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QUALITATIVE ASSESSMENT OF CERTAIN INSECTICIDES APPLIED BY DIFFERENT GROUND SPRAYERS AGAINST WHITEFLY, *BEMISIA TABACI* (GENN.) ON EGGPLANT.

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Abstract

Qualitative assessment of Actellic, Naturalis-L, and Applaud insecticides sprayed with the recommended dosages by means of five ground spraying techniques was conducted. The spray volume ranged between 6-233 l/fed. against whitefly on eggplant through two successive seasons at Damietta area. Sensitive cards were mounted on eggplant, spray collectors and ground wires were used also to determine the spray coverage and the spray lost on ground between plants. All treatments were applied as a placement spray technique. Number and size of leaves of different levels of eggplant and its distribution percentages were determined. The coefficient of curling was calculated for eggplant. Performance rate of the tested sprayers was determined. According to quality of spray coverage, the ground machines could be arranged descendingly as follows : knapsack motor sprayer "Arimitsu". knapsack sprayer "Solo", Micron ULVA, Semco sprayer and conventional sprayer. A positive relationship was found between application rate and the lost spray. About 25% from droplets were deposted on the lower surface of the leaves of different levels of eggplants with the low-volume sprayers : Micron ULVA, Semco, and Solo sprayers, respectively.

INTRODUCTION

Eggplant (*Solanum melongena* L.) is considered one of the major host plants of the whitefly, Bemisia tabaci (Genn.), during summer season in Egypt (El-Sayed *et al.*, 1989). In Egypt, the whitefly normally appears on eggplants at mid to late season (August-November) as a pest. When the plant canopy is fully developed the insects are covering all inter-row spaces and it becomes difficult for airborne droplets to penetrate and impact the middle and bottom leaves, where the majority of whiteflies infestation occurred. Improvement of penetration still remains in experimental stages (Pye, 1983; Cayley *et al.* 1983; Cayley *et al.*, 1984; Abdel-Bagi and

Adams, 1987). The efficacy of low volume and ultra low volume rates against whitefly showed that, both rates of application gave a similar effect 1-2 days after application, but at 5-8 days post-treatment the ULV treatment gave longer residual action (UK *et al.*, 1981) .

This physical foliage barrier is a constraint that, cannot easily be invaded as it is, inherently, related to the plant structure and its high coefficient of curling which was subject to the present study. This investigation spot light on qualitative determination of insecticidal deposits on different levels which were obtained by conventional high volume and modernized low-volume sprayes. Five commercial sprayers were tested on eggplants, using three insecticides for two successive seasons 1994 and 1995. The performance of the sprayers was estimated.

MATERIALS AND METHODS

1. Estimation of the coefficient of eggplant curling

Sixty mature eggplants were chosen at random from three feddans cultivated with such vegetable to determine its coefficient of curling. The leaves of each plant level were outlined on a millimetric drawing paper and the resulted areas were estimated by means of planimeter. The curling coefficient (C.C.) of plant was determined according to El-Metwally (1995) formula :

$$C.C. = \frac{\text{Leaf area}}{\text{Ground area}}$$

where cultivated ground area is the result of dividing the area of one feddan, i.e 4200 m2, by the mean number of eggplant in one feddan. The average geometrical structure of an eggplant model with all its branches and leaves was demonstrated in Fig. 1.

