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EFFECT OF APPLICATOR-TYPES ON FUNGICIDE EFFICIENCY AND ENVIRONMENTAL POLLUTION

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ABSTRACT

The effect of different fungicide applicator types, i. e. high volume (HV), low volume (LV) and ultra low volume (ULV) on the efficacy of five fungicides (Ridomil plus, Cupper Oxichloride , Ferro Z, Kocide 101 and Pervicur N) used to control downy mildew disease caused by ***Psendoperonospora cubensis*** on cucumber. The different rates of application (4 application rates 400,200,100 and 50 L/fed) were applied. In addition, some technical aspects, which play an important role in the environmental pollution, were estimated.

All the tested fungicides showed significant disease control. Ridomil puls and Previcur N showed the highest efficacy in the two successive years. When the HV applicator was used, decreasing the amount of the fungicide suspension from 400 to 50 L/fed resulted in drastically decreasing in the fungicide efficacy. The ULV applicator showed the highest fungicide efficacy compared with the other applicators. Applying the fungicide using ULV applicator at the rate of 100L/fed, showed more efficacy than that obtained by applying 400L/fed using HV applicator.

Technical field tests indicated that the ULV applicator produced very small droplets (204 droplets per cm^2 of 56.66μm in diameter). The LV applicator produced small spray droplets (163 droplets per cm^2 of 146μm in diameter), while the HV applicator produced relatively large spray droplets (98 droplets per cm^2 of 198μm in diameter).

The fungicide distribution curve in case of ULV applicator was sharp, in contrast to the HV applicator, which produced very wide curve. Thus, applying ULV applicator with rate of 100L/fed saved about 75% from recommended dose by using traditional applicator method; in turn, reduced the environmental pollution as well as decreasing the production costs.

Introduction

Chemicals play a major role in the rapid increasing of agricultural production. Meanwhile, the wide spread of pesticides use has resulted in some serious environmental and health problems.

Several types of spraying devices had been used in agricultural applications (Awady and Afifi, 1976). To increase the efficiency of spraying, and decrease the injury percent and the quantity of liquid, different fungicides were used. Awady (1977 and 2003), and Azime *et al.*, (1985) showed that the atomizer has three atomization functions, to regulate flow-rate to form and control droplet size and to disperse and distribution the droplets in a specific

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pattern. Keppner *et al.*, (1982) mentioned that the degree of atomization depends upon the characteristics and operating conditions of the atomizing device and upon the characteristics of liquid being atomized.

Irrational use of pesticides result in increasing amount of pesticide residues in the edible parts and environmental pollution (Ames and Gold,1997). Reduction of pesticide amount introduced in the environment becomes an international target, in order to maintain the environment and decrease the crop production costs. Moustafa and Ismail 2003 studied the effect of the different fungicide applicator types on the efficacy of fungicides used to control late blight disease caused by ***Phytophthora infestans*** on potato. They found that, using the ULV applicator resulted in reduction of the fungicide amount needed to perform appropriate control of this disease from 400 L/fed, (the recommended amount) to 50 L/fed. The lowered amount of the fungicide run-off in turn saves the environment and decreases the crop production costs.

This work is an attempt to find out the effect of different fungicide applicator types on the efficacy of the fungicides used to control downy mildew disease on cucumber caused ***Psendoperonospora cubensis,*** and at the same time estimates some technical proprieties, which play an important role in the environmental pollution.

Materials and methods

Five recommended fungicides were used in this study, namely: Ridomil plus 50% wp (metalaxyl 15%, cupper 35%) was applied at the concentration of 150 g/100 L water, Cupper Oxichloride 50% wp was applied at the concentration of 300 g/100 L water, Ferro Z 62.5% wp (mixture of Cupper oxide, sulfer, and F^{++}) was applied at the concentration of 150 g/100 L water, Kocide 101 (Cupper hydroxide 77%) was applied at the concentration of 150g /100 L water and Previcur N (Propamocarb hydrochlride 72.2% SL) was applied at the concentration of 250 g/100 L water. The aforementioned fungicides were applied at 4 application rates. 400, 200, 100 and 50 l/fed. In addition to a check treatment, which received water without any fungicide.

