a	221.96	-
F value	-	23.8	148.1	155.7	397.3	-	-
P value	-	0.000	0.000	0.000	0.000	-	-

Means within a column followed by the same letter are not significantly different using Duncan's Multiple Range Test

Table 2: Efficiency of some biological formulations against *Thrips tabaci* in onion field at 2008/2009 season

			(Mean alive thrips±SE)				
			Day post spray				
Formulation	Rate ml/l	Before spray	3	7	10	Grand Mean	Reduction (%)
1st spray (growing period)							
Nimbecidine	5	39.7±1.8e	29.3±2.2b	22.1±1.9b	24.4±1.9c	25.3	16.6
	10	58.4±2.2c	12.3±1.1d	10.9±0.9d	14.0±2.5d	12.4	72.2
Bio-Power							
	5	38.7±1.9e	22.7±1.9c	23.7±1.4b	19.8±2.0c	20.1	25.4
	10	49.9±1.8d	9.7±1.1d	13.9±0.9cd	13.0±1.2d	12.2	96.8
Jojoba	5	38.1±2.6e	21.9±1.8c	16.4±1.3c	40.1±2.1b	26.1	10.2
	10	68.1±1.7b	15.1±1.9d	5.1±0.6e	2.9±0.5e	7.7	85.2
Malathion	1	50.5±1.7d	30.9±2.1b	22.3±1.7b	21.9±1.6c	25.0	35.2
Control	0	112.6±4.2a	83.3±2.9a	84.9±2.5a	89.3±1.5a	85.8	-
F value	-	108.9	142.6	274.8	233.8	-	-
P value	-	0.000	0.000	0.000	0.000	-	-
2nd spray (growing period)							
Nimbecidine	5	32.9±1.5e	19.1±1.7de	33.7±1.8b	12.6±2.2d	21.8	52.3
	10	47.3±1.7d	7.7±1.9g	17.7±1.4c	4.3±0.8e	9.9	85.0
Bio-Power	5	62.9±2.7c	56.7±3.2b	29.6±1.4b	43.9±2.6b	43.4	50.4
	10	72.8±1.9b	34.6±1.7c	18.2±1.2c	37.1±1.3c	29.9	70.4
Jojoba	5	63.9±2.2c	22.5±0.9d	20.6±1.2c	33.9±1.0c	25.7	71.1
	10	64.0±2.5c	12.8±1.6fg	17.6±1.2c	9.0±1.0de	13.1	85.3
Malathion	1	62.7±2.9c	14.0±1.1ef	9.2±0.9d	10.5±0.6d	11.2	87.2
Control	0	83.7±2.1a	93.9±1.7a	114.6±3.4a	142.3±3.5a	116.9	-
F value	-	47.1	246.1	393.4	569.6	-	-
P value	-	0.000	0.000	0.000	0.000	-	-
3rd spray (flowering period)							
Nimbecidine	5	45.8±2.3e	24.9±2.1cd	30.5±3.3d	37.3±1.6c	30.9	48.1
	10	59.7±2.2d	7.2±0.7d	11.5±0.7e	13.5±0.8e	10.7	86.2
Bio-Power	5	76.6±2.1c	75.7±4.6b	92.9±2.3b	52.3±1.9b	73.6	26.0
	10	136.5±1.4b	20.6±1.2cd	25.5±1.7de	32.1±0.9c	26.1	85.3
Jojoba	5	84.7±1.4c	31.8±3.1c	46.7±1.6c	46.7±1.6b	41.7	62.1
	10	87.2±1.1c	21.3±0.9cd	23.1±0.9de	23.1±0.9d	22.5	80.2
Malathion	1	134.5±1.3b	27.7±1.0cd	21.9±2.1de	21.5±1.9d	23.7	86.5
Control	0	165.3±11.7a	204.7±18.5a	262.0±12.7a	176.1±5.6a	214.3	-
F value	-	88.2	88.5	295.9	476.5	-	-
P value	-	0.000	0.000	0.000	0.000	-	-

Means within a column followed by the same letter are not significantly different using Duncan's Multiple Range Test

Table 3: Vegetative characteristics of onion treated with different compounds against infestation by *Thrips tabaci* at 2007/2008 and 2008/2009 seasons

		Vegetative characteristics		
Formulation	Rate ml/L	Number umbel	Length of flower stalk/plant	Diameter of umbel
The first season (2008)				
Nimbecidine	5	4.33±0.50	71.67±4.43ab	18.92±1.79a
	10	5.92±0.66	72.75±4.99a	19.08±1.42a
Bio-Power	5	4.75±0.35	74.75±4.64a	20.33±1.77a
	10	4.50±0.57	75.58±4.23a	19.67±1.41a
Jojoba	5	3.83±0.49	59.08±2.17bc	16.33±0.69ab
	10	5.50±0.57	63.33±3.61ab	17.25±1.30ab
Malathion	1	4.69±0.46	68.90±4.77ab	19.44±1.63a
Control	0	3.92±0.50	49.08±3.96c	12.91±1.80b
F value	-	1.84	4.443	2.454
P value	-	0.083	0.000	0.024
The second season (2009)				
Nimbecidine	5	4.25±0.35bc	65.42±4.55a	18.17±1.23
	10	5.83±0.52a	71.33±2.71a	17.92±1.23

