Field Comparison Between The Bioresidual Activity And Droplet Distribution Of Different Insecticides Against Some Piercing And Sucking Insects Infesting Tomato Seedling By Using Certain Ground Spraying Equipment

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Abstract: Field experiments were carried out in an area of about 10 kirats planted with tomatto seedling varity (Viona) during season 2014 in 22th September at Elramla, Banha, Qalyoupia governorate. The selected area was split into 9 plots and control plots. Three products were sprayed Deltamethrin, Marchal and Mosbilan of recommended dose rate and one treatment left without spraying as control by using Knapsack sprayer-Lever Operated (Pulmic118) (80 L./Fed.), Economy Micron ULVA sprayer (15 L/Fed.) and hand held compression sprayer (Kwazar) (94 L/Fed.) Data indicated that, all tested compounds induce significant negative influenced on both *Bemisia tabaci* and *Empoasca discipiens* adults survival. The most effective compound is Marchal followed by Deltamethrin and Mosbilan. It could be recommended to use those compounds with LV spraying equipment with not less than (15L/Fed.). The data showed that Lever Operated (Pulmic 118) was the pest equipment to control both *Bemisia tabaci* and *Empoasca discipiens* on Tomato seadling. The productivity of Micron ULVA sprayer was 3.04 Fed./day. It was the best equipment, but the lowest productivity was Pulmic 118 sprayer since it could spray only 2.30 Fed./day.

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Key words: Tomato seedling, Bioresidual activity, *Bemisia tabaci, Empoasca discipiens*,Deltamethrin, Marchal, Mosbilan, LV and Ground Equipment.

1. Introducion

Percing and sucking insects are dangerous pests which infested Tomato seedling and couse great hazarads to it after short period of cultivation. In Egypt, majority of interest was directed to the type, dosage of insecticides used, while a lesser attention was given to the application methods. A comparative studies on the efficiency of certain ground sprayers was carried out by (**Hindy, 1992**), who recorded significant variation in the spray deposit due to arrangement of the nozzles, spray technique and rate of application. The world attention was directed to minimization of spraying volumes and the costs of control pests which may be achieved by using a cheap and effective insecticide or using developmental ground spraying technique with low cost of application per feddan (**Magdoline *et al*., 1992**) and (**Mathews, 1992**).This work aimed to determine the best insecticide and the best equipment controlling *Bemisia tabaci* and *Empoasca discipiens* on Tomato seadling.

2. Materials and Methods

The Tested Compunds:-

1. Carbosulfan (Marchal®), 20% E.C., 200 cm/ fed.

2.Deltamethrin (Decis®), 2. 5 % E.C., 250 cm /fed.

3. Acetamiprid (Mosbilan®), 20%S.p., 100 gm/ fed.

Spraying equipment tested on Tomato seadling:-

Three ground application machines were selected to perform the scope of this work as follows:

1. Economy Micron ULVA sprayer (15L./fed.)
2. Knapsack sprayer-Lever Operated (Pulmic 118) (80 L./fed.).
3. Hand held compression sprayer (Kwazar) (94 L./fed.)

Execution of field experiments:-

Arrangements of the experiments.

Field experiments were carried out during season 2014 on 22th September in private Tomato field located at Elramla, Banha District, Qalyoubia Governorate. The Tomato cultivated varity was Viona, the experiments were done under local meteorological conditions of 27°C average temperature, 55% average RH and 3 m/sec. average wind velocity. The selected area of 10 kirats was split into 9 plots and control plot. The area of each plot was 1 kirat, two rows of Tomato plants between treatments were not sprayed as barrier zones to avoid drift spray, spraying operations have not been done with any insecticides before execution

the field experiment. The experimental fields were sprayed with recommended dose rate, and one treatment left without spraying as a control, with three alternative insecticides Carbosulfan, Deltamethrin and Acetamiprid, respectively. In each plot twenty five Tomato plants were selected and remarked to define *Bemisia tabaci* and *Empoasca discipiens* adults numbers and follow the results before and after spraying.

Bioassay Procedure:-

Field experiments was conducted in tomato field highly infested with white fly *Bemisia tabaci*, and gassed, *Empoasca discipiens* adults at the seedling stage. In order to evaluate the tested compounds on them, pre-treatment count was recorded before spraying at five marked plants for each treatment, and post-treatment count was recorded after 1,3,5 days from treatment to determine the effect of the tested chemicals.

Phytotoxic effect:-

It was determined by recording any color change, leaf curling or flaming up to 8 days after spraying, according to Badr *et al*. (1995).