Three sprayer types were used to apply the different fungicides, namely, (a) knapsack sprayer, high volume (HV) easy action pump handle with metal hand lence tube; and with one hollow-con nozzle, (b) motorized knapsack sprayer, low volume (LV), which consists of a motor 2HP, 2-stroke, 35 cc, 6000 rpm and air speed at outlet about 75 m/s; and (c) A grooved toothed spinning disk sprayer, ultra low volume (ULV) operating with rechargeable battery, with rotation disk about 8000 rpm. This evaluation was carried out in two successive years (2001 and 2002). Cucumber field location in El-Gharbeia Governorat was divided into three plots to serve as replicates. Each was divided into six subplots, each of them received different an application rate. Each subplot was divided into 6 subplots, each of them received one of the five fungicides and the last one received water.

Cucumber leaves were randomizly collected from each subplot, the infection on each leaf was rated using the following index:

Table 1: Downy mildew infection on cucumber leaves and equivalent numerical values.

Numerical value (Infection category)	Infection
0	No infection spots on the leaf.
1	Very small infection spots occupying less than 1/10 of the leaf area.
2	Infection spots cover > ¼ of the leaf area.
3	Infection spots cover > ¼ and < ½ of the leaf area.
4	Infection spots cover > ½ of the leaf area, or the leaf is destroyed.

Disease severity was calculated using the equation developed by Townsend and Heuberger,(1943).

$$P = [\, \Sigma (n \times v) / 4N \,] \times 100$$

Where:-

P = Disease degree.

n = Number of leaves within infection category.

v = Numerical value of each category;

N = Total number of leaves.

Fungicide efficacy (FE) was calculated using Abbott equation (Fröhlich, 1979)

$$FE = [C - T / C] \times 100$$

Where:-

C = Disease severity in Control; control

T = Disease severity in Treatment.

Estimation of foliage coverage efficiency:

Foliage coverage efficiency of each applicator was determined by measuring the spray deposits in two directions, horizontally on both sides of the spray axis, and vertically on three levels of the plant as follows:

a-Horizontal coverage:

The method described by El-Gendy. (1994). Strips of polyethylene sheets (5 x 10 cm) were distributed on the field soil one meter on both side of the spray axis in distance of 25 cm from each other. Methyl blue solution (0.25%) was applied instead of the fungicide using the three applicators. After drying, the strips were collected and the indicator was resolved in known amount of distilled water and the amount of the dye on each distance was assessed by spectrophotometer at wavelength (340nm).

b-Vertical coverage:

The plants were divided into three levels: top; middle; and bottom to represent the higher, middle and lower leaves respectively, in the fashion used by Awady and Afifi (1976). Water sensitive paper cards were fixed on plants at straight radial lines on each level. The plants were treated with the different fungicides using the different applicator types at the rate of 400 l/fed. After the plant got dry, the cards were collected, the spray droplets were counted per square centimeter (No/cm^2), The volume median diameter (VMD) of each sprayer was calculated according to the following formula (Awady, 1977 and 2003):

$$\left[VMD = \left[\sum_{i=1}^{i=n} n_i X_i^3 \Big/ \sum_{i=1}^{i=n} n_i \right]^{1/3} \right]$$

Where:-

n_i = Summation of number of droplets at each classification of droplet size class;

Xi = Droplet diameter for the given class.

Results and discussion

Evaluation of five fungicides for their efficacy in controlling downy mildew disease on cucumber indicated clearly that all the tested fungicides showed sufficient disease control (Tables 2 and 3). In the year 2001, the fungicides efficiency ranged from 57.37% to 64.23% with very little difference among each other. In the second year (2002), the difference among the tested fungicides was more obvious. The fungicide efficiency ranged from 59.53% to 70.56%. Ridomil plus and Previcur N showed the highest efficacy in the two successive years (64.23% and 62.19 respectively in 2001 and 67.78% and 70.56% respectively in the year 2002), followed by Kocide 101 and Cupper Oxichloride with 60.98% and 62.09% respectively (in 2001) and 63.14% and 61.37% (in 2002). Ferro Z showed the least efficiency 57.37 and 59.53% in the years 2001 and 2002 respectively.

