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TRADITIONAL PRACTICES OF USING PESTICIDES ON VEGETABLES AND ITS IMPACTS ON RESIDUE LEVELS OF FENITROTHION ON CUCUMBER UNDER EGYPTIAN CONDITIONS

[43]

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ABSTRACT

The traditional practices of using pesticides on vegetables and its impacts on residue levels of the organophosphorus compounds, fenitrothion on cucumber fruits at Menofia Governorate were studied. The analyses of the collected answers of the farmers questionnair related to their using of pesticides in the pest control applications, the obtained results clearly indicated that a high percent of the incorrect farmer's behavior are responsible for the existence of pesticide residues in the environmental elements at the selected sites. In addition, based on the frequency of pesticides used, insecticides group ranked the first (50%) followed by fungicides (35.7%) then herbicides (7.14%). In addition, levels of fenitrothion residues on cucumber fruits when applied twice at the recommended rate use of application and under the dominant intensive use for five succssive sprays were determined under field conditions. Fenitrothion 50 % EC at the 2.5ml/l was applied by using knapsack sprayer on cucumber plants, which received normal agriculture practices in a private field, located at Ashmon village, Menofia Governorate. Degradation behavior of fenitrothion residues on treated cucumber was investigated. The obtained data indicated that repeating the insecticide application for five times into seven day intervals resulted of in the occurrence of higher levels of initial deposit (91.02 ppm) than those found with the recommended use of two sprays (71.03 ppm). As regard of degradation behaviour parameters, the half-life periods ($t_{1/2}$) indicated rapid dissipation of fenitrothion residues, i.e.2.006 and 1.875 days after1st and 2nd spray, respectively. However, the tenth-life periods ($t_{1/10}$) showed 5.72 and 5.48 days. Accordingly, the presence of fenitrothion residues on cucumber fruits is to be expected and showed variable degradation data on behaviour of the insecticide residues with repeating application.

INTRODUCTION

The intensive use of pesticides resulted in serious problems as regard to the target pests and adverse effects against human health and environment. Environmental contamination is one of the most important problems of these effects in many countries. The wide spectrum of contamination with pesticide residues as one of the main elements of our ecosystem and environment was reported by many investigators (**EL-Zemaity, 1988; Zidan *et al* 1996; Shady *et al* 2000 and Hegazy *et al* 2002**). The role of technological processes on pesticide residues decontamination in vegetables was studied by several researchers (**Calumpang *et al* 1988 and Zidan *et al* 1996**). Such findings indicated that the misuse or the incorrect application practice are the main reasons responsible for the problem of pesticide residues on edisble crops.

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Hence, the present investigation aimed to investigate the most frequently encountered traditions in relation with the pesticides applications by the farmers through 107 questionnaires and determine the levels of fenitrothion deposits and residues on cucumber fruits in relation to spray number and post treatment intervals.

MATERIALS AND METHODS

1. Questionnaire the traditional practices in using pesticides on vegetable crops

Appropriate questionnaire was prepared as described by (**El-Mashtouly, 2004**) and used during the survey to collect the information about the traditional practices of using pesticides on vegetable crops under local conditions in Egypt. Questionnaire design form was prepared to cover the information regarding the common pesticides used for control of vegetable pests, spray equipment, type of pest control operation, mixing, loading, application procedures and the disposable manner of pesticides packages. Questionnaires were distributed to collect required information from Menofia Governorate. The extracted information for 107 questionnaires collected from the surveyed investigated locations, i.e. Ashmon, Samadon and El-Ramla village, were summarized and tabulated to recognize the traditional practices of pesticides application on vegetable crops growing under field conditions.

2. Fenitrothion residue levels on cucumber in relation to repeating spray of the insecticide

2.1. Experimental design

The organophosphorus fenitrothion insecticide (50% EC): *O,O*-dimethyl *O*-4 – nitro-*m*-tolyl phosphorothioate (IUPAC) has been used throughout the present study. The experimental work was carried out under open field conditions during summer 2004 in a private farm located at Ashmon village, Menofia Governorate. The treated area was three kerates (175 m^2) with fifteen furrow each. The application rate of the tested insecticide (2.5 ml/l) on cucumber plants was applied by using knapsack sprayer to clarify the role of spray numbers on pesticide residues two and five sprays of the recommended rate were carried out at early morning.

