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Efficiency of Some Neonicotinoids Compounds Against Whitefly (*Bemisia Tabacion*) Stages in Tomato Under Field Conditions

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ABSTRACT:

Field experiments were carried out at the experimental farm of Etay-El-Baroud Agricultural Research Station, Beheira Governorate, Egypt, during the 2021 season to evaluate the efficiency of four neonicotinoids compounds [Thiamethoxam (Actara 25% WG), Imidacloprid (Pestidor 25% WP), Acetamiprid (Mosiplan 20% SP), and Thiacloprid (Calypso SC 480)] on whitefly (*Bemisia tabacion*) stages in tomato. These compounds were assessed as commercial formulation sizes using the recommended dose against whitefly stages on tomato for comparison between four sprays and their residues in leaves after different periods of application. The effects of all insecticidal treatments on the natural population of whitefly stages (nymphs and adults) were recorded as the reduction percentage of whitefly population stages at 2, 5 and 7 days after the first, second, third and fourth sprays in the field. In general, the obtained results indicate that all tested treatments decreased the whitefly population stages (nymphs and adults) compared to the control.

Keywords: Neonicotinoids compounds, whitefly (*Bemisia tabacion*), population, tomato.

Introduction:

Tomato (*Lycopersicone sculentum* Mill) is one of the most important solanaceous vegetable crops in Egypt. The tomato plants are currently infested with many serious pests. The most destructive pest is the whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae). The whitefly is a polyphagous insect pest on more than 600 different plant species **(Jahelet**

***et al*., 2017).**Whitefly causes economic losses in vegetable, fiber, and ornamental crops due to both direct damage through phloem feeding and injection of toxins and indirect damage to the host plant through its ability to transmit plant viruses (**Pereira *et al*., 2004; Brown, 2010).**Moreover, an unfavorable side effect of whitefly infestation is the production of carbohydrate rich honeydew excretions, which make the leaves sticky, impair photosynthesis and support the growth of sooty mold fungi on the plant leaf and fruit surfaces **(Stansly, and Natwick, 2009).**

Neonicotinoid insecticides are compounds acting agonistically on insect nicotinic acetylcholine receptors (nACHR). They are especially active on hemiptera pest species such as aphids, whiteflies and plant hoppers, but also recommended to control many coleopterans and some lepidopteran pest species **(Nauen*et al*., 2003).** The benefits of using systemic insecticides (Imidacloprid, Thiacloprid, Thiamethoxam and Acetampride) over contact insecticides are that in most cases, they provide continuous plant protection through most of the growing season without the need for repeated applications.

In addition, systemic insecticides are not susceptible to ultra violet light degradation or "wash off" during watering and the risk of overexposure to applicators is minimized **(Herbert *et al*., 2008)**. The aim of the research is to evaluate the effectiveness of some neonicotinoids compounds whitefly stages (nymphs and adults) in tomatoes under field conditions.

MATERIALS AND METHODS:

Experimental site:

The experiments were carried out at the experimental farm of Etay-El-Baroud Agricultural Research Station, Beheira Governorate, Egypt, during the summer and autumn plantations of 2021.

Tested insecticides:

Acetamiprid (Mosiplan 20% SP) at 25 g/100 L of water, Imidacloprid (Pestidor 25% WP) at 100 g/100 L of water, Thiamethoxam (Actara 25% WG) at g/100 L of water and Thiacloprid (Calypso 48% SC) at of 120 c/ feddan were used in this study.

Procedures of evaluation:

In this study, eight treatments were used in successive season 2021 on tomato plantations in summer and autumn. All treatments were divided into eight, including the control area of 182 m^2. The random block design was completely used in the field experiment, with four replicates per treatment (30 sheets per repetition) as well as the untreated piece. Each piece is separated from the other by a meter belt to reduce interference from another treatment drift. Observations were recorded before and after the treatment of whitefly on thirty leaves from the apical (each of the upper, middle and lower canopy) of five plants with a random marker of each segment in each recurrence in one day before and after 1, 3, 7 and 10 days of treatment. Population reduction was calculated using the **derson-Tilton equation (1955).**

Statistical analysis:

The Statistical Package for Social Sciences **(SAS Institute, 1988)** was used for all data analysis. One-way analysis of variance (ANOVA) was used to analyze the data, and Duncan's test was used to compare the effectiveness of the various treatment groups. Statistical significance was set at $p \leq 0.05$.