In general, decreasing the amount of the fungicide suspension applied resulted in drastically in the fungicides efficacy. When the fungicides were applied at the rate of 400 L/fed, 78.78% mean efficacy was obtained. Decreasing the amount of the fungicide suspension to 200 L/fed resulted in reduction of the mean efficacy to reach 72.54%. Further decreasing to 100 L/fed resulted in further fungicides efficacy reduction to reach 48.93%. When only 50 L/fed of the fungicides suspension were applied, only 45.26% mean efficacy of the fungicides was obtained. In the second year similar data were obtained since mean efficacy of the fungicides were 79.18%, 71.85%, 59.45% and 47.62% respectively. However, this fact cannot be valid for all cases. Regarding to each applicator separately, it is clear that it is valid in case of HV applicator, since drastical reduction in the mean efficacy of the tested fungicides can be noticed. Decreasing the amount of the fungicide suspension applied from 400 to 200, 100 L/fed and regarding the LV applicator, the difference in the fungicides efficacy, resulted by the decreasing of the fungicides amount, was not as drastical in the case of high volume applicator. Decreasing the amount of the fungicide suspension from 400 L/fed to 200, 100 and 50 L/fed resulted gradually reduction in the fungicides efficacy from 80.07% to 75.37, 61.71 and 43.22% respectively in the year 2001, and from 82.49% to 75.03%, 62.31% and 58.80% in the year 2002. The ULV applicator

Table 2: Effect of sprayer type and fungicide suspension amount on disease incidence (DI) and fungicide efficacy (FE) used to control downy mildew disease on cucumber plants in the year 2001.

Sprayer type	Fungicides	Recommended dose of spray suspension									
		400 l/fed.		200 l/fed.		100 l/fed.		50 l/fed.		Mean	
		DI	EF	DI	EF	DI	EF	DI	EF	DI	EF
H.V	Rodomil puts	12.50	75.33	18.50	63.48	36.83	27.30	42.80	15.52	27.65	45.41
	Kocide 101	14.50	71.38	21.00	58.55	36.00	28.94	46.40	08.41	29.47	41.82
	Cupperoxichloride	14.00	72.36	20.00	60.52	33.66	29.61	45.96	07.30	29.15	42.45
	Previcur N	13.50	73.35	19.50	61.51	36.33	28.29	48.20	04.86	29.38	42.00
	Ferro Z	16.68	67.07	24.00	52.63	37.50	25.98	48.56	04.45	31.68	37.46
	Mean	**14.24**	**71.90**	**20.60**	**59.34**	**36.46**	**28.02**	**46.58**	**08.05**	**29.47**	**41.83**
L.V	Rodomil puts	09.33	81.58	11.00	78.29	17.00	66.44	27.50	45.72	16.20	68.01
	Kocide 101	10.66	78.96	13.00	74.34	20.00	60.52	29.33	42.10	18.24	63.98
	Cupperoxichloride	10.33	79.61	12.00	76.31	19.00	62.50	27.00	46.70	17.08	66.28
	Previcur N	11.33	77.64	12.00	76.31	18.00	64.47	28.00	44.73	17.33	65.79
	Ferro Z	8.83	82.57	14.40	71.58	23.00	54.60	32.00	36.83	19.55	61.39
	Mean	**10.10**	**80.07**	**12.48**	**75.37**	**19.40**	**61.71**	**28.77**	**43.22**	**17.68**	**65.09**
U.L.V	Rodomil puts	07.66	84.88	08.33	83.56	10.00	80.26	16.00	68.42	10.49	79.28
	Kocide 101	07.66	84.88	08.33	83.56	12.50	75.33	17.83	64.80	11.58	77.14
	Cupperoxichloride	07.66	84.88	08.33	83.56	11.50	77.30	18.00	64.47	11.37	77.55
	Previcur N	07.00	86.18	08.00	84.21	11.00	73.29	17.00	66.44	10.75	78.78
	Ferro Z	09.66	80.93	10.33	79.61	13.17	74.00	21.00	58.55	13.54	73.27
	Mean	**07.93**	**84.35**	**08.66**	**82.90**	**11.63**	**71.04**	**17.97**	**64.54**	**11.54**	**77.22**
Mean of the three applicators	Rodomil puts	09.83	80.60	12.61	75.11	23.27	54.07	26.78	47.14	18.12	64.23
	Kocide 101	10.94	78.41	14.11	72.11	26.30	48.62	27.72	45.28	19.77	60.98
	Cupperoxichloride	10.66	78.95	13.44	73.46	25.82	45.03	26.89	46.93	19.20	62.09
	Previcur N	10.61	79.06	13.17	74.01	25.73	48.20	27.11	46.49	19.16	62.19
	Ferro Z	11.72	76.86	16.24	67.94	28.24	44.25	30.17	40.45	21.59	57.37
General mean		**10.75**	**78.78**	**13.91**	**72.53**	**25.87**	**48.93**	**27.73**	**45.26**	**15.94**	**61.37**
Control		**50.66**		**50.66**		**50.66**		**50.66**		**50.66**	

