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SPRAY DISTRIBUTION AND INSECTICIDAL ACTIVITY OF CERTAIN NATURAL PRODUCTS AGAINST WHITEFLY *BEMISIA TABACI* (GENN.) INFESTING EGGPLANT IN RELATION TO SPRAYING MACHINES

M.F. NEGM

Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza, Egypt.

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Abstract

Field Performance and efficacy of the natural product, Bemistop-98402 and KZ-oil when applied by different melhods against whitefly, *Bemisia tabaci* (Genn.) on eggplant was conducted at Shabrakhit district, Behera Governorate.

The obtained results revealed that, 400 rnl./100 lit. of water from the natural product, Bemistop induced high percentages of reduction in the population density of the immature stage of *B. tabaci* in all canopy levels of the treated eggplant. Bemistop exhibited slightly differences in its efficacy than KZ-oil when it was applied by Arimitsu sprayer, but the efficiency of the two chemicals increased after application with the Prototype sprayer because its good spray quality.

INTRODUCTION

Chemical plant protection has been an essential factor in the drive to increase agricultural production. But, the frequent application of pesticides represents the most important factor contributing to pest resistance development (Georghiou, 1983) such as whitefly *Bemisia tabaci* which exhibited high resistance to Dimethoate and Monocrotophos (Dittrich and Ernst, 1983). Moreover, population acceleration has been investigated and discussed for whitefly in the Sudan and mites in Egypt (Dittrich, 1987). Acceleration of *Bemisia tabaci* on cotton treated repeatedly with Cypermethrin, Deltamethrin and phosalone was reported by (David and Jesudasan, 1986). Also, Ultra Low Volume (U.L.V.) application of Phosalone against *Bemisia tabaci* on cotton showed the strongest tendency of population proliferation (Satput and Subramaniam, 1983). Thus, the selection of the proper active ingredient, method of application and distribution of insecticide deposits are a constraint that cannot easily be overcome in *Bemisia tabaci* control. To solve this problem, research efforts have been directed to the natural products such as azadirachtin extracted from seeds of the neem tree, *Azadirachta indica* which showed good effects against pest that become resistant to synthetic

compounds, specially *Bemisia tabact* (Warthen, 1989).

Therefore, the present study is an attempt to evaluate a specific natural product (Bemistop-98402) with two different methods of application against *Bemisia tabaci* on eggplant in Egypt.

MATERIALS AND METHODS

1. Chemicals used

Bemistop-98402: Novel and specific natural product, used by 400 ml./ 100 lit. of water. This natural product is composed of 10g of Laryl acetate, 4g of Carvacrol, 11g of Geraniol, 200 g of Huile, 120g of C11, 500g of Geropon and 124g of Butyl glycol in one liter.

The sample of Bemistop-98402 was a gift from NITCHIMAN corporation, Japan.

KZ-oil: Local mineral oil, produced by Kafr El-Zayaat Co. for Pesticides and Chemicals, formulated as emulsifiable concentrate used at a concentration of 1% (V./V.).

2. Sprayers and rate of application

A. Motorized knapsack sprayer, Arimitsu with a spraying volume of 30 lit. / fed.

B. The hand held drop tube Prototype sprayer with spraying volume of 40 lit./fed.

The technical data, spray parameters and performance of the sprayers are indicated in Table 1.

3. Field application

The evaluation of the efficiency of the natural product, Bemistop-98402 and the proper method of application against the whitefly, *Bemisia tabaci* on the black variety of eggplant, *Solanum melongena* L. was conducted at Shabrakhit district, Behera Governorate on September 13th, 1999.

3.1. Exploratory trials: To assess the proper rate of the natural product Bemistop-98402, three rates of 400, 300 and 200 ml./100 lit. of water applied against *Bemisia tabaci* (Genn.) in infested small plots of eggplant by Arimitsu sprayer.

Table 1. Technical data and spray parameters applied to control *Bemisia tabaci* on egyplant at El-Behera Governorate.

