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STUDIES ON RESIDUES OF SOME ORGANOPHOSPHORUS INSECTICIDES ON TOMATO PLANTS

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ABSTRACT

The residual behaviour of Malathion, pirimiphos-methyl and profenofos applied to tomatoe field, at recommended rates was studied. This investigation was carried out in summer and in winter. Samples of tomato fruits and leaves were analysed by gas chromatography using N-P detector for residues determination.

Initial deposits were higher on leaves than on fruits. Residue values at different days after applications revealed an initial fast degradation of the products, followed by a gradual elimination period. The dissipation pattern of three organophosphorus insecticides are presented .

Mathematical equations, resulted from numerical analysis, shows that Malathion and pirimiphos-methyl follow a linear elimination pattern. However, the degradation behavior of profenofos fits a Gompertz and logisitic curves.

Different equations presented can be used for forecasting the residual behavior of Malathion, pirimiphos-methyl and profenofos applied to tomato fields.

INTRODUCTION

Tomatos is a widely a grown crop in Egypt, it is cultivated in different seasons. Fresh tomasto fruits are available, in Egyptian markets throughout the year. Numerous pests attack tomatoes fields, mainly, white fly Bemisia tabaci, Some lepidopterous larvae, aphid (Aphididae) and grass hoppers (Acrididae).

The most common of the insecticides used was Malathion for the control of aphids and white flies. Pirimiphos methyl was introduced as a substitute for malathion with an additional advantage of lower mammalian toxicity. Profenofos reported to be particularly effective against white fly. s insect is, so far, the major pest of tomatoes, because its role in transmission of viral diseases.

The purpose of the present work is to investigate the idues of the three organic phosphorus insecticides, Mal- ion pirimiphos methyl and profenofos applied to tomatoes wn in two seasons; summer and winter. With the ultimate of recommending time to elapse between application and vest for human consumption.

MATERIALS AND METHODS

Tomato seedlings Lycopersicum esculentum variety Bz-86 e transplanted, in the farm of the faculty of agriculture Moshtohor, at two seasons. In February 12th 1989 as Sum- crop and in October 5th 1989 as summer crop. The Plants eived normal horticultural practices.

Malathion, pirimiphos-methyl and profenofos were used in C. formulation of the trade names (carbofos 57%), (Actelic %) and (Selecron 72%).

raying and Sampling

An experimental area of 1400 m² was divided into three ots, each, consisting of 60 rows (90 x30 cm). Each plot s sprayed with one of the three insecticides under inves- gation, using a knap-sac sprayer filled with 20 liters of ter containing 83.33 ml of malathion in the first plot. e pirimiphos methyl was sprayed in the second plot (125ml 20 liters of water). The profenofos was applied to the ird plot (62.5 ml in 20 liters of water). These concentra- ons correspond to the recommended rates of applications r the three insecticides. Some raws were left as treated control.

Samples of leaves and fruits were randomly collected om every treated area one hour after application and then 1,3,6,9,12 and 15 days. They were kept in polyethylene gs at -20ºC until time for analysis .

xtraction and Clean Up

The procedure of Steinwander (1985) for extraction was

evaporated to dryness and then transferred quantitatively to 10 ml volumetric flask brought to volume with hexane to be used for G.C. determinations.

Determination

A gas chromatograph Pye Unicam, series 304 equipped with flame thermionic detector (N, P detector) was used for determination. The column used was 1.5 m x 6.6 mm od. pyrex glass packed with OV-17 on chromosorb (80-100 mesh).

The running temperature was 260ºc , 255ºc , 265ºc for the injector, the column and the detector respectively. The apparatus was connected to a 3390 Hewlet Packard integrator for calculations.

RESULTS AND DISCUSSION

Residues of Malathion:

The amounts of residues of malathion recovered and detected in tomato fruits and leaves grown for the summer and winter crops are given in Table (1). The initial deposit was 41.59 ppm and 42.02 ppm on and in fruits while leaves retained a higher deposit of 62.51 and 62.93 ppm one hour after application in summer an winter crops respectively. From the above results, the initial deposit was greater on leaves than on fruits. This is probably due to the effect of the large surface per weight unit of leaves in comparison to fruits. These results are in accordance with reports by El-Sayed et al., (1976) and Ahmed et al., (1982).