LSD 5%

Applicator	**= 0.63**	**AxB**	**= 1.7879**
Fungicide (B)	**= 1.0322**	**AxC**	**= 1.4235**
Concentration (C)	**= 0.8219**	**AxBxC**	**=3.1831**

Table 3: Effect of sprayer type and fungicide suspension amount on disease incidence (DI) and fungicide efficacy (FE) used to control downy mildew disease on cucumber plants in the year 2002.

Sprayer type	Fungicides	Recommended dose of spray suspension									
		400 l/fed.		200 l/fed.		100 l/fed.		50 l/fed.		Mean	
		DI	EF	DI	EF	DI	EF	DI	EF	DI	EF
H.V	Rodomil puts	13.66	75.16	20.50	62.73	28.00	49.09	44.66	18.80	26.71	51.44
	Kocide 101	15.00	72.73	22.33	59.40	35.00	36.36	45.66	16.98	29.50	46.36
	Cupperoxichloride	17.00	69.09	23.50	57.27	36.66	33.35	46.00	16.36	30.79	44.02
	Previcur N	12.033	77.58	20.00	63.64	31.00	43.64	37.33	32.13	25.17	54.24
	Ferro Z	17.50	68.56	25.66	53.35	36.33	33.95	47.00	14.55	31.62	42.51
	Mean	**15.09**	**72.56**	**22.39**	**59.29**	**33.39**	**36.29**	**44.14**	**19.76**	**28.76**	**47.71**
L.V	Rodomil puts	8.33	84.85	12.00	78.18	18.66	66.07	20.66	62.44	14.91	72.89
	Kocide 101	10.33	81.22	14.00	74.55	21.00	61.82	23.16	57.89	17.12	68.87
	Cupperoxichloride	11.33	79.40	15.66	71.53	22.00	60.00	23.83	56.67	18.21	66.90
	Previcur N	06.50	88.18	11.00	80.00	18.00	67.27	19.33	64.85	13.71	75.08
	Ferro Z	11.66	78.80	16.00	70.91	24.00	56.36	26.33	52.13	19.50	64.55
	Mean	**09.63**	**82.49**	**13.73**	**75.03**	**20.73**	**62.31**	**22.66**	**58.80**	**16.69**	**69.65**
U.L.V	Rodomil puts	08.33	84.85	09.33	83.04	11.00	80.00	17.50	68.18	11.54	79.02
	Kocide 101	10.33	81.22	10.83	80.31	13.50	75.45	20.33	63.04	13.75	75.00
	Cupperoxichloride	11.33	79.40	11.66	78.80	14.66	73.35	21.33	61.22	14.75	73.19
	Previcur N	06.50	88.18	07.00	87.27	09.33	83.04	16.00	70.91	09.71	82.35
	Ferro Z	11.66	78.80	12.66	76.98	15.33	72.13	23.00	58.18	15.66	71.52
	Mean	**09.63**	**82.49**	**10.30**	**81.29**	**12.76**	**76.76**	**19.83**	**64.31**	**13.08**	**76.22**
Mean of the three applicators	Rodomil puts	10.11	81.62	13.94	74.65	19.22	65.05	27.61	49.81	17.72	67.78
	Kocide 101	11.89	78.39	15.72	71.42	23.17	57.88	29.72	45.97	20.12	63.41
	Cupperoxichloride	13.22	75.96	16.94	69.20	24.44	55.56	30.39	44.75	21.25	61.37
	Previcur N	08.44	84.65	12.67	76.97	19.44	64.65	24.22	55.96	16.19	70.56
	Ferro Z	13.61	75.25	18.11	67.08	25.22	54.15	32.11	41.62	22.26	59.53
General mean		11.45	79.18	15.48	71.86	22.30	59.46	28.81	47.62	19.51	64.53
Control		55.00		55.00		55.00		55.00		55.00	