Calculation and data analysis:

a. The percentage of reduction in the field experiment was calculated according Henderson and Tilton (1955).

b. Statistical analysis of results according to SAS (1996) for Biological studies: Duncan's for biological evaluation of insecticides in field.

2-Spraying equipment tested on Tomato field:

Three ground application machines were selected to perform the scope of this work, as commonly used equipment in applying pesticides on Tomato seedling.

The tested equipment could be represented according to the technical categorization mentioned in Table (1).

Calculations of productivity and rate of performance were recorded as described by **Hindy (1992).**

3-Calibration and performance adjustment of the tested equipment:

- Collection and measurement of Spray deposit:
- Collection of spray deposit:

Before spraying each Tomato field treatments, a sampling line was constructed of five wire holder fixed in diagonal line inside each treatment to collect lost spray between plants; each wire holder top has a fixed water sensitive paper (Novartis Cards) on it. Also, each five Tomato plants, the water sensitive paper cards were put at plant; to collect the droplets deposit on Tomato leaves, were designed according to the method described by **Hindy (1989)**. All cards were collected and transferred carefully to the laboratory for measuring and calculating the number of droplets/cm² and its volume (VMD) µm in all treatments.

Table (1): Techno-Operational data of certain ground sprayers applied on Tomato field during season (2014).

Item	Pulmic (118) sprayer	Spining disc ULVA sprayer	Hand held compression sprayer
Type of atomization	Hydraulic	Rotary	Pneumatic
Nozzle type	Full cone nozzle	One restirector	Hollow cone nozzle
Pump type	Piston	-	Compression
Number of nozzles	1	1	1
Pressure (bar)	5	-	7
Spray tank (L.)	20	1+10	8
Rate of application (L/fed.)	80	15	94
Working speed (Km/h.)	2.4	2.4	2.4
Swath width (m.)	0.75	1.0	1.0
Flow rate (L/min.)	0.577	0.150	0.90
Spray height (m.)	0.5	0.5	0.5
Type of Spraying	Target in all sprayres		
Productivity * (fed./h.)	0.340	0.571	0.425
Rate of performance* (fed./day)	2.30	3.04	2.5

* Number of spraying hours = 6 hours daily. * Calculations of productivity and rate of performance after Hindy (1992).

Determination of spray deposit:

Number and size of blue spots (deposited droplets) on water sensitive papers (Novartis cards) were measured with a special scaled monocular lens (Strüben)® (15X) Japanes lens. The volume mean diameter (VMD) µm and number of droplets in one square centimeter (N/cm²) were estimated according to **Hindy (1992)**.

3. Results

Bioresidual activity of Carbosulfan against *B. tabaci* and *E. discipiens* on tomato seedling:

Efficiency of Carbosulfan represented as mortality percentages after one day of treatments Tables (2 and 3) indicated that, the 100% reduction in population of *B.tabaci* and *E.discipiens* adults was occurred by using the three sprayers, the droplet sizes were 156,171 & 168µm and N/cm^2 were 132,131 & 139 for recommended dose sprayed with Economy Micron ULVA sprayer, Lever Operated (Pulmic 118) sprayer and Hand-Held compression (Kwazar) sprayer, respectively.

Bioresidual activity of Deltamethrin against *B.tabaci* and *E.discipiens* on Tomato seedling:

Efficiency of Deltamethrin represented as mortality percentages after 24 hours of spraying as presented in Tables (2, 3). The highest reduction in population of *B.tabaci* adults was occurred by Pulmic 118 sprayer (80 L/fed.) the droplet sizes were 160, 168, & 169 and N/cm^2 were 138, 132 & 142. Mortality percetages after one day were 90,100 & 90% for initial for recommended dose sprayed with Economy Micron ULVA sprayer, Lever Operated (Pulmic 118) sprayer and Hand-Held compression (Kwazar) sprayer,and 94 & 100 for residual sprayed with Economy Micron ULVA sprayer, and Hand-Held compression (Kwazar) sprayer, respectively. Revealed mortality percentages of *E.discipiens* adults after one day of treatment by using Deltamethrin formulation as 60,72.5 & 50% for initial for recommended dose sprayed with Economy Micron ULVA sprayer, Lever Operated (Pulmic 118) sprayer and Hand-Held compression (Kwazar) sprayer, 100% for residual with all sprayers.