2.2. Sampling technique

Nine samples of cucumber fruits were collected before as well as after each spray in three replicates (each sample was 4 Kg). The collected samples were transferred to the laboratory, prepared and subjected to residue analysis. As for two sprays treatment, samples of cucumber fruits were collected 0, 1, 3,5, 7, 14 and 21 days. With five sprays treatment cucumber fruits were collected at different periods after application for two times.i.e. 0, 7, 14, 21, 28 and 35 days from application. Fruits were chopped and 50 g were taken for residue analysis.

2.3. Extraction and clean-up procedures

Both of the extraction and clean-up procedures of the collected and representative cucumber samples were carried out according to the Method described by the Official Methods Of Analysis (**A. O. A. C. 1990**).

2.4. Separation, identification and quantitative determination of fenitrothion residues

Fenitrothion residues, were separated, identificated and determined quantitatively by using gas chromtogrphic technique. The operating conditions for the GC (Shimadzu 12-A) using the following conditions: G.C. column packed with 3% silicon OV-101 of chromosorb Q, connected with flame ionization detector (FID); Inj./ Det. Temp. (250°C); oven Temp. (210°C); carrier gas, N_2 (1.0 kg/cm, Flow: 30 ml/min); burner gas, H_2 (1.0 kg/cm, Flow: 30 ml/min); air (1.0 kg/cm, Flow: 30 ml/min) and attenuation (10 x 5). The mean of recovery percentage of spiked sample of fenitrothion at 1.0 ppm was 80.50.

RESULTS AND DISCUSSION

1. The common practices of used pesticides on vegetables and the impact of traditional practices on residue levels of fenitrothion on cucumber fruit

To facilitate the understanding of the collected information, from answers of 107 questionnaires that covered the three villages, i.e. Samadon, Ashmon and El Ramla, it was found to express such information as frequency and percentages. The collected information, could be divided as follows:

1.1. The traditional practices of application of pesticide

The information related to the traditional practices of the pesticides application was collected through the answers of farmers, which were dependent on both of their knowledge and experiences in such field. Based on the frequency and percentage the obtained answers are listed in **Table (1)**. In such table the data indicate that the decision to use pesticides was found to be 34.57, 20.05, 15.88 14.95 and 14.01 % for pesticide trader, other sources such as personal experience, neighborhood consultation...etc, operator, farmer, and agricultural guide, respectively. The percentage of choosing the used pesticides by the farmers was found to be 50.46, 28.97, 12.14 and 8.41% for the efficiency, pesticide price, safety and availability, respectively.

In relation to the information sources about the selected pesticides, it was found that 42.05, 28.03 , 15.8, 88.41 and 5.60% of the farmers are obtaining such information form pesticide trader, agricultural pamphlet, advertisements, personal experience and labels, respectively. The mode of preparation of the selected pesticide was found to be using the irrigation water, drainage water, ground water and tap water, which represented by 49.53, 34.57, 15.88 and 0.00%, respectively. The time of pesticide application showed that 66.35, 16.82, 10.28 and 6.54% of the farmers was decided according to the pest appearance, routine spraying, economic threshold and protective treatment, respectively. Also, the frequency of pesticide applications was found to be in three categories, i.e. many times (57.01%), two times (26.16%) and one time (16.82%).

In case of time of spraying of the selected pesticide, it was found that such factor was represented by 36.44, 23.36, 21.49 and 18.69 % of farmers are spraying in early morning, after sun rise, before sun rise and through day light, respectively. After application of the selected pesticides, the collected answers related to the mode of disposal of excess pesticides was in the following order, spill in irrigation channels (38.31%), spill on land (32.71%), re-spraying (24.29%) and spill in bores far away from a farm (4.67%).

In addition, the disposal of empty package of pesticides was found to be in irrigation channel (47.66%), in drainage channel (25.23%) in rubbish (24.29%) and by incineration (2.80%) while burying the empty package was found to be (0.00%). At the end, it was found that the farmers whose eating the treated fruits without any consideration to the preharvest intervals (PHI) and/or removal processing of pesticide residues are represented by 45.79, 35.51 and 18.69 % which are eating the treated fruits immediately,, after one day and/or many days of application the selected pesticide(s), respectively.