LSD 5%

Applicator = 0.1289
Fungicide (B) = 0.2662
Concentration (C) = 0.2658

AxB = 0.46
AxC = 0.594
AxBxC =1.03

showed another performance pattern. Decreasing the fungicide suspension amount from 400 L/fed to 200 L/fed resulted in very slight difference. Since the fungicide efficacy decreased from 84.35% to 82.90% with difference of only 1.49% in the year 2001 and from 82.49% to 81.28% with the difference of only 1.21% in the year 2002. Lowering the fungicide suspension amount from 100 to 50 L/fed, resulted in lowering the fungicides efficacy to 77.04% and 64.54% respectively in the year 2001 and to 76.79% and 64.31% in the year 2002.

From the last data, it is clear that, the ULV applicator showed the highest fungicides efficacy compared with the other applicators (HV and LV), even when the tested fungicides were applied at 100 or 50 L/fed. When the fungicides were applied at the rate 100 L/fed using ULV applicator, the fungicides efficacy was higher than when fungicides were applied using HV applicator at the rate of 400 L/fed, and when the fungicides were applied using LV applicator at the rate of 200 L/fed. Applying the fungicides at the rate of 50 L/fed using ULV applicator resulted in 64.54% in the year 2001 and 64.31% in the year 2002 compared with 43.22% and 58.80% when the LV applicator was used in the two successive years, and 8.05% and 19.76% when the HV applicator was used in the two successive years respectively.

Foliage coverage efficiency of each applicator:

a-Horizontal coverage

The efficiency of the three-applicator types to cover the plant foliage horizontally was assessed by spectrophotometer (Table 4 and Fig. 1).

Table 4: Coverage and distribution of the spray solution on both side of the spray axis:

Applicators	Distances between the stripes and spray axis and amount of solution captured on the strips (µg/cm^2)									Mean	Slop
	-100	-75	-50	-25	0	+25	+50	+75	+100		
HV	287	332	346	358	367	372	359	328	291	338	0.74
LV	144	261	275	292	296	305	284	277	156	254	1.34
ULV	31	127	201	229	234	231	195	135	28	157	2.04

It is demonstrated that the amount of the indicator captured on the strips was low when ULV applicator was used. The estimated mean amount of the captured indicator was higher with 54% by using LV applicator and with 38% by using HV applicator than amount obtained by ULV.

It is indicated, that in all cases, the amount of the captured indicator decreased as the distance between the strips and spray axis increased on the both sides.