Results and discussion:

The effects of all insecticidal treatments on the natural population of whitefly stages (nymphs and adults) were recorded as a reduction in percent of the whitefly population stage at 2, 5, and 7 days after the first, second, third, and fourth sprays in the field. Overall, the results showed that all insecticidal treatments reduced the whitefly population stage (nymphs and adults) when compared to the control.

all the insecticidal treatments decreased the whitefly population stage (Nymph and Adults) comparing with control.

1-First Spray:

Data presented in **Table (1)** showed that, at 2 days, after One first spray Actra formulation caused the highest percent reduction of natural population of Nymph and Adults whitefly rates (95.56 and 88.03%) followed by Pestidor (88.18 and 75%), finally Mosiplan (87.13 and 81.19), respectively. On the contrary, calypso, treatment gave the lowest

percent reduction which represent (64.34 and 82.05%), respectively, (table1).

Table (1): Effect of some insecticides against whitefly, *Bemisiatabaci* population on tomato after first spray under field conditions.

Treatments	Reduction over control in % (days)							
	2		5		7		mean	
	Nu	%	Nu	%	Nu	%	Nu	%
Nymph								
Pestidor	56.00 c	88.18	107.00 b	77.18	118.00 b	75.00	93.66	80.12
Calypso 48% EC	169.00 b	64.34	48.33 e	90.40	89.00 cd	81.14	101	78.62
Mosiplan 20% SP	61.00 c	87.13	65.00 d	86.14	94.00 c	80.08	73.33	84.45
Actra 25% wg	21.00 d	95.56	84.00 c	82.08	84.00 d	82.20	63.00	86.61
control	474.00 a	-	469.00 a	-	472.00 a	-	-	-
LSD 0.05	21.34		8.41		5.02			
Adults								
Pestidor	117.00 b	75.00	181.00 b	62.05	197.00 b	59.04	165	65.36
Calypso 48% EC	84.00 c	82.05	90.00 d	81.13	105.00 e	78.17	93.00	80.45
Mosiplan 20% SP	88.00 c	81.19	101.00 d	78.82	139.00 d	71.10	109.33	77.03
Actra 25% wg	56.00 d	88.03	119.00 c	75.50	182.00 c	62.16	119.00	75.23
control	468.00 a	-	477.00 a	-	481.00 a	-	-	-
LSD 0.05	8.32		13.54		13.94			

Nu= Mean number of White fly Nymph and Adult / 30 leaves**%**= %Reduction.

Also, the results tabulated in table (1) clearly show the effect of the tested insecticides on individual whitefly population stages (nymphs and adults) at 5 days after One first spray recorded the highest percent reduction of Calypso, Mosiplan, Actara and Pestidor rates of 90.40, 86.14, 82.08, and 77.17% of the nymph stage, respectively, while Pestidor formulation gave the lowest controlling rates of 62.05 % of the adult stage. The corresponding adult stages of the whitefly population, Mosiplan and Actara gave, had intermediate controlling rates of 78.82 and 75.50%, respectively. Comparing with calypso treatment, it gave the highest controlling rates (81.13%, respectively) (table 1).

After seventh day during One first spray, Actara was found to be more effective compared to all insecticidal treatments in percent reduction on individual whitefly population stages (nymphs) after the seventh day, but Calypso gave superior to all insecticidal treatments to percent reduction on individual whitefly population adults stage (adults) compared control. On the contrary, pestidor, treatment gave the lowest percent reduction which represent (75%) of nymphandActara gave the lowest percent reduction which represent (62.16%) of adults, respectively, (Table1).

2-Second Sprays:

Table (2) shows the differences in the effects of Calypso, Mosiplan, Actara, and Pestidor on these whitefly population stages (nymphs and adults) at 2, 5, and 7 days after the second spray. Calypso formulation reduced whitefly population Nymph at 2, 5, and 7 days after second spray compared to other treatments. It had the highest percent reduction rates (95.58,86.04, and 81.13%), followed by Mosiplan (95.37, 85.20, and 78.19%), Actara (95.16,80.12, and 76.10%), and Pestidor (85.08,81.18, and 79.24%). Also Pestidor treatment gave the lowest percent reduction in whitefly population adults at 2 and 5days after second spray, but, it gave the highest percent reduction at 7days after second spray followed by all insecticidal treatments to percent reduction on individual whitefly population stage (adults).