According to the obtained results, it is clear that a high percent of the incorrect farmer's behavior are responsible for the existence of pesticide residues in the environmental elements. For example, both of the farmer's decision to use a pesticide (34.57%) and to obtain the information about the selected pesticide (42.05%) are depending on the pesticide trader which may not be a suitable decision in relation to the target pest.

In addition, the collected answers showed that 66.35% of farmers are applying the pesticide according to the pest appearance not to the economic threshold. Furthermore, 57.01% are applying the selected pesticide many times. In the same time, both of 38.31 and 47.66% of those farmers are disposing either the excess of pesticides or the empty of pesticide package in the irrigation canals. Also, 49.53% of farmers prepare the selected pesticide using the irrigation water which may be contained other pesticide residues.

However, our finding are in agreement with other results obtained by **(El-Matshtouly, 2004)** who studied the conventional practices of pesticide applications on vegetable crops under open field and greenhouse conditions through collecting an answers of 121 questionnaires covered five Governorates in Egypt, i.e. Qualyiobia, Giza, Sharquia, Menofia and Behira.

1.2. The commonly used pesticides in controlling vegetable pests

Data in **Table (2)** clearly indicated that the most commonly used pesticides on vegetable and fruit crops in the selected sites, Samadon, Ashmon and El-Ramal, Menofia Governorates during the period of study included insecticides, fungicides, herbicides and acaricides. Based on the frequency of pesticides used, insecticides group ranked the first (50%) followed by fungicides (35.7%) then herbicides (7.14%) and acaricides (7.14%).

The total number of the most commonly used pesticides in these three sites was 14 compounds. Such number, represents only (5.90%) of the registered pesticides in Egypt for vegetables (237 compounds against 16 target pests). Regarding insecticides used, fenitrothion revealed the most

Table 1. Frequency and percentages of farmer's answers of the designed questionnaires related to the traditional practices of the used pesticides on vegetables and fruit crops in the selected sites, Samadon, Ashmon and El-Ramla, Menofia, Governorate, Egypt.

Traditional Practice	Information	Frequency	%
Decision of using pesticide(s)	- Pesticides trader	37	34.57
	- Others	22	20.05
	- Operator	17	15.88
	- Farmer	16	14.95
	- Agricultural guide	15	14.01
Choosing the used pesticide(s)	- Efficiency	54	50.46
	- Price	31	28.97
	- Safety	13	12.14
	- Availability	9	8.41
Source of Information	- Pesticides trader	45	42.05
	- Agricultural pamphlets	30	28.03
	- Advertisements	17	15.88
	- Labels	6	5.60
	- Other sources	9	8.41
Preparation of pesticide	- Irrigation water	53	49.53
	- Drainage water	37	34.57
	- Ground water	17	15.88
	- Tap water	0	0
Time of application	- Pest appearance	71	66.35
	- Routine spray table	18	16.82
	- Economic threshold	11	10.28
	- Protective application	7	6.54
Frequency of pesticide application	- Many times	61	57.01
	- Two times	28	26.16
	- One time	18	16.82
Time of application	- Early morning	39	36.44
	- After sun raise	25	23.36
	- Before sun set	23	21.49
	-Through day light	20	18.69
Disposal of excess pesticides	- Spill in the irrigation channels.	41	38.31
	- Spill on the land.	35	32.71
	- Re-spray.	26	24.29
	- Spill in bores away a farm.	5	4.67
Disposal of empty Pesticide package	- In irrigation channel	51	47.66
	- In drainage channel	27	25.23
	- In rubbish	26	24.29
	- Incineration	3	2.80
	- Burying	0	0
Eating treated fruits	- Immediately	49	45.79
	- After one day	38	35.51
	- After many days	20	18.69

Table 2. The current used pesticides on vegetable crops in Menofia Governorate in Egypt, their common names, trade names, toxicological & safety values and hazard category