2. The used chemicals and bio-agents

Experiments were carried out in two feddans of eggplants cultivated at Damietta governorate, during the first week of September of two successive seasons; 1994 and 1995. By means of each tested application technique, the following compounds were used according to the dosage recommendations announced by the Ministry of Agriculture. Actellic insecticide (Pirimiphosmethyl) 50% EC 1.5 l/fed., Na-

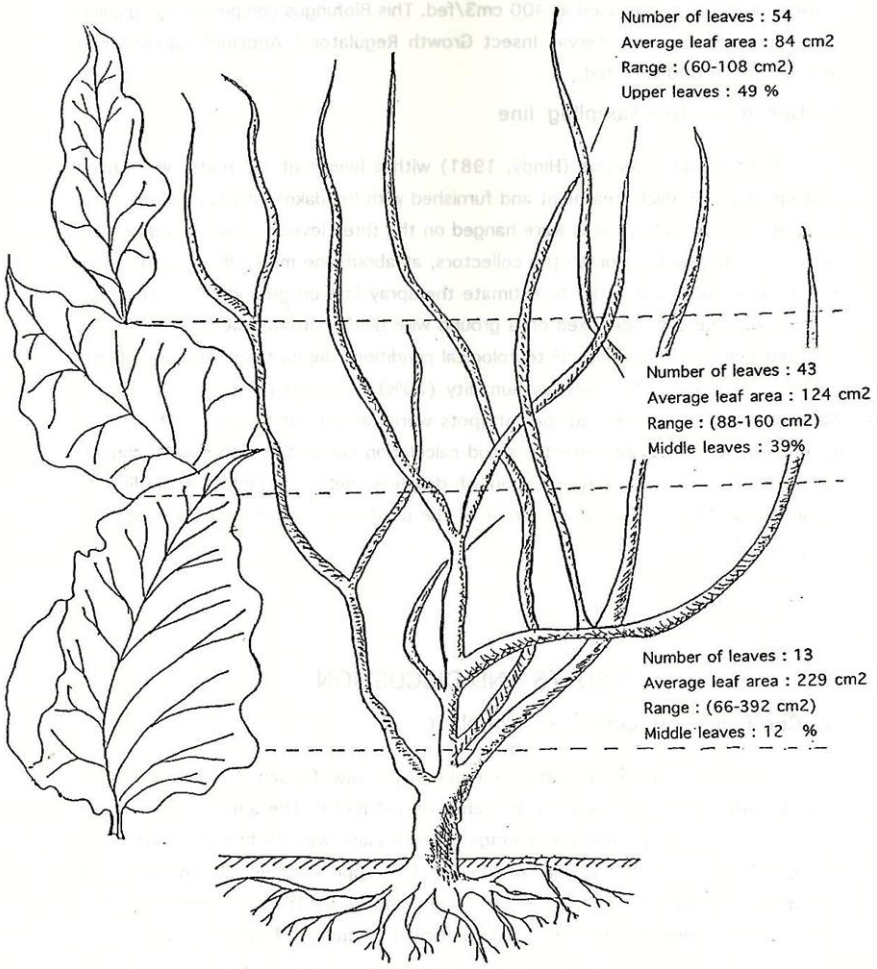

Fig. 1. Model of Full-grown Plant of Eggplant.

turalis-L (Beauveria bassiana) 1.67% ($2.3x10^7$ conidia per milliliter product inert ingredients 98.33% was used at 400 cm3/fed. This Biofungus compound was applied three times at 5 days interval. Insect Growth Regulator " Applaud" (Buprofezin) with dosage of 600 cm3/fed .

3. Design of the sampling line

Thirty spray collectors (Hindy, 1981) with a height of 1.2 meter were fixed in diagonal line in each treatment and furnished with Bendakote cards in three levels of each spray collector. Cards were hanged on the three levels of thirty eggplant selected in a parallel position to the collectors, at about one meter distance between two adjacent plants. In order to estimate the spray lost on ground between plants, one of sensitive card was fixed on a ground wire holder situated between each two adjacent plants. The average meteorological conditions during tests were as follows: Air temperature (29^oC), relative humidity (70%) and wind velocity (1.5 m/sec). Measurements of size and number of spots were carried out by means of a scaled monocular. All necessary corrections and calculation connected with such technique of measurements and determination of droplets were conducted according to Anonymous (1978). The spread factor of the used Nigrozine dye (0.5%) was 1.59 (Gabir *et al.*, 1991).