Table 3: Continued

Formulation	Rate ml/L	Vegetative characteristics		
		Number umbel	Length of flower stalk/plant	Diameter of umbel
Bio-Power	5	5.17±0.30abc	73.92±4.12a	18.50±0.84
	10	4.83±0.39abc	73.17±3.48a	17.00±0.64
Jojoba	5	3.83±0.41c	69.42±2.78a	16.33±0.54
	10	5.42±0.31ab	67.00±2.22a	16.58±1.11
Malathion	1	4.63±0.52abc	72.80±4.85a	18.97±1.44
Control	0	3.83±0.42c	48.78±4.44b	18.77±4.37
F value	-	2.848	4.36.1	0.321
P value	-	0.010	0.000	0.943

Means within a column followed by the same letter are not significantly different using Duncan's Multiple Range Test

Table 4: Weight of 100 seeds, germination percentage and yield of onion seeds treated with different compounds against infestation by *Thrips tabaci* at 2007/2008 and 2008/2009 seasons

Formulation	Rate ml/L	Parameter		
		Weight of 100 seeds (g)	Seed yield (g)	Seed germination (%)
The first season (2008)				
Nimbecidine	5	0.38±0.01d	307.63±39.74a	88.67±0.67ab
	10	0.44±0.01bc	362.40±40.21ab	93.00±1.00a
Bio-Power	5	0.48±0.01a	163.53±20.37c	74.33±2.60c
	10	0.44±0.01bc	167.33±16.54c	83.00±3.51bc
Jojoba	5	0.46±0.01abc	127.93±6.07c	75.33±5.33c
	10	0.43±0.00c	162.33±8.53c	81.00±2.00bc
Malathion	1	0.47±0.02ab	245.03±15.14b	81.33±2.19bc
Control	0	0.46±0.00abc	104.53±4.80c	42.00±4.36d
F value	-	7.634	15.582	25.259
P value	-	0.000	0.000	0.000
The second season (2009)				
Nimbecidine	5	0.40±0.01c	152.25±22.20c	80.00±5.77ab
	10	0.44±0.01b	370.76±12.76a	85.00±5.77a
Bio-Power	5	0.47±0.01ab	180.40±10.09c	80.50±1.44ab
	10	0.46±0.01ab	169.62±2.40c	72.00±11.55ab
Jojoba	5	0.46±0.00ab	189.56±10.45bc	63.50±6.64bc
	10	0.47±0.01ab	218.29±11.71b	65.00±0.00bc
Malathion	1	0.48±0.01a	185.23±8.04bc	75.00±4.04ab
Control	0	0.45±0.02ab	74.42±4.78d	48.50±2.02c
F value	-	5.519	50.766	4.212
P value	-	0.001	0.000	0.004

Means within a column followed by the same letter are not significantly different using Duncan's Multiple Range Test

effective followed by Nimbecidine, Bio-Power and Malathion at 2007/2008 season (Table 1). However, Bio-Power was the highest effective followed by jojoba oil, Nimbecidine and Malathion at 2008/2009 season (Table 2). According to the reduction percentages corresponding to the high rates, the effective of the tested compounds in the second spray could be arranged as follows Bio-Power, jojoba oil, Nimbecidine and Malathion at 2007/2008 season (Table 1). While, Malathion was the highest effective followed by jojoba, Nimbecidine and Bio-Power at 2008/2009 season (Table 2).

Effect of Treatments Against *T. tabaci* During the Flowering Period: The number of alive thrips for each Nimbecidine, Bio-Power and Malathion before the third spraying was significantly lower than control, while it was insignificant with jojoba oil at 2007/2008 season. In this season, Nimbecidine was the highest effective followed by jojoba oil, Bio-Power and Malathion (Table 1). The mean number of alive thrips for each compound before spraying was significantly lower than control at 2008/2009 season. The effective of the tested compounds can be arranged as Malathion, Nimbecidine, jojoba oil and Bio-Power in this season (Table 2).

Effect of Treatments on Vegetative Characteristics: The number of umbel per plant showed insignificant effect between treatments and control at 2007/2008 season. While it was significant with high rate for Nimbecidine and jojoba oil at 2008/2009 season in comparison with the control. The length of seed stalks per plant for each treatment was significantly higher than that of control at 2007/2008 and 2008/2009 seasons. The diameter of umbel for each treatment was significantly higher than that of control at 2007/2008 season but it was insignificant at 2008/2009 season (Table 3).