Equipment used / Spray parameters	Knapsack motor sprayer Arimitsu	Hand held drop tube prototype sprayer
Atomization type	Pneumatic + Rotary	Pneumatic+rotary
R.P.m.	6000	8500
No. & type of nozzle	One spinning disc	Four spinning discs Pink, Red, Orange and Yellow(1)
Flow No.	3	- - -
Flow rate (l./min.)	1.4	0.760
Capacity of solution tank (l.)	16	10
Spray volume (l.fed).	30	40
Swath width (m.)	5	2
Rate of performance (fed./day)	11.0	4.5

(1) Vertical arrangement of spinning discs on tail boom from upper to lower at hand held prototype sprayer.
- Spraying type: Target.
- Averge working speed : 2.4 K.P.H.

3.2. Chemicals evaluation: The most effective rate, 400 ml./100 lit of water was evaluated in comparison to the recommended rate of KZ-oil (one lit./100 lit. of water). Such appraisal was conducted by Arimitsu and Prototype sprayers with 30 lit./fed. and 40 lit./fed. for each sprayer, respectively. The application was carried out against *Bemisia tabaci* in small plots (225 m2) of eggplant, using three replicates for each chemical and each sprayer.

Before Spraying, the immature stages of whitefly were counted on eggplant leaves at three levels of it's canopy (upper, middle and lower). Within each plot, ten leaves were randomly picked from each level of the middle rows of the plot and collected in paper bags for counting the immature stages by steromicroscope in the laboratory. Samples were collected before application and 2, 5, 8, 11 and 14 days after spraying.

The activity of the applied chemicals was evaluated as reduction percentages in the population of the immature stages by Henderson and Tilton formula (1955). The initial effects was calculated after 2 days of application, while residual activity was estimated after 5, 8, 11 and 14 days of spraying.

4. Sampling of sprayed deposition: To estimate spots (droplets) distribution through the canopy of the eggplants in the treated plots, Novartis, watery sensitive paper were fixed as a sandwich on three levels of thirty selected plants at about one meter distance between each two adjacent plants. Parallel with this line, thirty metal spray collectors (1.2 meter hight) were fixed in a diagonal line in each treatment and furnished with the same sensitive paper on three levels of each spray collector (Hindy, 1981).

In order to estimate spray losses on the ground through the canopy of the treated eggplant, one sensitive paper was fixed on a ground wire holder situated between each two plants in each of the tested sprayer Arimitsu and Prototype sprayers. Measurements of droplets size and number were carried out with a scaled monocular, the corrections and calculation of such technique for measurements and determination of droplets were conducted according to (Anonymous, 1978). The average climatic conditions of air temprature, relative humidity and wind velocity were, 27°C, 70% and 0.5- 1 m/sec., respectively.

RESULTS AND DISCUSSION

1. Efficiency of Bemistop-98402 against *Bemisia tabaci*: The exploratory trials which were carried out to disclose the proper and effective rate of Bemistop revealed that, the tested three rates, 400, 300 and 200 ml./ 100 lit. of water resulted in 85.3, 73.2 and 65.2 percent of reduction in immature of *Bemisia tabaci* on the whole eggplant.

The most effective rate (400 ml./ 100 lit. of water) was chosen to evaluate the efficiency of this product in a large scale in comparison with the recommended rate of Kz-oil (1 lit./100 lit. of water) under field conditions.

Table 2 indicates that, 400 ml./ 100 lit. of water of Bemistop induced high reduction percentages in the population density of the immature stages of *Bemisia tabaci* after 2 days on all treated levels of eggplant than KZ-oil after their application with Arimitsu sprayer. The application of Bemistop resulted in, 86.9, 82.9, 81.4 and 82.3 reduction percentages against the immature stages of this pest on all levels of eggplant canopy (upper, middle and lower) and whole plant, compared with 83.6, 81.4, 75.0 and 78.3 in the case of KZ-oil application by the same sprayer.

