Toxicity of Certain Insecticides and their Mixtures for Manage of Thrips (Thripidae: Thysanoptera) on Onion Crop under Field Conditions

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ABSTRACT

The common onion *Allium cepa* L., belonging to family Alliaceae is considered as one of the oldest cultivated plants worldwide and cultivated under a widely range of climates. Onion has a great economic importance and used in the nutrition habits in all households. There are several insect pests linked with cultivated onion in the filed such as onion thrips. Onion thrips (*Thrips tabaci*) are important pests on onion and the populations can develop very rapidly so it is necessary to control its population on onion. The experiments were applied in the field to evaluate four synthetic pesticides (imidacloprid, acetamiprid, thiamethoxam and lambda-cyhalothrin) and insecticide "abamectin" and their mixtures, also to study combination of these compounds with Nonylphenol Ethoxylate (NP9) as adjuvants on their toxicity against *Thrips tabaci* on the onion field during 2023 season. The obtained results showed that, all tested compounds when used alone or in their mixtures or combination with (NP9) as adjuvants were highly effective in controlling *Thrips tabaci*.

Key words: Toxicity, Insecticide, Thrips, Onion.

INTRODUCTION

The central insect pest of onion is a *Thrips tabaci* in the worldwide (Gill *et al.,* 2015). Onion thrips reduce the plant's photosynthetic facility, feeding directly on onion foliage (Boateng *et al.,* 2014), and finally leading to a decrease in bulb size and yield (Fournier *et al.,* 1995). Onion thrips can facilitate the extent of other plant infections and spread main pathogens for example Iris yellow spot virus (Leach *et al.,* 2020). Although populations of onion thrips can be reduced by certain cultural management strategies, they have been controlled by synthetic pesticides as necessary cultural program (Leach *et al.,* 2019). Several highly active synthetic pesticides are described for controlling onion thrips in traditional onion production (Moretti & Nault, 2019 and Khozimy *et al.,* 2021), whereas synthetic insecticides are often fewer costly, save longer, easier to employ, faster working and usually assumed to be extra beneficial than bio pesticides (Arthurs & Dara, 2019; Tomizawa and Casida, 2005), imidacloprid and acetamiprid are neonicotinoid insecticides that entering the pest by direct contact or ingestion and they action as agonists of insect nicotinic acetylcholine receptors and cause paralysis then death. The neonicotinoid pesticides have many advantages, for example low residue, high efficiency and low toxicity to mammals. El- Wakeil *et al*. (2010), used thiamethoxam and imidacloprid in controlling the sucking insect containing thrips, whitefly, aphid and cotton, and they stated that, imidacloprid decreased the pest number better than thiamethoxam. Mandi and Senapati (2009), applied different insecticides for the management of onion thrips and found that thiamethoxam and acetamiprid had the highest death percentage of 89.9% and 93.3%, respectively. Organizations between big agrochemical groups to improve novel preparations and use technologies have perfected bio insecticides more useful (Dunham, 2015). Bio insecticides also serve a significant part in combined pest management (IPM) programs for they often have a slight residual activity agreeing farm workers to rapidly return treated fields, least non-target effects, and little human and environmental harmfulness (Sporleder and Lacey, 2013). Moreover, several bio pesticides have been agreed with the organic materials review institute, approving them to remain exercised in organic and in traditional crop manufacture systems. Successful management of foliar sucking onion insect pests by means of insecticides requirements co-treatment through an adjuvant (Nault *et al.,* 2020). Abamectin is a biogenic pesticide, wide spectrum properties obtained from the bacterium *Streptomyces avermitilis* and high efficiency. Abamectin has strong ability to resistor insect pests of Diptera, Lepidoptera, Hymenoptera, Dictyoptera, Coleoptera, and Homoptera (Zhenya *et al.,* 2020). Onion leaves stay oriented vertically and remain waxy (Damon and Havey, 2014), which are descriptions that impede the insecticide's capability to extent, enter leaves and stick. Adjuvants may increase the effectiveness of pesticides by dissolving the waxy epicuticular layer and transfer through the leaf cuticle (leaf penetration), adherence to leaf surfaces, also raising the pesticide's dispersal on leaf surfaces (Ryckaert *et al.,* 2007). Nault (2013) discovered an enhancement of methomyl when used with fatty acids potassium salts of contrasted to methomyl used only.