RESULTS AND DISCUSSION

1. Coefficient of curling of eggplant

The mean number of mature eggplants per one feddan was about 40.000 plants, with an average height of branches of 1.2 meter. The age of plants during spraying was 126 days and the average of each plant was 15 branches. The slope angle of leaves in relation to the horizon was 45^o, approximately. The average number and total surface area of leaves per one plant were 110 leaves and 1.280 m2, respectively. Therefore, the estimated coefficient of curling of eggplant was 12.2 .

From the previous results, it was found that, selection of proper spray parameters especially rate of application was closely related to the structure of the treated plants expressed as coefficient of curling with different crops according to such coefficient should vary with stage of plant maturity, where the dense foliage have to retain more spray coverage. Himel (1974) referred to the loss of spray between foliage down to ground as "endodrift" in contrast to losses due to "exodrift"

outside the treated area. Tunstall *et al.* (1961) recommended maximization of the volume of spray applied on cotton according to plant height, and Matthews (1971) recommended narrowing of swath width relatively to stage of cotton plant growth.

2. Performance of tested sprayers

Data in Table 1 showed that, the tested sprayers might be arranged descendingly according to its performance from highest to lowest rates, as follows: the knapsack motor sprayer "Arimitsu", hydraulic sprayer lever-operated "Solo", "Semco" sprayer, Micron ULVA sprayer and conventional sprayer. These rates agree with those obtained by Hindy (1992).

3. Qualitative distribution of Actellic deposits on eggplant by using certain spray volumes

Table 2 shows the distribution of spray deposits of Actellic insecticide produced by five ground sprayers namely hydraulic compression sprayer (Semco) at 6 l/fed., rotary sprayer (Micro ULVA) at 13 l/fed., hydraulic knapsack sprayer at 22 l/fed., motorized knapsack sprayer "Arimitsu" at 32 l/fed. and conventional hydraulic sprayer at 223 1/fed. The distribution of spray deposits of Actellic insecticide on eggplant could be analysed and represented, as follows :

The droplets sampled on spray collectors proved to be sufficient in number and suitable in size, with all the tested sprayers, except of the conventional one. The mean numbers/cm2 were 55,51-5,42 and 36-3, respectively. The mean droplet size was 180, 273-135, 128, 193-25 µm, respectively. In case of hydraulic knapsack sprayers, a significant reduction in number of droplets/cm2 was accompanied with a huge increase in droplet size. The reduction percentage in number was about one half and the percentage increase in diameter was near to be triple, compared with "Solo" sprayer. In eggplants a great tendency to catch more droplets was found on the lower surfaces about 24 % with comparison of upper surfaces in case of "Semco" and "Micro ULVA" sprayer. The size of droplets deposited on eggplants were smaller with about 9% than droplets deposited on spray collectors, with no significant differences in number of those droplets. It was noticed that, increasing of spray volume caused a higher loss of spray between plants. The percentages of spray lost between plants related to the whole spray bulk in the conventional sprayer motorized "Arimitsu", "Solo" sprayer, "Micro ULVA" and "Semco" sprayer were 48%, 40%, 16%, 19.9% and 18.0%, respectively.

Table 1. The technical data, spray parameters and performances of the tested ground sprayers.

Treatment / Sprayers	Comression sprayer "Semco F.P.*"	Rotary sprayer "Micro ULVA"	Hydraulic knapsack sprayer "Solo"*F.P.	Motorized knapsack sprayer "Arimitsu"	Hydraulic knapsack sprayer* V.P.
Type of machine	Compression pump	Spinning disc	Piston pump with pressure chamber	Pneumatic	Piston pump
No. of nozzles	2	1	4	1	1
Nozzle type	*F.F. (650017)	Tube	Tx-4	Rotary disc	Hollow cone
Operational pressure, Kg/cm2	7.2	-	4.5	-	1.7
Flow rate (l/min.) for one nozzle	0.055	0.180	0.180	1.520	1.620
Swath width (m.)	2.0	1.5	3.5	5.0	0.5
Spray height (m.)	0.50	0.50	0.75	°15 for down	0.50
Spray volume, (l/fed.)	6.0	13.0	22.0	32.0	223.0
Productivity (fed./h)	1.140	0.850	2.000	2.850	0.285
Rate of performance (fed./day)	6.0-8.0	4.5-5.5	8.0-10.0	13.0-15.0	1.5-2.0

Spraying technique : Target spraying in all treatments
Working speed 40.0 meter/min.