Also, Table 2 shows that, the residual effect of Bemistop after 5 to 14 days of spraying by Arimitsu was higher than the residual effect of KZ-oil against the immature stages of *Bemisia tabaci.* The reduction percentages of Bemistop residual effect were 79.6, 78.7, 69.6 and 74.2 compared with KZ-oil which were 77.5, 74.1, 65.4 and 68.9 percentages of reduction in each level of eggplant canopy, respectively.

On the other hand, the using of Prototype sprayer increased the initial Kill and the residual effect of Bemistop and KZ-oil than the using of Arimitsu sprayer, Table 2. But after using Prototype, the initial Kill and residual effects of KZ-oil increased than Bemistop. Table 2 indicates that, the reduction percentages produced by KZ-oil were 92.0, 90.9, 82.1 and 84.7 after 2 days of application and 85.8, 82.3, 72.0 and 77.2 after 5 to 14 days in each level of eggplant canopy and whole plant, respectively. In the case of application of Bemistop with the same machine, the produced reduction percentages were 87.1, 85.3, 88.2 and 86.5 after 2 days of application and 81.2, 76.9, 75.4 and 76.2 after 5 to 14 days of application in each level of eggplant canopy and whole plant, respectively.

Data in Table 2 reveal that, the natural product Bemistop could be considered as a good and effective product for controlling *Bemisia tabaci* even it was applied with

Table 2. Effects of specific natural product, Bemistop-98402 aginst *Bemisia tabaci* in comparison with the recommended rate of KZ-oil and the effect of different spraying machines on its efficiency against this pest.

Sprayers used.	Eggplant Canopy	No. of unterated control nymphs			% Red. Of Bemistop-98402			% Red . Of KZ-oil		
		Pre-treatment No.	Post treatment with 2-days	Post treatment with 5-14 days	Pre-treatment No.	Overall I.K%	Overall R.E%	Pre-treatment No.	Overall I.K%	Overall R.E%
Arimitsu (30L./Fed)	Upper	49.2	54.1	59.1	29.1	86.9(4.2)	79.6(7.1)	21.1	83.6(3.8)	77.5(5.7)
	Middle	59.8	67.5	102.6	54.4	82.9(10.6)	78.7(79.9)	37.1	81.4(7.9)	74.1(16.0)
	Lower	76.9	150.0	123.0	65.4	81.4(23.7)	69.6(31.8)	39.6	75.0(19.3)	65.4(24.9)
	Whole plant	185.9	271.6	284.7	148.9	82.3(38.5)	74.2(58.8)	97.8	78.3(31.0)	68.9(46.6)
Prototype (40L./Fed).	Upper	49.2	54.1	59.1	27.5	87.1(3.9)	81.2(6.2)	22.9	83.0(2.0)	85.8(3.9)
	Middle	59.8	67.5	102.6	41.1	85.3(6.9)	76.9(16.3)	31.0	90.9(3.2)	82.3(9.4)
	Lower	76.9	150	123.0	88.3	88.2(20.2)	75.4(34.7)	55.4	82.1(19.3)	72.0(24.8)
	Whole plant	185.9	271.6	284.7	156.9	86.5(31.0)	76.2(57.2)	109.3	84.7(21.5)	77.2(38.1)

* The figures in paranthesis indicate the post-treatment numbers of the nymphs.

I.K.: Initial kill (Reduction after 2days of spraying).

R.E.: Residual effect (Average of reduction after 5,8,11 and 14 days of spraying).

Arimitsu or Prototype sprayers. Spraying of Bemistop with Prototype exhibited slight efficiency than Arimitsu, but the two tested sprayers gave sufficient reduction percentages against whitefly nymphs on eggplant. This result agreed with (Carlos *et al.*, 1995) who stated that, the effectiveness of insecticides does not only depends upon the material used, but also on some other factors such as, application method, timing and rate of application and weather conditions.

In respect of material used, the natural product, Bemistop could be considered as a good and effective natural material against *Bemisia tabaci* such as azadirachtin extracted from seeds of the neem tree, *Azadirachta indica* which showed high efficiency against pests that become resistant to synthetic compounds, specially *Bemisia tabact* (Warthen, 1989).