Pesticides		Frequency	%	WHO Hazard Categorry	ADI* (mg/kg)
Common name	Trade name				
Fenitrothion	Sumithion 50% EC	87	81.3	II	0.005
Profenofos	Selecron 72% EC	83	77.5	II	0.01
Malathion	Malathion 57%EC	62	57.9	III	0.02
Methomyl	Lannate 90%SP	54	50.4	Ib	0.03
Pirimiphos - methyl	Actellic 50%EC	52	48.6	III	0.03
Chlorpyrifos	Dursban 48% EC	23	21.4	II	0.01
Carbosulfan	Marshal 25%WP	19	17.8	II	0.01
Carboxin + Thiram	Vetafax	37	34.6	U+III	n.a.
Metalaxyl + Copper	Ridomil plus 50%WP	34	31.7	II+III	n.a.
Dimethomorph + Copper oxychloride	Acrobat/Copper 46% WP	28	26.2	U+III	n.a.
Diniconazole	Sumi-eight 5%EC	26	24.1	III	n.a.
Penconazole	Topas 10%EC	13	12.1	U	0.03
Abamectin	Vertimec 1.8%EC	29	27.1	n.a	0.0001
Atrazine	Atrazex 80% WP	73	68.2	U	0.005

EC: Emulsifiable Concentrate, WP: Wettable Powder, SP: Soluble Powder.
ADI*: Acceptable Daily Intake, n.a.:Not available.
Ib: Highly hazardous, II: Moderately hazardous, III: Slightly hazardous, U: Unlikely to present acute in normal use

frequently used insecticide (87) which represent 81.3 % of the total used insecticides. Such compound was followed by profenfos, malathion and methomyl, pirimiphos-methyl, chlorpyrifos-ethyl and carbosulfan which their frequencies were determined by 83, 62, 54, 52, 23 and 19, representing 77.5, 57.9, 50.4, 48.6, 21.4 and 17,8 % of the insecticide used, respectively.

In case of the used fungicide, the most frequently compound was carboxin+thiram followed by metalaxyl plus copper, dimethomorph, diniconazole and penconazole which their frequencies were 37, 34, 28, 26 and 13 representing 34.6, 31.7, 26.2, 24.1 and 12.1 % of the total used pesticides, respectively. In addition, the most commonly used acaricide was abamactin, which its frequency was 29 representing 27.1% of the pesticide used. The only herbicide used was atrazine, which its frequency was 73 and its percentage was 68.25%.

The collected data related that the commonly used pesticides in the selected sites clearly indicate that the farmer's behavior throughout their personal usage of pesticides may present the main responsibility of the direct contamination of most of the environmental components with the pesticides residues. In addition, the above mentioned factors especially those related with the high frequency and percentage among pesticides used, we have to take into our consideration the physicochemical characteristics of such compounds, i.e. solubility, stability, leaching, its ability to be adsorbed by the organic matter may be represent a key factor of the environmental contamination by pesticides. However, similar interpretations are obtained by (**Kenaga, 1975 and Haque 1975**) whose studied the partioning, uptake and adsorption of pesticides in the biological systems.

From toxicological point of view and according to the WHO classification of the hazard degree of pesticides (**WHO, 2002**), it is interesting to notice that few of the commonly used pesticides on vegetables in the mentioned sites belong to extremely or highly hazardous pesticides comparising (9.09%) while the moderately hazardous were (31.81%). Fortunately, the most commonly used pesticides are slightly hazardous were (36.36%). Such classification indicate the importance of the regular monitoring processes of the

pesticide residues in several components of the environment. However, it was found that most of the listed pesticides are mentioned in the list of compounds that recommended by the Egyptian Ministry of Agriculture while few pesticides are banned such as atrazine which was banned according to the Ministerial decision No. 719/2005.

2. Effect of spray repeating and levels of fenitrothion residues on cucumber fruits

Data on the levels of fenitrothion residues on cucumber fruits before and after sprays for five times into seven day interval are tabulated in **Table (3)**. The obtained results clearly indicated that the initial deposits of fenitrothion detected at 0-time of the first spray were slightly elevated with the increase of the number of applications. In terms of figures, the initial deposits detected after 1st spray were increased from 63.91 mg / kg to 71.03, 80.11, 76.24 and 91.02 mg / kg after the 2nd, 3rd, 4th and 5th sprays, respectively. It is interesting to notice that the deposits of fenitrothion detected before the next spray were elevated with increasing the numbers of application, i.e.were 5.59, 8.47, 12.83 and 19.72 mg / kg before 2nd, 3rd, 4th and 5th sprays, respectively. This may be explained due to the accumulation of the insecticde deposits and residues by repeating application. It could be concluded that the intensive use of the insecticide resulted in higher levels of deposits showing 91.02 and 71.03 mg / kg with two and five sprays, respectively. These results are in agreement with the finding of **Moon *et al* (2003)** and **Kumar *et al* (2003).**