* F.F.: Flat-fan
* F.P. : Fixed pressure with pressure control valve
* V.P. : Variable pressure

Table 2. Qualitative distribution of Actellic insecticide on eggplant, using different spraying volumes.

Equipment used / Spray volume (1/fed.) Card's position	Card's Level	Semco sprayer 6			Rotary sprayer Micro ULVA 13			Hydraulic knapsack sprayer Solo 22			Motorized knapsack sprayer "Arimitsu"			Hydraulic sprayer variable pressure 223		
		N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm
On eggplant	Upper	24-18	36	120-50	55-10	45	170-50	64	42	180	82-0	75	220-00	15	47	500
	Middle	25-13	31	125-50	45-20	33	200-50	50	33	175	57-0	31	250-00	29	24	480
	Lower	29-00	33	100-50	32-00	22	120-00	38	25	150	42-12	24	300-150	18	29	620
	Mean	26-15		115-58	44-6		163-50	51		168	60-4		257-150	21		533
On spray collector	Upper	67	53	140	38-10	40	253	80	48	210	90-0	56	240-00	38	48	650
	Middle	47	37	125	46	39	200-00	60	36	180	40-6	29	260-150	25	32	554
	Lower	12	10	120	25	21	125-00	26	16	150	22-3	15	320-120	16	20	480
	Mean	42		128	36-3		193-25	55		180	51-5		273-135	26		561
On ground wire between plants	Horizontal	15	79	120	12	91	150	22	52	140	21	64	375	20	56	650
	Vertical	4	21	50	5	29	200	20	48	50	12	36	325	16	44	560
	Mean	10		85	9		175	21		95	17		350	18		605

Values after (-) represent the number of droplets/cm2 and its volume on lower surfaces of treated leaves.

4. Qualitative distribution of deposits of Naturalis-L on eggplants using various spraying volumes

Table 3 showed distribution of spray deposits of Naturalis-L produced by the mentioned sprayers. The obtained results could be presented as follows: By means of Micro ULVA and Solo sprayer, the droplets sampled on spray collectors proved to be sufficient in number and suitable in size with a mean number per cm2/size μm of 60/220, 74/322, respectively. A decrease distribution deposition occurred in case of "Semco" sprayer, motorized sprayer "Arimitsu" and conventional sprayers. The mean numbers/cm2 and its sizes were 32/133, 17/269 and 25/527 μm, respectively.

Comparing depositions on eggplants and spray collector obtained by "Arimitsu" sprayer, it was found that, plants catched 60% more in droplets number than that, on spray collectors. The size of droplets deposited on plants was smaller with about 4.5% than size of droplets deposited on spray collectors. In general, eggplants caught equal or more number of droplets than the spray collectors, but in smaller sizes. Using "Semco" sprayer and "Micro ULVA", the number of droplets on eggplants and spray collectors were quite equal with about 22.5% and 16.8% reduction in sizes, respectively. With the same arrangement, about 10-30% of fine droplets (50 μm) were recorded on the lower surface of eggplant leaves. The percentage of spray lost between plants in relation to the total spray was 57.3, 53.7, 25.7, 22.8 and 22.4 with the use of conventional sprayer, motorized sprayer "Arimitsu", "solo" sprayer, "Micro ULVA" sprayer and "Semco" sprayer, respectively. This confirms the positive relationship between rate of application and the spray lost on ground between the treated plants.