Bioresidual activity of Acetamiprid formulation against *B.tabaci* and *E.discipiens* on Tomato seedling:

Table (2): The relation between droplet distribution obtained by the tested ground spraying equipment and the corresponding mortality of *Bemisia tabaci*, and gassed adults, using the total recommended rate of insecticides on Tomato seedlings, during season (2014) at Qalubyia area.

Insecticide & dose rate/ fed.	Tested sprayer	VMDµm	N / cm^2	% Mortality	
				After 1 day of treatment	Average (Mean Residual)
Deltamethrin (250 cm)	Micron ULVA	160	138	90	94.6
	Pulmic	168	130	100	100
	Kwazar	169	142	90	95
Carbosulfan (200 cm)	Micron ULVA	156	132	100	100
	Pulmic	171	131	100	100
	Kwazar	168	139	100	100
Acetamprid (100 gm)	Micron ULVA	165	137	82.5	91.6
	Pulmic	167	160	87.5	93.75
	Kwazar	169	132	87.5	93.75

VMD = Volume Mean Diameter. N / cm^2 = Number of droplets per square centimeter.

Table (3): The relation between droplets obtained by the tested ground spraying equipment and the corresponding mortality of, *Empoasca discipiens* adults, using the total recommended rate of insecticides on tomato seedlings during season (2014) at Qalubyia area.

Insecticide & dose rate/ fed.	Tested sprayer	VMDµm	N / cm^2	% Mortality	
				After 1 day of treatment	Average (Mean Residual)
Deltamethrin (250 cm)	Micron ULVA	160	138	60	80
	Pulmic	168	130	72.5	86.25
	Kwazar	169	142	50	75
Carbosulfan (200 cm)	Micron ULVA	156	132	100	100
	Pulmic	171	131	100	100
	Kwazar	168	139	100	100
Acetamprid (100 gm)	Micron ULVA	165	137	67	83.5
	Pulmic	167	160	100	100
	Kwazar	169	132	100	100

VMD = Volume Mean Diameter. N / cm^2 = Number of droplets per square centimeter.

Efficiency of Acrtamiprid represented as mortality percentages after 24 hours of spraying as presented in Tables (2 & 3), the droplet sizes were 165, 167, & 169 and N/cm^2 were 137,160 & 132. Mortality percetages after one day were 82.5,87.5 & 87.5% for initial, and 92,5,100&100 for residual, for recommended dose sprayed with Economy Micron ULVA sprayer, Lever Operated (Pulmic 118) sprayer and Hand-Held compression (Kwazar) sprayer, respectively. Revealed mortality percentages of

E.discipiens adults after one day of treatment by using Acetamiprid formulation as 67,100 & 100% for initial for recommended dose sprayed with Economy Micron ULVA sprayer, Lever Operated (Pulmic 118) sprayer and Hand-Held compression (Kwazar) sprayer, 100% for residual with Economy Micron ULVA sprayer.

Relationship between lost spray on ground and the bioresidual activity of insecticides used:

Data in Tables (4 & 5) showed that there were a negative correlation between lost spray on ground equipment and the bioresidual activity of insecticides used.

Economy Micron ULVA sprayer (15 L/fed):

Data in Tables (4 & 5) showed that the lost spray percentages were 6.8, 8.9 & 8 % from the total spray volume in the case of Deltamethrin, Carbosulfan and Acetamiprid, and percentages of *B.tabaci* adults mortality were 90, 100 & 82.5% at total recommended dose, respectively, in the case of the same insecticides, and mortality percentages of *E.discipiens* adults were 60, 100& 67 % and the same insecticides, successively.

Lever Operated (Pulmic118) sprayer (80 L/fed):

Data in Tables (4 &5) showed that the lost spray percentages were 16, 16.6 & 13 % from the total spray volume in the case of Deltamethrin, Carbosulfan and Acetamiprid, and percentages of *B.tabaci* adults mortality were 100, 100 & 87.5% at total recommended dose, respectively, in the case of the same insecticides, and mortality percentages of *E.discipiens* adults were 72.5, 100& 100 % and the same insecticides, successively.

Hand held compression sprayer (Kwazar) (94L/fed.): Data in Tables (4 & 5) showed that the lost spray percentages were 18, 20 & 21 % from the total spray volume in the case of Deltamethrin, Carbosulfan and Acetamiprid, and percentages of *B.tabaci* adults mortality were 90, 100 & 87.5% at total recommended dose, respectively, in the case of the same insecticides, and mortality percentages of *E.discipiens* adults were 50, 100& 100 % and the same insecticides, successively.