All insecticidal treatments recorded the highest percentage of reduction in whitefly population (nymph and adults) at 2, 5 and 7days after second spray comparing un treatment.

Table (2): Effect of Some Neonicotinoids Compounds Against Whitefly Population on Tomato After Second Sprays Under Field Conditions.

Treatments	Reduction over control in % (days)							
	2		5		7		mean	
	Nu	%	Nu	%	Nu	%	Nu	%
Nymph								
Pestidor	71.00 b	85.08	89.00 c	81.18	99.00 d	79.24	86.33	81.83
Calypso 48% EC	21.00 c	95.58	66.00 d	86.04	90.00 e	81.13	59.00	87.58
Mosiplan 20% SP	22.00 c	95.37	66.67 d	85.20	104.33 c	78.19	76.66	86.25
Actra 25% wg	23.00 c	95.16	94.00 b	80.12	114.00 b	76.10	77.00	83.79
control	476.00 a	-	473.00 a	-	477.00 a	-	-	-
LSD 0.05	**8.17**		**4.89**		**3.35**			
Adults								
Pestidor	118.00 b	75.05	129.00 b	73.18	82.00 e	83.09	109.0	77.10
Calypso 48% EC	104.00 c	78.01	105.00 e	78.17	116.00 d	76.08	108.33	77.42
Mosiplan 20% SP	85.00 d	82.02	115.00 d	76.09	135.00 c	72.16	111.66	76.75
Actra 25% wg	85.00 d	82.02	125.00 c	74.01	145.00 b	70.10	118.33	75.37
control	473.33 a	-	481.00 a	-	485.00 a	-	-	-
LSD 0.05	**5.35**		**3.58**		**9.25**			

Nu=Mean number of White fly Nymph and Adult / 30 leaves**%**= %Reduction

3-<u>Third Sprays</u>:

The results in Table (3) show that all of the tested insecticidal treatments reduced whitefly population stage (nymph and adults) compared to the control at 2, 5, and 7 days after the third spray. Furthermore, all of the chemical treatments resulted in the greatest percentage reduction of whitefly population stage. Actara provided the highest percent reduction of mean whitefly population stage (nymph and adults) with rates of (89.85 and 79.07%), followed by all insecticidal treatments. Pestidor gave the lowest percent reduction of mean whitefly population stage (nymph and adults) with rates of (80.37 and 74.53%), respectively. After two, five, and seven days of spraying in each

insecticidal treatment, the population of whitefly gradually decreased and the percent reduction over control increased.

Table (3): Effect of some neonicotinoids compounds against whitefly population on tomato after third sprays under field conditions.

Treatments	Reduction over control in % (days)							
	2		5		7		mean	
	Nu	%	Nu	%	Nu	%	Nu	%
Nymph								
Pestidor	81.00 b	83.01	90.00 b	81.09	110.00c	77.03	93.66	80.37
Calypso 48% EC	33.00 c	93.08	71.00 d	85.08	111.00c	76.82	71.66	84.99
Mosiplan 20% SP	27.00 c	94.12	80.00 c	83.19	86.00d	82.04	64.66	86.45
Actra 25% wg	31.00 c	93.50	81.67 c	80.04	119.00b	96.03	81.66	89.85
control	477.00a	-	476.00a	-	479.00a	-	477.33	-
LSD 0.05	**8.49**		**2.60**		110.00c			
Adults								
Pestidor	120.00 b	75.05	120.00 c	75.50	132.00 c	73.06	124.33	74.53
Calypso 48% EC	62.00 d	87.11	111.00 d	77.11	161.00 b	67.14	111.33	77.12
Mosiplan 20% SP	61.00 d	87.31	126.00 b	74.02	117.00 d	76.12	101.33	79.15
Actra 25% wg	77.33 c	81.08	87.00 e	82.06	126.00 c	74.08	101.66	79.07
control	481.00 a	-	485.00 a	-	490.00 a	-	485.33	-
LSD 0.05	**9.21**		**5.72**		**6.34**			