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Nault (2015) recovered advancement of an arrangement of synthetic insecticides after putting through one of several various crop oils containing a non-ionic surfactant, an organosilicone, two mineral oils and a methylated seed oil. Additional mixtures of adjuvants and bio-insecticides applied for control the onion thrips in the field onion too need to be explored. The aim of this study is to find the best successful mixture of adjuvants and insecticides for infestations treatment onion by thrips. Pesticides were carefully chosen built on their action on the onion thrips.

MATERIALS AND METHODS

The trials to assess four synthetic pesticides and insecticide to management the onions thrips which applied through 2022-2023 time in onion field of plant protection department. The experiments were applied by Randomized Complete Block Design by six treatments with three replications at both positions in addition to control plots. The assessment insecticide at these experiments is recorded in Table (1) and their doses used were established on the sticker approval amount. The pesticides were taken from Shoura Company for Pesticides Cairo.

The make plot extent for all treatment stayed 10x8 m^2. The onion crop was planted on 15^{th} of October and transferred on attaining the time of 45 times to the ridges. The ridges remained 30 cm apart with two lines of onion plants at their tops. These lines stayed 20 cm separately from each other and the distance from plant to plant were ten-cm. All agronomic methods were applied by equal on each treatments excluding applications of the pesticides to be investigated for the thrips management. In other experiments, invariable pesticides were applied including NP9 as surfactant at the rate of 0.5 mL per liter of water which treated for the experiments. In the latter, insecticides were applied with mix imidacloprid + lambda-cyhalothrin, Imidacloprid + acetamiprid, imidacloprid+ thiamethoxam, lambda-cyhalothrin + thiamethoxam, lambda-cyhalothrin + acetamiprid, and acetamiprid + thiamethoxam by ratio 1:1 ml/L for assessment through spray. Before-treatment insecticide, numbers of thrips were documented at normal weekly intervals from 10 randomly chosen plants in both replicate then the amounts of thrips founded in all management were visually reckoned and mean to find the average population for both replicates. Insecticidal treatment was employed once economic injury level of onion thrips from 5 to 10 thrips/plant. In the early morning hours spraying insecticide were done to prevent the mid-day high temperature. In all investigational design, 5 plants were randomly carefully chosen labeled for recording observations. Before applying insecticides by a day in different treatments the number of thrips “adults and nymphs” per plant were under the range of 7 to 9, which considered in the formula. After application of the insecticides, the observations were note down at 14-, 10-, 7-, and 3-Days next spray. Reduction percent was documented according to Henderson and Tilton’s (1955) formula as fellow:

$$\textbf{Reduction \%} = \mathbf{1 - \left(\frac{Ta \times Cb}{Tb \times Ca}\right) \times 100}$$

Where: -

Cb = Aveg. % of infestation in control before spray.

Ta = Aveg. % of infestation in treatment plots after spray.

Tb = Aveg. % of infestation in treatment plots before spray.

Ca = Aveg. % of infestation in control after spray.

Completely data were evaluated statistically for investigation of variance to determine the significant difference between the insecticide and statistical analyses applying used MSTAT-C software v.11.0.