5. Qualitative of deposits of Insect Growth Regulator Applaud (I.G.R.) on eggplants using certain spraying equipments

Table 4 showed distribution of Applaud spray deposits produced by the tested sprayers. The obtained results could be discussed as follows: The droplets sampled on spray collectors were sufficient in number, suitable in size with Micro ULVA, and Solo sprayers. The mean (number/cm2) and (size, μm) deposited on spray collectors were 83/198 and 75/166, respectively. In case of Semco sprayer, Arimitsu sprayer, and conventional sprayer the mean (numbers/cm2 and size μm) were 29/125, 36/260 and 31/485. successively. Concerning deposit characteristics on eggplants and spray collectors the same trend mentioned before occurred by means of Semco, Micro ULVA, and Arimitsu sprayers but in case of "Solo" and conventional sprayers an adverse relationship was recorded in droplet sizes. On the other hand,

Table 3. Qualitative distribution of deposits of Naturalis-L on eggplant, using different spraying volumes.

Equipment used / Spray volume (1/fed.) / Card's position	Card's Level	Semco sprayer 6			Rotary sprayer Micro ULVA 13			Hydraulic knapsack sprayer Solo 22			Motorized knapsack sprayer "Arimitsu" 32			Hydraulic sprayer variable pressure 223		
		N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm
On eggplant	Upper	26-9	40	135-50	75-11	50	190-50	824	52	200	40	47	300	40	65	580
	Middle	19-18	31	100-50	42-8	30	160-90	36	23	250	15	18	250	12	19	710
	Lower	25-00	29	75-00	33-00	20	20-00	40	25	224	30	35	222	16	16	480
	Mean	23-13		103-50	50-10		183-70	53		225	28		257	21		590
On spray collector	Upper	49	51	140	70	39	220	70	32	310	27	54	265	22	29	420
	Middle	33	34	110	85	47	250	92	41	205	11	22	218	16	21	550
	Lower	15	15	150	25	14	190	60	27	450	12	24	325	38	50	610
	Mean	32		133	60		220	74		322	17		269	25		527
On ground wire between plants	Horizontal	8	57	150	15	60	250	25	71	250	38	84	350	35	61	550
	Vertical	6	43	100	10	40	200	10	29	210	7	16	375	22	39	600
	Mean	7		125	13		225	18		230	23		363	29		575

* % distribution of droplets.

Values after (-) represent the number of droplets/cm2 and its volume on lower surfaces of treated leaves.

Table 4. Qualitative distribution of deposits of Applaud (I.G.R.) on eggplant, using different spraying volumes.

Equipment used Spray volume (1/fed.) Card's position	Card's Level	Semco sprayer 6			Rotary sprayer Micro ULVA 13			Hydraulic knapsack sprayer Solo 22			Motorized knapsack sprayer Arimitsu			Hydraulic sprayer variable pressure 223		
		N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm	N/cm2	% distrib. of drop.	VMD µm
On eggplant	Upper	27-7	42	125-50	60-22	56	140-90	82	55	220	60-12	46-0	185-100	45	54	600
	Middle	14-18	27	100-70	35-3	37	120-75	45	30	185	45-4	35-0	210-100	22	27	480
	Lower	25-00	31	100-00	25-00	17	175-00	23	15	125	25-0	19.0	280-00	16	19	482
	Mean	22-12		108-60	40-13		145-83	50		177	43-5		225-100	28		521
On spray collector	Upper	31	36	130	117	48	200	105	47	200	52	49	220	62	66	520
	Middle	18	21	135	61	24	220	75	33	172	32	30	250	22	23	420
	Lower	38	43	110	72	28	175	45	20	125	23	21	310	10	11	514
	Mean	29		125	83		198	75		166	36		260	31		485
On ground wire between plants	Horizontal	12	66-6	120	16	44-4	210	25	67-5	175	20	44	300	25	40	400
	Vertical	6	33-3	125	20	55-6	150	12	32-5	200	25	56	200	38	60	500
	Mean	9		123	18		180	19		188	23		250	32		450

* % distribution of droplets.