Fig. (1) shows obviously that, the curve of distribution of the indicators of HV applicator on both sides of the spray axis has a low slope factor (0.74) which leads to splashing the fungicides in a very wide area of the ground around the plants, and in turn, more environmental pollution. This finding as in contrast with that was found in the case of the ULV applicator, which showed a high slope factor (2.04), which lead to concentrate the spray solution in a narrow rang on both sides of the spray axis. Since the cucumber plants are planted on rows of one-meter apart each, most of the fungicides will be captured on the plants and very little amount will be splashed on the ground, which means less environmental pollution risk. In case of LV applicator, the slope of the curve was in between the slope of ULV and HV.

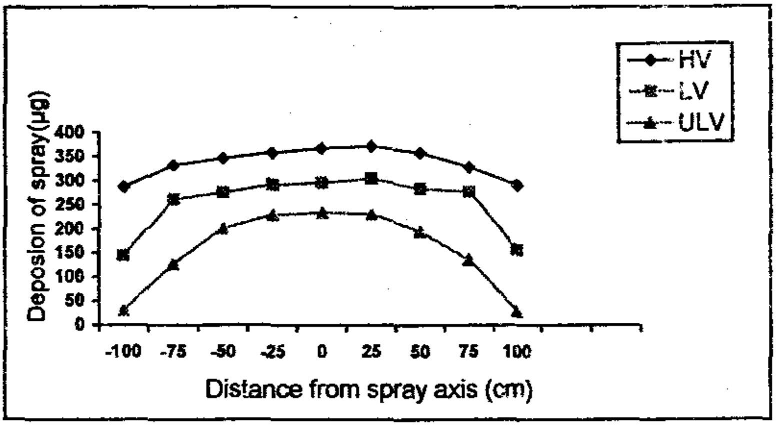

Fig. 1: Coverage and distribution of fungicide, produced by the three different applicator types, on both sides of the spray axis.

b-Vertical coverage:

Distributions of the spray suspension and mean spray droplets diameter were estimated on water sensitive papers hung on three levels on the plants representing the lower, middle leaves and on plant tops.

The data presented in (Table 5) indicated that the ULV applicator performed the highest number of droplets either on the upper; middle or on the lower leaves. Mean number of droplets was 198 droplets. Meanwhile, less number of droplets was gained using LV applicator with mean number of droplets of 146. Using the HV applicator resulted in the lowest number of droplets with mean number of droplets of 56.66. It was manifested, that in all cases, the highest number of droplets was found on the upper leaves, this number decreased gradually on the middle and lower leaves, however this decreasing of the number of droplets differed from an applicator to another.

In case of the ULV applicator, relatively smooth reduction in droplet number was noticed. Number of droplets reduced from 246 on the upper leaves to 203 on the middle leaves representing 17.5% reduction. The number of droplets on the lower leaves decreased to 145 droplets which representing 41.1% reduction.

In case of LV applicator the decrease of the droplets number was more obvious; since the droplets number ranged from 197 on the upper leaves to 132 on the middle leaves representing 33% reduction, and decreased to 109 droplets on the lower leaves representing 55% reduction. In the case of HV applicator, this decrease was drastical; since the droplets number decreased from 86 on the upper leaves to 61 on the middle leaves representing, and decreased to 23 droplets on the lower leaves representing 73.3% reduction.

From the same table, it can be noticed that the least VMD was obtained using the ULV applicator (98 µm), followed by LV applicator with (163-µm).

The largest droplets (204 μm) resulted from HV applicator. In general, data agree with finding of Awady and Afifi (1976).

Table 5: Vertical distributions of the spray suspension droplets per cm^2 and volume mean diameter (VMD)

Sprayer type	Number of droplets/cm^2 at the levels of plant			Mean number of droplets/cm^2	(VMD) μm,
	Top	Middle	Bottom		
HV	86	61	23	56.66	204
LV	197	132	109	146	163
ULV	246	203	145	198	98

Downy mildew disease, caused by ***PsendoperoOnospora cubensis*** is a major threat to cucurbit production all over the world (Palti and Cohen 1980, Weit *et al*; 1987 and Tsia *et al*; 1992). In Egypt, many fungicides are recommended to control this disease. All the tested fungicides showed good control of the disease, while Ridomil plus, Previcur N and Kocide 101 showed the best control efficacy. This data is in accordance with that found in the applied recommendation for control of agricultural pests (Anonymous, 1997 and 2001).