Table 1. The tested insecticides and their field rates

No.	Trade name	Common name	Amount per Fadden
		Neonicotinoid Insecticides	
1	Magnock 70%WG	Imidacloprid	140 gm
2	Aceta gold 20%SP	Acetamiprid	50 gm
3	Actara 2.5 WG	Thiamethoxam	60 gm
		Pyrethroids Insecticides	
1	Lambagoc 5% EC	Lambda-cyhalothrin	500 ml
		Avermectins Insecticides	
1	Bermectine 1.8% EC	Abamectin	200 ml
		Emulsifier	
1	NP9	Nonylphenol Ethoxylate	0.5 ml/L

RESULTS AND DISCUSSIONS

1- Effectiveness of several insecticide used only against the onion *T. tabaci* in the field.

Table (2) demonstrated that, each from of these insecticides were confirmed the decreases significances of the onion thrips over the untreated check. Ability of insecticide treatments in controlling *T. tabaci* reduced with increase in data collecting interval after 7day. Imidacloprid and lambda-cyhalothrin was the superior followed abamectin, thiamethoxam, and acetamiprid, correspondingly. The mean reduction percentages next spray was 70.7, 70.4, 67.7, 67.5 and 61.15% for imidacloprid, lambda-cyhalothrin, abamectin, thiamethoxam, and acetamiprid, respectively. These calculations stand in agreement by Barakat (2020).

The impact of bio-Catch®, tracer®, actellic®, nimbecidine®, admire®, admiral®, lannate® and emacit® against *T. tabaci* at their mentioned rates in open field. The maximum effective among the tested insecticides was Admire®, caused 98.08%, followed by nimbecidine® 94.88% and tracer® provided 94.34% against thrips adults next seven days of spray, at primarily season. The insecticides gave important reduction values of infestation. The insecticides recorded significant reductions in thrips numbers at the 7th day for the residual effect, but for admiral® and bio-Catch®, where they conferred the lowest values 86.55% and 85.89% of reduction percentage correspondingly, at the same time. imidacloprid 17.8 SL was the greatest when used by 1 ml/ liter in decreased thrips population in onion as reported by Das *et al.* (2017). Uddin *et al.* (2019) establish that acetamiprid 125 gm/acre remained the top action against onion *T. tabaci* then profenofos 500 ml/acre and imidacloprid 80 ml/acre (Rao *et al.*, 2019). Imidacloprid is activity on various sucking pests, containing thrips and wide variety insecticide known for pest (McKenzie *et al.*, 2015). A study worked on effectiveness of biorational insecticides on chilli thrips and *S. dorsalis* (Ravikumar *et al.*, 2016), where they reported that, emamectin benzoate 5 sg @0.4 g per liter was very successful against chilli thrips and *S. dorsalis.*

2-Influence of NP9 additive on the ability of insecticides against the onion *T. tabaci* in the field.

Table (3) demonstrated that, result of NP9 adding rate 0.5% as emulsifier element on the efficacy of imidacloprid, lambda-cyhalothrin, abamectin, thiamethoxam, and acetamiprid against *thrips tabaci* in the onion filed. Imidacloprid was the upper followed by lambda-cyhalothrin abamectin, thiamethoxam, and acetamiprid, by arrangement. The mean reduction percentages for the insecticides were 77.95, 76.05, 73.15, 72.6 and 65.8%, by arrangement. The influence of surfactants in enhancing the ability of pesticides has been described through previous study's (Nault, 2013). Gangwar *et al.* (2016), decided that the external surface for the onion leaf is smooth and waxy which does not let the insecticide to stick correctly and also spread the residual influence of pesticide is less toxicity due to the spray droplets were roll off on the surface of the leaves. Applying the surfactant mix insecticides is the greatest way to prevent this problem (Nault, 2015). Using adjuvants in field onion are universally for increasing ability of conventional synthetic insecticides for onion thrips control**.**

Table 2. Effectiveness of several insecticides used only against the onion *T. tabaci* under field conditions