2. Qualitative distribution of Bemistop-98402 and KZ-oil deposits on eggplant: Bemistop and KZ-oil were sprayed by Arimitsu and Prototype sprayers against *Bemisia tabaci* on eggplant to study the effect of spray quality and quantity in relation to its biological effectiveness.

Bioassay results in table 3 show that the quantitative and qualitative specification of Bemistop and KZ-oil spectrum produced by Prototype sprayer are higher than which were produced by Arimitsu. Prototype sprayer produced sufficient number of drops, suitable volume median diameter (VMD) and good distribution on the treated surface of each level of eggplant. The average of droplets number of Bemistop after spraying with Prototype sprayer was 161/86 (upper/ lower surface of the leaf) drop/ cm^2 compared with 101/43 drops/cm^2 after spraying with Arimitsu. The same trend was obtained after application of KZ-oil with Prototype and Arimitsu sprayers, the average number of droplets/cm^2 (upper/ lower) was 166/87 compared with 107/48 drops/cm^2 with Arimitsu sprayer.

Also, Table 3 indicates that, the volume median diameter of the droplets (VMD) produced by Prototype sprayer was bigger than those produced by Arimitsu. In the case of the Prototype sprayer, the diameter (VMD) of Bemistop was 83/74 µm (upper /Lower) compared with 79/68 µm in the case of spraying of KZ-oil. In case of Arimitsu sprayer, the diameter (VMD) of Bemistop was 79-67 µm (upper/ lower) compared with 74 - 59 µm (upper / lower) in the case of spraying with KZ-oil.

The deposits on spray collectors support the previous results, since the average of droplets number/cm^2 produced with the use of Bemistop and KZ-oil by means of the Prototype sprayer were 160 drops/cm^2 and 159 drops/cm^2 compared with 110 drops/cm^2 and 112 drops/cm^2 in the case of spraying with Arimitsu sprayer for each chemical, respectively, Table 3.

Table 3. Qualitative distribution of the chemicals used against *Bemisia tabaci* on eggplant and the amount of spray losses on the ground by each sprayer

Material		Bemistop-98402						Kz-Oil					
Cards Location.	Cards levels.	Prototype sprayer			Arimitsu sprayer			Prototype sprayer			Arimitsu sprayer		
		N/Cm^2	% Distrip.	VMD (µm)	N/Cm^2	% Distrip.	VMD (µm)	N/Cm^2	% Distrip.	VMD (µm)	N/Cm^2	% Distrip.	VMD (µm)
On Eggplant	Upper	203-109*	42.2	91-80	136-60*	43.2	84-70	208-114*	42.2	84.71	144-71*	46.2	82-61
	Middle	156-90	33.3	80-72	119-51	39.2	82-68	162-85	32.3	77.67	124-51	37.6	72-58
	Lower	123-58	24.5	79-71	49-19	15.6	72-64	128-63	25.5	76.67	52-23	16.2	69-59
	Mean	161-86	--	83-74	101-43	--	79-67	166-87	--	79-68	107-48	--	74-59
On Spray collector	Upper	210	43.8	93	149	45	83	204	42.9	86	151	44.9	83
	Middle	158	32.9	90	127	38.4	80	164	34.4	85	129	38.4	78
	Lower	112	23.3	85	55	16.6	79	108	22.7	85	56	16.7	75
	Mean	160	--	89	110	--	81	159	--	85	112	73.4	79
On ground wire between plants.	Horizontal	109	69	90	75	78.1	88	104	68.4	88	80	26.6	80
	Vertical	49	31	86	21	21.9	84	48	31.6	79	29	--	81
	Mean	79	--	88	48	--	86	76	--	84	55	--	81
% Losses on ground		18.9			21.7			18.3			21.0		

* Indicates the number of recorded droplets on upper-lower surface of the treated eggplant leaves.