Table (4): Lost spray on ground, as produced by low volume ground spraying equipment, by using certain insecticides at total recommended rate against *B. tabaci* adults during season (2014).

Insecticide & dose rate / fed.	Tested sprayer & spray volume (L / fed.)	*N / cm^2 of total spray droplets	N / cm^2 droplets (on ground)	%N/cm^2 (ground) ———— x 100 N/Cm^2 (Plants+ground)	% Mortality	
					After1 day of treatment	Average (Mean Residual)
Deltamethrin (250cm)	Micron ULVA (15)	148	10	6.8	90	94.6
	Pulmic(80)	155	25	16	100	100
	Kwazar (94)	174	32	18	90	95
Carbosulfan (200 cm)	Micron ULVA (15)	145	13	8.9	100	100
	Pulmic(80)	157	26	16.6	100	100
	Kwazar (94)	174	35	20	100	100
Acetamprid (100 gm)	Micron ULVA (15)	149	12	8	82.5	91.6
	Pulmic(80)	184	24	13	87.5	93.75
	Kwazar (94)	167	35	21	87.5	93.75

N / cm^2 = Number of droplets per square centimeter. * On Tomato seedlings and lost spray on ground

Table (5): Lost spray on ground, as produced of low volume ground spraying equipment, by using certain insecticides at total recommended rate against *E. discipiens* adults during season (2014).

Insecticide & dose rate / fed.	Tested sprayer & spray volume (L / fed.)	*N / cm^2 of total spray droplets	N / cm^2 droplets (on ground)	% N/cm^2 (ground) ———— x 100 N/cm^2 (Plants+ground)	% M rtality	
					After1 day of treatment	Average (Mean Residual)
Deltamethrin (250cm)	Micron ULVA (15)	184	10	6.8	60	80
	Pulmic(80)	155	25	16	72.5	86.25
	Kwazar (94)	174	32	18	50	75
Carbosulfan (200 cm)	Micron ULVA (15)	145	13	8.9	100	100
	Pulmic(80)	157	26	16.6	100	100
	Kwazar (94)	174	35	20	100	100
Acetamprid (100 gm)	Micron ULVA (15)	149	12	8	67	83.5
	Pulmic(80)	184	24	13	100	100
	Kwazar (94)	167	35	21	100	100

N / cm^2 = Number of droplets per square centimeter. * On Tomato seedlings and lost spray on ground.

Table (6): Reduction Percentages in *B.tabaci* adults affected by certain insecticides sprayed with certain ground equipment during the season (2014), using the total recommended dose rate, data were averages of five replicates.

Equipment / Treatment	Counted adults before treatment			% Reduction after the day indicated																							
				2 nd						4 th						6 th						General mean					
	Micron ULVA	Pulmic	Kwazar	Micron ULVA(15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)		Micron ULVA(15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)		Micron ULVA(15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)		Micron ULVA(15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)	
				C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%
Deltamethrin (ml/fed.)	50	45	40	5	90	0	100	4	90	3	94	—	—	0	100	0	100	—	—	—	—	2.7	94.6	0	100	1.3	95
Carbosulfan (150gm/100L.)	40	35	50	0	100	0	100	0	100	—	—	—	—	—	—	—	—	—	—	—	—	0	100	0	100	0	100
Acetamiprid(25gm/100L.)	40	35	35	7	82.5	4	87.5	4	87.5	3	92.5	0	100	0	100	0	100	—	—	—	—	3.4	91.6	1.4	93.8	1.3	93.8
Untreated	54	53	55	54	—	53	—	55	—	52	—	52	—	54	—	50	—	50	—	53	—	52	—	51.7	—	54	—

C = Count of life adults after treatment.

R = % Reduction of adults.

Table (7): Reduction Percentages in *E. discipiens* adults affected by certain insecticides sprayed with certain ground equipment during the season (2014), using the total recommended dose rate, data were averages of five replicates.

Equipment / Treatment	Counted adults before treatment			% Reduction after the day indicated																							
				2 nd						4th						6 th						General mean					
	Micron ULVA	Pulmic	Kwazar	Micron ULVA(15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)		Micron ULVA (15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)		Micron ULVA(15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)		Micron ULVA(15 L/fed.)		pulmic (80 L/fed.)		Kwazar (94 L/fed.)	
				C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%	C	R%
Deltamethrin (ml/fed.)	10	15	10	4	60	4	72.5	5	50	0	100	0	100	0	100	—	—	—	—	—	—	1.3	80	1.3	86.3	1.7	75
Carbosulfan (150gm/100L.)	10	10	15	0	100	0	100	0	100	—	—	—	—	—	—	—	—	—	—	—	—	0	100	0	100	0	100
Acetamiprid (25gm/100L.)	15	10	15	5	67	0	100	0	100	0	100	—	—	—	—	—	—	—	—	—	—	1.7	83.5	0	100	0	100
Untreated	20	24	26	20	—	24	—	26	—	20	—	23	—	25	—	19	—	23	—	24	—	19.7	—	23.3	—	25	—

C = Count of life adults after treatment. R = % Reduction of adults.