Fig. 1: Onion flowers: A&B) Untreated, C) Treated with Nimbecidine

Effect of Treatments on Yield and Germination of Seeds: There were insignificant differences between the weight of 100 seeds of treatments and control at 2007/2008 and 2008/2009 seasons exceptionally Nimbecidine (5ml/L) which showed significant difference. The yield of Nimbecidine and Malathion only was significant increasing than that of control at 2007/2008 season, while all treatments induced significant increasing in yield at 2008/2009 season. All tested compounds exhibited significant increasing in germination percentage in comparison with the control at 2007/2008 and 2008/2009 seasons. Nimbecidine was the most effective in improving germination (Table 4 and Fig. 1).

DISCUSSION

To obtain a significant reduction in thrips population crops must be sprayed more than one time. The general control recommendation of thrips is to spray the crop with insecticides as soon as the pest appears and to continue thereafter throughout the crop season [26]. However, three sprayings of chemical insecticides is generally not permitted in farming practice [27]. Therefore, it is necessary to search an alternative safe control method against *T. tabaci*. In order to find the most efficient and environmental friendly method of thrips control, this study was conducted on the field at 2007/2008 season and repeated at 2008/2009 season. Nimbecidine, Bio-Power, jojoba oil and Malathion (reference insecticide) were sprayed three times against *T. tabaci* in the field. Different Neem and *Beauveria bassiana* products were previously evaluated against various thrips species, while jojoba oil was firstly evaluated against thrips in onion field trials. Several reports revealed that *Frankliniella occidentalis, T. palmi* and *T. tabaci* were successfully controlled by using entomopathogenic fungi under field conditions [10, 28, 29]. *T. tabaci* was the most susceptible to the entomopathogenic fungi *Beauveria bassiana* [20]. Several neem products induced significant reduction in thrips population [18, 19].

In this study, the number of alive onion thrips *T. tabaci* increased in the control through the successive days for each spray in both the two seasons, while it decreased with the most tested compounds. Similar results were recorded by various authors. Neem oil reduced significantly chili thrips *Scirtothrips dorsalis* than untreated control [19]. Neem pesticides were noticed significantly superior over control in reducing the population of turmeric thrips *Panchaetothrips indicus* [18]. Thrips infestation was significantly higher in unprotected plots than all the protected plots in the first and second trials [26]. In the present study, the number of alive thrips before the second spray of the two seasons was lower than the first spray. This finding indicates that the first spray might have prolonged effects on the thrips. In 2002, Trdan *et al.* [27] found the similar result on cabbage infested by *T. tabaci*. They found little differences between one and two sprayings but three spraying showed a significant improved result.

The reduction percentage in *T. tabaci* population was more than 40% for all tested compounds through the first and second sprayings at 2007/2008 season. It was ranged between 10.2% to 87.2% with the same sprayings at 2008/2009 season. Deligeorgidis *et al.* [30] found that insecticide application reduced thrips population in tobacco fields in Northern Greece up to 78%. Meena and medhi [17] reported that the maximum percent reduction in thrips population *Dichromothrips nakahari* treated with neem oil was 82.1% under field experiment. Generally the results of this study showed that all tested compounds reduced thrips population but there was a fewer differences between of them. According to the reduction percentage of thrips population induced by the high rate (10ml/L), the compound arrange as jojoba oil, Nimbecidine, Bio-Power and Malathion with the first spray at 2007/2008 season. On the second spray at the same season and the first spray at 2008/2009 season, the effective of these compounds was arranged as Bio-Power, Jojoba oil, Nimbecidine and Malathion. The jumping of Bio-Power to tack place the first may attribute to the selectivity of this biological compound, wherever, it kill thrips pest only and it has not any action against predators of thrips like spider and mits [10, 29].

Nimbecidine was more effective on the flowering onions (3rd spray) at 2007/2008 season followed by Jojoba oil, Bio-Power and Malathion. This finding may attribute to the active ingredient of neem compound is more stability than other compounds which were more than Nimbecidine on growing onions, wherever, the onion flowers expose to the direct sun light that may be affect the stability of Jojoba oil and Bio-Power. The high rate of Nimbecidine and Malathion gave the same level of reduction in thrips population on the flowering onions at 2008/2009 season. This finding may due to the same reason mentioned above.

Vegetable characteristics such as tall and diameters of umbels were significantly increased with all treatments at 2007/2008 and 2008/2009 seasons. These significant results may have a role in exceeding the production of seed. The results revealed that seed yield of Nimbecidine and Malathion only gave significant increasing than control at 2007/2008 season, while all treatments induced significant increasing in seed yield at 2008/2009 season. Moreover, all tested compounds improved significantly the seed germination at 2007/2008 and 2008/2009 seasons. The exceeding both yield and germination of seed may due to the reduction in thrips populations that induced by treatment with the tested compounds. These finding agree with Deligeorgidis *et al.* [30] those recorded that the reduction of thrips population resulted to insecticide application induced double field yield performance of tobacco in comparison to untreated fields.

CONCLUSION

It is recommended to use the neem product "Nimbecidine" in controlling of *T. tabaci* on onion fields in spite of it gave low efficacy on growing onion period. Otherwise, it can be used Bio-Power and jojoba oil on growing onion and Nimbecidine used on flowering onion periods.

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