The efficacy of the different tested fungicides was greatly affected with the fungicides suspension amount per fed. Decreasing the fungicides suspension amount resulted in clear reduction in the fungicides efficacy. However this reduction depended upon the applicator type. This reduction was great in the case of HV applicator, intermediate in case of LV applicator and low in case of ULV applicator. Grayson *et al.* (1996) attributed the enhanced performance of fungicides by low volume applicator to the higher spray retention with spray drop coalescence and lower run-off. On the other hand, the number and size of the spray droplets per cm^2 reaching the crop or ground play their part in determining the biological efficacy of the treatment in addition to the efficacy of the fungicide (Anonymous. 1985). Similar data were obtained be Moustafa and Ismail (2003). In this study, field technical tests indicated that the ULV applicator produced very small droplets (56.66 droplets per cm^2 of 204 μm in VMD). The LV applicator produced small droplets (146 droplets per cm^2 of 163 μm in VMD), while the HV applicator produced relatively large droplets (198 droplets per cm^2 of 98 μm in VMD).

This data is in the same range mentioned by (Gruzdyev *et al.*, 1983). Matthews (1992) reported that it might seem impossible to achieve control of a disease unless there is complete coverage, since hophead can penetrate plants at the site of spore deposition when suitable conditions occur. However, each speck of fungicide from a droplet has a zone of fungicidal influence. Courshee, *et al.*, (1954) referred to this as the biocide range of droplet. They postulated that the maximum ratio between the effective fungicidal cover and actual cover is by deposit of the fungicide residue of a droplet on drying when droplet size is minimal. On these bases, the data obtained in this study can be explained, since the very small volume and high number of the spray droplets produced by ULV applicator performed a very good fungicides coverage, which enhanced the fungicides efficacy, in contrast to HV applicator which produced relatively little number of large droplets with a large inter space, which in turn resulted in bad coverage with the fungicides and bad control efficacy.

The amount of the indicator captured on the strips was high when HV applicator was used compared with LV and ULV. This higher amount may due to the higher ability of the large droplets produced by the HV applicator to run off, which resulted in little amount of indicator solution captured on the plant foliage and increased amount of the indicator that reached the soil. Brunskill (1956) discussed such suggestion; he mentioned that droplets, which reach a surface, might not be retained on it. He added that droplets which strike a surface become flattened, but the kinetic energy is such that the droplets then retract and bounce away. Droplets below certain size (< 150 µm) have insufficient kinetic energy to overcome the surface energy and viscous changes and cannot bounce; conversely, very large droplets have so much kinetic energy.

Studying the horizontal distribution of the indicator showed that the three tested applicators could cover one meter on both side of the spray axis (2m. spray width). However, the indicator distribution curve in case of HV applicator was very wide, in contrast of the ULV applicator which produced sharp curve. Since the cucumbers are planted on rows about 1m wide, therefore applying the fungicides using ULV applicator will concentrate the fungicides on the plant foliage and decrease the fungicide amount lost on the soil between the rows. Conversely, the HV applicator will cover the planted area in addition to the free area between the rows which results in pollution of the soil with the fungicides. In addition, applying only 25% of the recommended dose of the fungicides using ULV applicator resulting in fungicide efficiency as high as applying the full dose using HV applicator. Accordingly the ULV applicator reduces the environmental pollution as well as decreases the production costs.

It can be concluded that Ridomil puls and Previcur N showed the highest efficacy in the two successive years. When the HV applicator was used, decreasing the amount of the fungicide suspension from 400 to 50 L/fed resulted in drastically decreasing in the fungicide efficacy. The ULV applicator showed the highest fungicide efficacy compared with the other applicators. Applying the fungicide using ULV applicator at the rate of 100L/fed showed more efficacy than that obtained by applying 400L/fed using HV applicator.