Relationship between the tested chemicals, techniques, and the mortality percentages of *B.tabaci and E.discipiens* on Tomato seedlings.

Bioassay evaluation:

To study the influence of various compounds and spraying techniques before and after application Abbot's formula (1925), and Handresson & Tilton's formula (1955) was adopted to calculate the reduction percentages in the population. Tables (6 & 7) showed that, the percentages of reduction of *B.tabaci* and *E.discipiens* on Tomato seedlings affected by certain insecticides sprayed with certain ground application techniques during the season of (2014) using total recommended dose rate. The productivity of Micron ULVA sprayer was 3.04 Fed./day. It was the best equipment, but the lowest productivity was Pulmic 118 sprayer since it could spray only 2.30 Fed./day.

The following remarks and results were obtained:

- There was no Phytotoxic effect on Tomato leaves after treatments, no change in the leaves color, no leaf curling or flaming up phenomena was happened.
- Insecticides treated plants revealed the lowest Tomato yield loss in comparison with untreated plots; their application reduced the incidence of whitefly and gassid infestation on Tomato and decreased the percent loss of Tomato yield in all treatments and with all sprayers.
- There was a significant differences between both the distribution percentages of droplet sizes (LSD=2,66 for equipment, 2.1719 for levels and 2,66 for compounds), for the droplets number/cm^2 (LSD=5,266 for equipment, 4,2997 for levels and 5,266 for compounds) and for reduction percentages (LSD=8,0422 for equipment, 6,5664 for pest and 8,0422 for compounds).

4. Discussion and Conclution

Field experiment was carried out on infested area with whitefly and gassid adults at early season on tomato seedlings. For evaluation the field performance of Low-Volume spraying machines; Economy Micron ULVA sprayer (15 L/fed.), Hand-held compression sprayer (Kwazar) (94 L/fed.) and Lever Operated Sprayer (Pulmic 118) (80 L/fed.); to spray Carbosulfan, Deltamethrin and Acetamiprid with full recommended dose. A satisfactory coverage was obtained on Tomato seedlings, the droplet spectrum was obtained in field experiment was agreed with the optimum droplet sizes which mentioned by **Himel (1969).** The best obtained result was 80 L/fed. as spray volume, 166 µm and 138 droplets/cm2, these results agreed with (**Himel *et al.*, 1969**) in the optimum droplet size to control cotton leafworm in cotton fields by ground equipment. Carbosulfan revealed the best bioefficiacy results with the three tested sprayers. Also, Deltamethrin for whitefly, Acetamiprid for gassid revealed the best bioefficiacy results with Pulmic 118 sprayer (80 L/fed.). Acetamiprid revealed higher mortality than Deltamethrin with Kwazar sprayer (94 L/fed), and these results agreed with **Hindy *et al.* (2004)** and **Genidy *et al.* (2005)** which recommended KZ oil and Pyriproxyfen followed by Agerin using low volume spraying because of reducing the time lost in process filling the machines, improve the homogeneity of the spray solution on the plant leaves and saving the lost spray on the ground, these results also in agreement with **Bake *et al.* (2014)** recommendation by using Profenofos followed by Pyriproxyfen and Spinosad with Agromondo sprayer (20L/fed.).

The data showed that, Lever Operated (Pulmic 118) sprayer (80L/fed.) was the best equipment to control whitefly and gassid on Tomato seedlings. Also, the lowest spray volume and the lowest percentage of lost spraying between plants, this results was agreed with **Hindy *et al.* (1997)**, who mentioned that, there was a positive relationship between rate of application and lost spray on ground.

It could be recommended to use Carbosulfan followed by Deltamethrin and Acetamiprid with low volume (LV) spraying equipment with not less than (15L./fed.) and use recommended dose which revealed successful results. There was a negative complete correlation between (VMD) and the mean residual of mortality of *B. tabaci* and *E.discipiens* while there was a positive complete correlate between N/cm² and the mean residual of mortality of *B.tabaci* and *E.discipiens* in all treatments.

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