Values after (-) represent the number of droplets/cm2 and its volume on lower surfaces of treated leaves.

one quarter of droplets were deposited on the lower surfaces of eggplant leaves, in the low volume treatment only. There was a significant difference in the percentage distribution of droplets number in all treatments at different targets as shown in table 4. The positive relationship mentioned before between rate of application and spray lost on ground was confirmed also in this test, where the lost sprays were 50.0, 52.5, 28.7, 32.0 and 26.3% with the use of conventional, Arimitsu, Solo, Micro ULVA and Semco sprayer, successively. It is recommended to reduce the dosage for low volume treatments in order to estimate correlation between droplet distribution and the reduction percentage. Data also showed that, the physical properties of the spray materials, dosage, meteorological conditions significantly affected the droplet spectrum. According to the quality of spray coverage, the tested machines could be arranged descendingly as follows : knapsack motor sprayer Arimitsu, knapsack sprayer "Solo, Micro "ULVA", "Semco" sprayer and conventional sprayer.

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تقييم كيفى لبعض المبيدات المعاملة بواسطة آلات رش أرضية مختلفة ضد الذبابة البيضاء على نباتات الباذنجان

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تم استخدام خمس رشاشات أرضية مختلفة تمثل كلا من حجم الرش القليل والكبير وذلك لرش ثلاثة مبيدات هى الأكتليك ، نيوترااليس، وأبلود بالجرعات الموصى بها وهى ١,٥ ، ٠,٤ ، ٠,٦ ، ٠ لتر/الفدان على نباتات الباذنجان ، مع عمل تقييم كيفى باستخدام كروت ورق بنداكوت على النباتات ومستقبلات رش خاصة علاوة على سلك أرضى لاستقبال الفاقد من الرش بين النباتات المعاملة ضد آفة الذبابة البيضاء خلال موسمين متتاليين من حيث كان أسلوب الرش فى كل المعاملات هدفيا. قدرت أعداد وأحجام الأوراق والنسب المئوية لتوزيعها على كافة مستويات نباتات الباذنجان. كما تم حساب معامل التعرج لنباتات الباذنجان تحت الدراسة والذى قدر ب ١٢,٢ .

تم تقدير معدل الأداء اليومى لالات الرش المختبرة وكان أعلاها موتور الرش أرميتسو. أظهرت النتائج وجود اختلافات معنوية فى توزيع غطاء الرش بين المركبات المختبرة وكذلك بين الأهداف المعاملة. زاد الفاقد من الرش بين النباتات بزيادة حجم الرش فى كل المعاملات تحت ظروف التجربة. وجد حوالى ٢٥٪ من أعداد القطيرات على الأسطح السفلية لأوراق نباتات الباذنجان باستخدام حجوم الرش القليلة كما فى حالة الرشاشات سيمكو (٦ لتر/فدان) والميكرون أولفا (١٣ لتر/فدان) والرشاشة الصولو (٢٢ لتر / فدان).

كما أظهرت النتائج أيضا أن كلاً من الخواص الطبيعية للمركبات المختبرة ومعامل التعرج للنباتات المعاملة وزاوية ميل الأوراق والظروف الجوية وحجوم الرش المختبرة ونوع وحدة التجزئ قد لعبت دورا معنويا فى تحديد غطاء الرش ومعدل ونسب توزيعه على المستويات المختلفة للنباتات المعاملة.

كانت أفضل آلات الرش المختبرة من ناحية التغطية هى: الموتور الظهرى أرميتسو يليه الرشاشة الصولو ثم الرشاشة ميكرون أولفا ثم الرشاشة سيمكو وأخيرا الرشاشة اليدوية التقليدية ذات حجم الرش الكبير.