The fungicide distribution curve in case of ULV applicator was sharp, in contrast to the HV applicator, which produced very wide curve. Thus, Appling ULV applicator with rate of 100L/fed saves about 75% from recommended dose by using traditional applicator method; in turn reduced the environmental pollution as well as decreasing the production costs. Thus, it is recommended that, ULV can be used with rate 100L/fed to control mildew disease caused by ***Psedoprenospora cubensis*** on cucumber by using Ridomil puls and Previcur N.

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تأثير نوع تطبيقات الرش علي كفاءة المبيدات الفطرية وتلوث البيئة

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تم دراسة تأثير أنواع آلات الرش المختلفة، والتي تختلف فيما بينها في حجم قطيرات محلول الرش (الحجم كبير والحجم صغير وقطيرات متناهية الصغر) علي كفاء بعض المبيدات الفطرية المستخدمة في مكافحة مرض البياض الزغبي علي الخيار بجرعات مختلفة من محاليل الرش بالإضافة إلي دراسة تأثيرها علي تلوث البيئة بالمبيدات .

تم اختبار خمسة مبيدات فطرية هي: الريدوميل بلاس وكوبر اوكسي كلوريد وفيرو زد وكوسيد ١٠١ والبريفيكور أن ، وذلك بالتركيزات الموصي بها وبجرعات ٤٠٠ و ٢٠٠ و ١٠٠ و ٥٠ لتر/فدان .

قد أظهرت جميع المبيدات المختبرة كفاءة معنوية في مكافحة المرض ، وأعطي كلا من (الريدوميل بلاس والبريفيكور أن) أعلي كفاءة خلال سنتين متتاليتين .

عند استخدام آلة الرش كبيرة القطيرات مع تقليل كمية محلول الرش ادي إلي انخفاض شديد في كفاءة المبيدات ، في حين أنه عند استخدام آلة الرش ذات القطيرات متناهية الصغر ، كان أنخفاض المبيد ضئيلا ومتدرجا. أظهرت الآلة ذات القطيرات متناهية الصغر أعلي كفاءة في مكافحة المرض ، وعندما تم رش المبيدات بمعدل ١٠٠ لتر/ فدان باستخدام هذه الآلة أعطت كفاءة اعلي من تلك التي استخدمت فيها ٤٠٠ لتر للفدان بواسطة الآلة ذات القطيرات الكبيرة.

تقدير حجم وعدد القطيرات الناتجة من الآلات المختلفة وكذلك توزيع قطيرات الرش أفقيا ورأسيا علي محور الرش أظهر أن الآلة ذات القطيرات متناهية الصغر أعطت ٢٠٤ قطيرة/سم٢ ذات نصف قطر ٥٦,٦٦ ميكرون . اعطت آلة ذات قطيرات صغيرة الحجم ١٦٣ قطيرة/سم٢ ذات نصف قطر ١٤٦ ميكرون. أما آلة الرش كبيرة القطيرات فقد أعطت ٩٨ قطيرة /سم٢ ذات نصف قطر ١٩٨ ميكرون .

القطيرات الناتجة من آلة الرش كبيرة القطيرات توزع أفقيا علي شكل منحني متسع قليل الانحدار ، بعكس آلة الحجم متناهي الصغر التي أعطت قطيرات تتوزع أفقيا علي شكل منحني شديد الانحدار ، مما يشير إلي تركيز المحلول في وسط الخط علي النباتات المعاملة وعدم انتشار المحلول علي جانبي الخط ، مما يؤدي إلي تقليل تلوث التربة بالمبيدات ، بعكس آلة الرش كبيرة القطيرات التي تنتشر قطيراتها من جانبي الخط فتتجاوز النباتات وتؤدي إلي تلوث التربة بالمبيدات . لذا فان استخدام الآلة ذات القطيرات متناهية الصغر يؤدي إلي خفض كمية المبيد المستخدمة بنسبة ٧٥% من الكمية الموصي بها ، ويعطي كفاءة أعلي في مكافحة المرض ، فتقل تكاليف الإنتاج ويقل تلوث البيئة بالمبيدات .

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