Nu=Mean number of White fly Nymph and Adult / 30 leaves**%**= %Reduction

4-**Forth sprays:**

Table (4) shows that after the fourth spray at 2, 5, and 7 days, all tested insecticidal formulations reduced whitefly population stage (nymph and adults) compared to uncontrolled. Pestidor formulation had the lowest percent reduction of whitefly population stages (nymphs and adults) at 2, 5, and 7 days, ranging from 71.16 to 78.87%. Furthermore, it was found that after the fourth spray, all insecticidal treatments reduced whitefly populations better than the untreated control. The percentage reduction in whitefly population over control ranged between 70.74 and 93.18%. After five and seven days of fourth spray, the population of whiteflies gradually decreased, and the percent reduction over control increased.

Table (4): Effect of some insecticides against whitefly population on tomato forth sprays under field conditions.

Treatments	Reduction over control in % (days)							
	2		5		7		mean	
	Nu	%	Nu	%	Nu	%	Nu	%
Nymph								
Pestidor	101.00 b	78.87	134.00 b	72.08	139.33 b	71.16	124.66	74.3
Calypso 48% EC	52.00 d	89.12	72.00 d	85.00	115.00 c	76.14	79.66	83.40
Mosiplan 20% SP	33.00 e	93.09	81.00 cd	83.12	141.00 b	70.74	85.00	82.29
Actra 25% wg	76.00 c	84.10	91.00 c	81.04	110.00 c	77.17	92.33	80.76
control	478.00 a	-	480.00 a	-	482.00 a	-	480.00	-
LSD 0.05	9.83		9.15		5.37			
Adults								
Pestidor	106.00 b	78.09	122.00 b	75.10	128.67b	74.08	118.66	75.75
Calypso 48% EC	97.00 c	79.95	98.00 c	80.00	83.33 e	83.19	92.66	81.00
Mosiplan 20% SP	33.00 d	93.18	83.33 d	83.06	98.00 c	80.16	71.33	85.42
Actra 25% wg	96.00 c	80.16	73.00 e	85.10	93.00 d	81.17	87.33	82.15
control	350.67 a	-	356.67 a	-	494.00 a	-	489.33	-
LSD 0.05	7.21		7.08		4.53			

Nu= Mean number of White fly Nymph and Adult / 30 leaves**%**= %Reduction.

On the other hand, Calypso gave the greatest percent reduction of mean whitefly population stage (nymph) in rats (83.40%), while Mosiplan provided the greatest percent reduction of mean whitefly population stage (adults) in rats (85.42%), followed by all insecticidal treatments (Table 4).The present findings are more or less similar with earlier workers like **Al-Kherb (2011)** highest efficacy against whitefly in cucumber and tomato with thiamethoxam which is partially agreed with the above results. **Zhang *et al*.(2011)** the high efficacy of Actara is due to its long-term effect on the population of the whiteflies because it is dissolved slowly within the plant tissues. **Ramalkshmi*et al*., (2012)** studied the bioefficacy of novel insecticides viz., fipronil 5% SC @ 50 g a.i. ha-1 , fipronil 80% WG @50 g a.i. ha-1, diafenthiuron 50% WP @ 375 g a.i. ha-1, buprofezin 25% SC @150g a.i. ha-1, acephate 75SP @ 750 g a.i. ha-1 and imidacloprid 70% WG @ 21 g.a.i. ha-1 for their efficacy against cotton leafhopper. Among all treatment fipronil found effective and next