3. Degradation behaviour and kinetics of fenitrothion residues on cucumber fruits

The initial deposits of fenitrothion on cucumber fruits were 63.91 ppm and 71.03 ppm after the first and second sprays, respectively **(Table 4)**. Fenitrothion residues were rapidly dissipated by the progression of post application periods.Approximate complete dissipation occurred within 14 days from the first spray (99.71% dissipation)., and after 21 days from the second spray (99.93%). The detected amounts of fenitrothion residues after first spray reached 49.79, 26.79, 9.71, 3.01 and 0.18 ppm, after 1, 3, 5, 7 and 14 days, respectively..Such the corresponding dissipation percent were 22.06, 58.06, 84, 80, 95.28 and 99.71 % respectively. The detected amounts of residues after second spray were 51.05, 17.09, 10.11, 3.43, 1.10 and 0.04 ppm, after the same intervals, showing 28.15, 75.93, 85.93, 95.17, 98.45 and 99.94 % dissipation, respectively.

As for degradation kinetics of fenitrothion residues on cucumber fruits, parameters of statistical and mathematical evaluation are presented in **Table (5)** and illustrated in **Figure (1)**. The half life periods ($t_{1/2}$) were 2.006 and 1.761 days after 1st and 2nd application, respectively. Also, the tenth life periods ($t_{1/10}$) were respectively. 5.72 and 5.48 days, indicating slow degradation behaviour of the residues after the 2nd application. This statement was emphasized by the degradation rates (k), i.e. 0.432 and 0.335 after the 1st and 2nd spray, respectively. Based on coefficient of determination (r^2) the dependence of the logarithm of residues on time was obviously demonstrated for fenitrothion residues on cucumber fruits.

Such results show dependent pseudo-first-order kinetics for the degradation behavior of fenitrothion on cucumber fruits. In fact, the slope of the degradation lines (B) and the degradation rates (K) for fenitrothion residues on cucumber fruits were –0.1878 and 0.432 after first spray, -0.1441 and 0.3350 after second spray, respectively.

However, the rapid dissipation of fenitrothion residues on cucumber fruits probably resulted from the dilution by plant growth in addition to the volatilization from the plant surface. However, the difference in the persistence of residues after second spray than that of the first spray may be explained due to the difference in environmental and meteorological conditions such as direct sun light, temperature, humidity, UV rays and high vapor pressure of fenitrothion (4 x 10 mm Hg at 30°C), metabolic conversions or other degradation process.

These finding indicate the occurrence of pseudo-first order reactions for the degradation behavior of fenitrothion on cucumber fruits under open field conditions. In fact, all parameters show variable degradation behaviour of the insecticide residues with repeated application. This difference may be explained due to the amounts remained of residues resulted from the 1st spray as well as the change in environmental conditions. The present results are in agreement with the findings of **EL-Zemaity (1988); AL-Azawi and AL-Samariee (1991); Mustafa *et al* (1994); Zidan *et al* (1996); Kumar *et al* (2000)** and **Moon *et al* (2003).**

Table 3. Initial deposits of fenitrothion on cucumber fruits after five successive sprays.

Number of sprays	Deposits (ppm)		MRL,s
	Before spraying	After spraying	
1	0	63.91	
2	5.59	71.03	
3	8.47	80.11	0.5 mg/kg
4	12.83	76.24	
5	19.72	91.02	

Table 4. Initial deposits of fenitrothion and percentages of dissipation on cucumber fruits

Time after application (days)	After first spry		After second spray	
	Residues (ppm)	% Dissipation	Residues (ppm)	% Dissipation
0	63.91	-	71.03	-
1	49.79	22.06	51.05	28.15
3	26.79	58.06	17.09	75.93
5	9.71	84.80	10.11	85.76
7	3.01	95.28	3.43	95.17
14	0.18	99.71	1.10	98.45
21	N.D	-	0.04	99.94

ND: Not detected

Table 5. Statistical and mathematical analysis of the degradation of fenitrothion residues on cucumber fruits under open field conditions

Parameters*	No. of spray	
	First	Second
Intercept of degradation line (A)	1.8812	1.7713
Slope (b)	-0.1878	-0.1441
Degradation rate (k)	0.432	0.3350
Coefficient of determination (r^2)	0.994	0.976
Half-life ($t_{1/2}$) days	2.006	1.761
Tenth-life ($t_{1/10}$) days	5.72	5.48