Insecticides	Number of thrips/ plant and reduction percent of *T. tabaci* before and after spray					A mean reduction percent
	Pre-spray	3 days	7 days	10 days	14 days	
Control	8	23	87	207	321	-
Imidacloprid	7	8	17	43	87	70.7
	*R%	60	77.7	76	69	
Lambda-cyhalothrin	8	8.5	21	52	103	70.425
	*R%	63	75.9	74.9	67.9	
Abamectin	9	11	25	63	120	67.7
	*R%	57	74	73	66.8	
Thiamethoxam	7	9	18	47	99	67.55
	*R%	55.3	76	74.1	64.8	
Acetamiprid	8	11	30	68	128	61.15
	*R%	52	65.6	67	60	

Table 3. Influence of NP9 additive on the ability of insecticides against thrips in the onion filed

Insecticides	Number of thrips/ plant and reduction percent of *T. tabaci* before and after spray					A mean reduction percent
	before-spray county	3days	7days	10 days	14days	
Control	8	23	87	207	321	-
Imidacloprid	7	5.5	15	27.5	73	77.95
	*R%	72.7	80.3	84.8	74	
Lambda-cyhalothrin	7	6	16	29	81	76.05
	*R%	70.2	79	84	71	
Abamectin	8	8	20	38	98	73.15
	*R%	65	77	81.6	69	
Thiamethoxam	9	9	23	47	112	72.575
	*R%	65	76.5	79.8	69	
Acetamiprid	10	8	25.5	55.5	118	65.825
	*R%	56.5	70.7	73.1	63	

3. Field efficiency of some insecticides mixture on thrips in the onion filed.

Table (4) showed the toxicity of lambda-cyhalothrin + imidacloprid, lambda-cyhalothrin thiamethoxam, lambda-cyhalothrin + acetamiprid, imidacloprid + thiamethoxam, imidacloprid + acetamiprid and acetamiprid + thiamethoxam on the thrips infesting onion plants. The highest synergistic effects were obtained with lambada-cyhalothrin + imidacloprid when mixed in (1:1) ratio with 82% reduction. All treatments showed significant effect than untreated control, and after the applications of insecticide alone in reducing the infestation of thrips. The lowest synergistic effect was observed for mixed acetamiprid + thiamethoxam with 69.1% average reduction. The average percent reduction for the insecticide's mixtures lambda-cyhalothrin + imidacloprid, lambda-cyhalothrin + thiamethoxam, lambda-cyhalothrin + acetamiprid, imidacloprid+ thiamethoxam, imidacloprid + acetamiprid, and acetamiprid + thiamethoxam were 82, 76.6, 76.5,74.8,73.7 and 69.1% reduction, respectively.

Table 4. Field efficiency of some insecticide's mixture on thrips in the onion filed

Insecticides	Number of thrips/ plant and reduction percent of *T. tabaci* before and after spray					A mean reduction percent
	before-spray county	3 days	7 days	10 days	14 days	
Control	8	23	87	207	321	-
Lambda-cyhalothrin + Imidacloprid	7	5	7.8	23.6	68	82
	*R%	75.2	89.8	87	75.8	
Lambda-cyhalothrin + Thiamethoxam	7	6.5	12.5	31.5	77	76.6
	*R%	67.7	83.6	82.6	72.6	
Lambda-cyhalothrin + Acetamiprid	8	3	17.5	56	109	76.5
	*R%	87	80	73	66	
Imidacloprid + Thiamethoxam	8	8	15.2	38	97	74.8
	*R%	65.2	82.5	81.6	69.8	
Imidacloprid + Acetamiprid	9	7	21.6	52.5	118	73.7
	*R%	72.4	78	77.5	67	
Acetamiprid + Thiamethoxam	8	7	26	52.5	122	69.1
	*R%	69.6	70	74.6	62	