best treatments were diafenthiuron and buprofezin followed by acephate and imidacloprid. **El-Naggar and Zidan (2013)** reported that the effect of imidacloprid and thiamethoxam against sucking insect pest like white fly, jassids and aphids and reported the maximum reduction percentage at 40 days. **Zewain *et al.*, (2013)** evaluated three insecticides, viz. sulfoxaflor 24% SC at following three doses (100, 200 and 300 ml/ha), for their efficacy against whitefly (*Bemisia tabaci* Genn) on cucumber. Sulfoxaflor @ 200 and 300 ml/ha and Proteus at its field recommended dose caused significant mortality of whitefly up to three days after first application. AbdElhady *et al*.,(2014) found that Actara gave a high mortality rate of 87% against the whiteflies (Biotype B) on the cucumber when used in the spraying method with a concentration of 2 g/L water. **Das and Islam (2014)** found that imidacloprid, fipronil and buprofezin were exibited high efficacy against white flies and jassids while, thiamethoxam + emamectin benzoate showed moderate efficacy. **Surwase (2017)** evaluated seven insecticides viz. Acetamiprid 20 SP at 150 g/acre, imidacloprid 200 SL at 250 ml/acre, bifenthrin 10 EC at250 ml/acre, carbosulfan 25 EC at 500 ml/acre, thiamethoxam 25 WG at 24 g/acre, diafenthiuron 50 WP at 200 ml/acre and methamidophos 60 SL at 500 ml/acre for their efficacy against jassid, whitefly andthrips in cotton they observed that imidacloprid and acetamiprid against jassid, acetamiprid and thiamethoxam against whitefly and acetamiprid, imidacloprid and methamidophos against thrips found most effective. **Mohammad, ali *et al.*, (2019)** this study showed the high efficacy of the Neocontinoids, Acatra, and Calypso which gave the best mortality after one day of the application; the high efficacy is related to the destructive effect of these insecticides on Nicotinic acetylcholine receptor (NAchR) receptors in the neurotransmitter fibers of the central and peripheral nervous system of the insect; the high-polarity Neocontinoids absorb rapidly and are transported to all parts of the plant; Neocontinoids have the ability of continuous transmission of nerve impulses, causing agitation, paralysis, and death of the insect. **Lasheen, (2020)** revealed that the spray application of spiromesifen provided residual control of white fly, *B. tabaci* on spring cantaloupes.In conclusion it could be recommended using four

neonicotinoids [Thiamethoxam (Actara 25% WG), Imidacloprid (Pestidor 25% wp), Acetamiprid (Mosiplan 20% SP) and Thiacloprid (Calypso SC 480)] in commercial formulation size using recommended dose against whitefly stage on tomato.

Conclusion:

The aim of the research is to evaluate the effectiveness of some neonicotinoid compounds[Thiamethoxam (Actara 25% WG), Imidacloprid (Pestidor 25% wp), Acetamiprid (Mosiplan 20% SP) and Thiacloprid (Calypso SC 480)]on some stages of whitefly (Nymph and Adults)on tomatoes at the Itai Al-Baroud Agricultural Research Station during the fall season 2021.In general, the obtained results indicated that all insecticidal treatments decreased the whitefly population stage (Nymph and Adults) comparing with control on tomato.

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كفاءة بعض مركبات (النيونيكوتينويد) ضد مراحل الذبابة البيضاء على الطماطم تحت الظروف الحقلية

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الملخص العربي:

أجريت تجارب حقلية بمحطة البحوث الزراعية بإيتاي البارود بمحافظة البحيرة، خلال موسم 2021 لتقييم كفاءة أربعة مركبات مختلفة تابعة لنيونيكوتينويدات وهي، ثياميثوكسام (أكتارا ٢٥% WG)، إيميداكلوبريد (بستيدور 25٪ WP)، أسيتاميبريد (موسيبلان ٢٠٪)، ثياكلوبريد(كالبسو480 SC) في تجهيزات تجارية باستخدام الجرعة الموصى بها ضد الذبابة البيضاء على الطماطم للمقارنة بين أربع رشات تحت الظروف الحقلية وبقاياها في الأوراق بعد فترات مختلفة من الاستخدام. تم تسجيل تأثيرات جميع المعاملات بالمبيدات الحشرية على التجمعات الطبيعية للذبابة البيضاء (طور حورية، الحشرة الكاملة) كنسبة مئوية من الانخفاض المئوي للذبابة البيضاء (حورية والحشرة الكاملة) في 2 و5 و7 أيام بعد الرش الأول والثاني والثالث والرابع تحت الظروف الحقلية. وبصفة عامة أشارت النتائج المتحصل عليها أن جميع المعاملات بالمبيدات قللت من مجموع الذبابة البيضاء (حورية والحشرة الكاملة) مقارنة بمجموعة الكنترول.