* Source: **Timme and Frehse, 1980.**

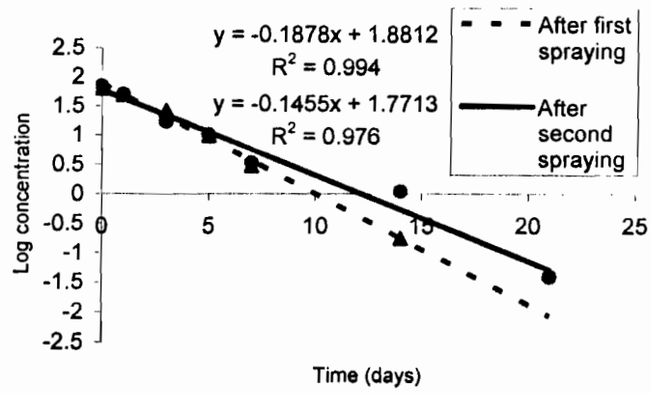

Fig. 1. Degradation regression lines of fenitrothion insecticide on cucumber fruits

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حوليات العلوم الزراعية
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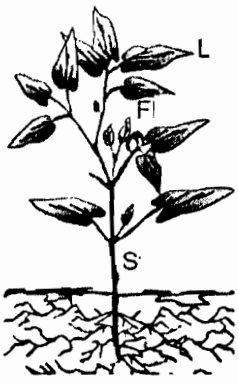

الممارسات السائدة فى إستخدام المبيدات على الخضروات وأثرها على مستويات متبقى الفينيتروثيون على الخيار تحت الظروف المصرية

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الكلمات الدالة : الممارسات السائدة ، المبيدات ، الخضروات ، فينيتروثيون ، متبقيات ، خيار ، إنهيار

تم دراسة الممارسات الزراعية السائدة فى إستخدام المبيدات على الخضروات وتأثيرها على مستوى متبقيات المبيد الفوسفورى العضوى ، الفينيتروثيون وذلك على ثمار الخيار بمحافظة المنوفية. وقد أشارت تحليلات الإجابات التى تم تجميعها من المزارعين والمتعلقة بإستخدام المبيدات فى مكافحة الآفات أن نسبة كبيرة من المزارعين يتبعون سلوكا خاطئا ومن ثم ترجع إليهم المسئولية لتواجد المبيدات بالمكونات البيئية بالمناطق المختارة. إضافة إلى ذلك ، فإنه إعتماداً على مدى تكرارية المبيدات المستخدمة، فقد إتضح أن المبيدات الحشرية قد أخذت المرتبة الأولى (٥٠%) ، تتبعها المبيدات الفطرية (٣٥,٧%) تليها مبيدات الحشائش (٧,١٤%). أيضا، فقد تم دراسة مستويات متبقيات مبيد الفينتروثيون على ثمار الخيار تحت ظروف الحقل المفتوح عند استخدام المبيد تبعاً لما هو موصى به بالرش مرتين وكذا في حالة الاستخدامات المكثفة السائدة بالرش خمس مرات، تم تطبيق المبيد فى صورة مركز قابل للإستحلاب بمعدل ٢,٥ مل/لتر باستخدام الرشاشة الظهرية، على الخيار المزروع مع العمليات الزراعية العادية وذلك فى مزرعة خاصة بقرية أشمون، محافظة المنوفية. كذلك تم دراسة سلوك التدهور للمبيد المذكور على الخيار الملوث. وقد أظهرت النتائج المتحصل عليها أن تكرار رش المبيد أسبوعيا، لخمس مرات نتج عنه مستوى أعلى من الرواسب الأولية (٩١,٠٢ جزء في المليون) عنه مع الاستخدام الموصي به بالرش مرتين (٧١,٠٣ جزء في المليون). وأوضحت قيم فترة نصف العمر($t_{1/2}$) إلى حدوث إختفاء سريع لمتبقيات المبيد، وبلغت قيم عشر العمر ($t_{1/10}$) ٥,٧٢ و ٥,٤٨ يوما بعد الرشة الأولى والثانية، على الترتيب، مما يشير إلى توقع وجود متبقيات المبيد على ثمار الخيار حتى بعد انقضاء فترة ما قبل الحصاد الموصى بها.

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