Combinations of pyrethroids and neonicotinoids arisen an improver influence. Our results are concurred with Reddy *et al.* (2018), who noticed that lambda-cyhalothrin combinations with thiamethoxam decreased *A. craccivora* quantities in the cowpea fields. The improver result may be produced by the statement that pyrethroids and neonicotinoids are balancing in a perfect technique, pyrethroids give succeed through contact and a quick knockdown effect; neonicotinoids are systemic, meaning they can reach hidden pests by distributed throughout the plant sap. According to results of IRAC, these combinations used for agricultural management, supplied that, the pest populations continue not resistant to any of the components (Housset *et al.*, 2009). There are few revisions on neonicotinoids-pymetrozine or neonicotinoids abamectin combinations. The interface patterns of abamectin- thiamethoxam combinations were investigated by this revision. Combinations with a 1: 5 rate abamectin: thiamethoxam proved an additive stimulus, whereas combinations by 1:1 relationship shown strong synergism. Equally, Levchenko and Silivanova (2019), establish that a 2.5: 1 acetamiprid / ivermectin combination provided strong synergistic effects. Moreover, the mixture of thiamethoxam and abamectin gave the maximum residual toxicity anti the Asian citrus by Vanaclocha *et al*. (2019). Concerning thiamethoxam-pymetrozine combinations neonicotinoids–pymetrozine, combination with a percentage of 4: 3 showed high synergism effect, whereas the assortment with rate 1:1 showed small synergism against the *A. gossypii* Glover, similar results were found with pymetrozine: imidacloprid combinations, the ratio 1:1 manufactured resulted the highest synergistic effect (Somar *et al.*, 2019). Mohammed *et al.* **(**2022**)**, reported that neonicotinoid combinations, particularly those through cholinesterase inhibitors (pyrethroids, and abamectin) caused either synergistic or additive effects. It can kill aphid resistance to certain traditional pesticides. The gained results indicate to stipulate valuable indications about mixtures that can stimulating in pest used for controlling.

CONCLUSION

According to the results, these admixed compounds can be included in an integrated control program for *T. urticae* on cucumber crops in greenhouses and/or used interchangeably with acaricides that have a longer PHI period to avoid resistance to abamectin compounds, which are widely and frequently used during this period in most fields.

Therefore, we can say that amongst the suitable acaricides for integrated pest management (IPM) for *T. urticae* are Ignar® and Highpoint®.

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الملخص العربي

سمية بعض المبيدات وخلائطها في مكافحة آفات التربس على محصول البصل تحت الظروف الحقلية

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يعتبر البصل الشائع *Allium cepa* L. الذي ينتمي إلى عائلة Alliaceae أحد أقدم النباتات المنزرعة في جميع أنحاء العالم ويتم زراعته في ظل مدى واسع من التنوع المناخي. البصل له أهمية اقتصادية كبيرة ويستخدم في العادات الغذائية لجميع الأسر. هناك العديد من الآفات الحشرية المرتبطة بالبصل المنزرع في الحقل مثل تربس البصل. تربس البصل (*Thrips tabaci*) هي آفة مهمة على البصل حيث يتطور تعدادها بسرعة كبيرة، لذلك من الضروري التحكم في تعداد حشرة التربس على نبات البصل. أجريت هذه التجربة في مزرعة كلية الزراعة جامعة الأزهر بأسيوط لتقدير فاعلية أربعة من المبيدات وهم اللمبادا سيهالوثرين والأسيتامبريد وثياميثوكسام والإميداكلوبريد بالإضافة إلى مبيد الأبامكتين ومخاليطها فى خفض الإصابة بالتربس على محصول البصل. كما تمت دراسة تأثير إضافة السيماسول Nonylphenol Ethoxylate (NP9) كعامل منشط لهذه المبيدات. وأوضحت النتائج أن جميع المركبات ساهمت في خفض الإصابة بالتربس على محصول البصل وكذلك أدت إضافة وخلط بعض هذه المواد مع بعضها إلى تنشيط وزيادة سمية بعض المركبات المستخدمة في مكافحة التربس. وكذلك أدت إضافة السيماسول كماده منشطة إلى تنشيط وزيادة سمية جميع المركبات المستخدمة في مكافحة التربس.

الكلمات المفتاحية: سمية – المبيدات – التربس – البصل.