In conclusion, Prototype sprayer produced - generally - the denser droplets number/cm^2 and bigger sizes in comparison to Arimitsu sprayer, It which due to two main factors, the first is the rate of application applied which was 40 lit./ fed. and 30 lit./ fed. for the Prototype and Arimitsu, respectively. The second factor is the percentage of losses of spray on the ground between plants which was 18.9 and 21.7% after spraying of Bemistop with Prototype and Arimitsu sprayers, respectively and 18.3% after spraying of KZ-oil with Prototype compared with 21.0% in the case of KZ-oil spraying with Arimitsu,Table 3.

Finally, the high percentages reduction of whitefly nymphs obtained by Bemistop-98402 and KZ-oil, Table 2, applied with the Prototype sprayer could be attributed to its good spray quality produced and the efficacy of these chemicals. Although, spraying ol Bemistop and KZ-oil with Prototype sprayer resulted in slight difference in their efficiency than Arimitsu sprayer, the two sprayers produced sufficient results with the two chemicals against *Bemisia tabact* on eggplant at all its canopy levels. It is in agreement with (El Sayed *et al.* , 1997) who stated that, high volume sprayers were nearly equal to the low volume ones, but they recommended the use of low volume sprayer to insure the penetration of droplets to the middle and lower levels of the plant canopy.

Moreover, the results of Bemistop-98402 in the present study may be considered as an alternative controlling method against *Bemisia tabaci* which has developed resistance to most of th commercially available insecticides (Forer, 1990).

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توزيع الرش وفعالية المبيد الحشري لبعض المنتجات الطبيعية ضد الذبابة البيضاء التي تصيب الباذنجان وعلاقته بآلات الرش

محمد فاروق نجم

معهد بحوث وقاية النباتات، مركز البحوث الزراعية، الدقى، الجيزة، مصر.

أجرى هذا البحث بمركز شبراخيت- محافظة البحيرة عام ١٩٩٩ بغرض تقييم كل من المنتج الطبيعي Bemistop -98402 والمستخدم بمعدل ٤٠٠ سم٣/ ١٠٠ لتر ماء والزيت المعدني (ك زد) المستخدم بمعدل لتر / ١٠٠ لتر ماء ضد الذبابة البيضاء على الباذنجان باستخدام آلات الرش الآتية:

- الموتور الظهرى أرمتسو Arimitsu بحجم رش ٣٠ لتر/فدان

- رشاشة ذات حامل رش رأسي مزود بـ ٤ وحدات تجزيئ "تحت التجريب" Prototype بحجم رش ٤٠ لتر/فدان.

وقد أظهرت النتائج الحقلية الآتي:

- أدى استخدام المنتج الطبيعى Bemistop -98402 إلى خفض تعداد الحوريات بنسب ٨٢,٣٪ بعد يومين و ٧٤,٢٪ بعد ٥-١٤ يوماً مقارنة بالزيت (ك زد) حيث أعطى استخدامه نسب خفض بلغت ٧٨,٣ ٪ بعد يومين و ٦٨,٩٪ بعد ٥-١٤ يوماً في المتوسط في حالة استخدام الرشاشة أرمتسو Arimitsu.

- كانت نسب الخفض في تعداد هذه الحشرات هي ٨٦,٥٪ بعد يومين و٧٦,٢٪ بعد ٥-١٤ يوماً مقارنة بالزيت (ك زد) حيث أعطى ٨٤,٧٪ بعد يومين و ٧٧,٢٪ بعد ٥-١٤ يوماً في المتوسط في حالة استخدام الرشاشة Prototype.

- زادت الفعالية للمركبين عند استخدام الرشاشة Prototype نظراً لكفاءة غطاء الرش الناتج منها عما في حالة الرشاشة Arimitsu.

وعلى ذلك يمكن القول أن الرش باستخدام المنتج الطبيعى Bemistop يمكن إعتباره طريقة بديلة لخفض تعداد الحشرات غير الكاملة للذبابة البيضاء على الباذنجان التي زادت مناعتها لمعظم المبيدات الحشرية المستخدمة في مكافحتها.