The loss of malathion after 24 hours was slow but in subsequent samples decline of residues was accelerated. The rate of decline of the insecticide was faster in and on fruits than in and on leaves in the crops of the two seasons. The pattern of degradtion of malathion is shown in (Fig 1). These results are in agreement with the results obtained by Linskinc et al., (1965). For example, in fruits of summer crop, the loss of residue were 18.97, 53.38, 84.49 and 95.84% of the initial deposit at 1, 3, 6 and 9 days respectively. In leaves of the same season, the losses were

Table (1) : Residues of malathion, pirimiphos-methyl and profenofos in tomatoe leaves and fruits cultivated as summer and winter crop at different days after application .

DAYS AFTER TREATMENT	RESIDUES IN TOMATOE FRUITS (PPM)											
	MALATHION				PIRIMIPHOS - METHYL				PROFENOFOS			
	Summer		Winter		Summer		Winter		Summer		Winter	
	F	L	F	L	F	L	F	L	F	L	F	L
0	41.59	62.51	42.02	62.93	47.56	66.91	47.99	67.28	36.12	49.24	36.22	50.09
1	33.61	52.49	43.71	52.98	38.12	55.93	38.64	57.01	29.37	42.92	29.49	43.75
3	19.39	34.61	21.44	36.25	20.33	36.89	22.29	38.55	16.79	28.65	17.27	29.53
6	06.45	17.04	08.57	19.61	05.25	17.62	06.92	19.60	10.50	18.64	10.98	19.75
9	01.73	07.52	03.95	09.95	00.42	05.04	02.76	07.82	06.55	12.13	06.39	13.44
12	N.D.	02.81	N.D.	05.53	N.D.	00.82	N.D.	03.87	03.77	06.61	04.39	07.85
15	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	00.15	03.19	00.74	04.50
Half life in Day : Hour	2:8	2:19	2:4	3:16	2:20	3:12	2:16	3:7	2:19	4:0	2:22	4:0

F = Fruits L = Leaves ND = Not Detected

The tolerance limit for malathion in 3 ppm (Anon, 1989) This limit was reached after 9 days in fruits (1.73 ppm) in Summer and after 12 days in winter. While on leaves the limit was reached after 12 days (2.81 ppm) in summer and after 15 days in winter. The half lifes of malathion calculated for different treatments are given in Table (1).

The weather differences between the spraying times in the two seasons had an intermediate effect on malathion residues.

Residues of Pirimiphos-Methyl:

Residues of pirimiphos-methyl detected on and in tomato fruits and leaves grown in two seasons (summer, winter) are shown in Table (1). The initial deposits determined one hour after application were 47.56 and 47.99 ppm in fruits and 66.91 and 67.82 ppm in leaves in summer and winter respectively. These results showed the same phenomenon observed in malathion greater initial deposit on leaves than on fruits. The pattern of deteioration of residues are given in (Fig 2). In comparing the rate of residue deterioration in the two seasons, noticeable difference could be observed. In all cases losses during the first day were relatively small and ranged between 19.85 and 16.41 ppm in summer crop and 19.48 and 15.26 ppm in winter crop in fruits and leaves respectively.

The tolerance level of pirimiphos-methyl on and in tomatoes is 1 ppm (Anon, 1989).

In the two seasons, loss of residues reached a peak on 3rd day after application. This was followed a plateau till the 6th day. The major bulk of the residue disappeared on the 9th day for fruits of summer crop (0.42 ppm) and on the 12th day for leaves of summer crop (0.82 ppm). In winter crop the residue undetected on the 12th day for fruits and on 15th day for leaves.

This may be taken as an indication of the importance of ambient temperature on the rate and pattern of deterioration of pirimiphos-methyl which needs further investigation. The half life of pirimifos-methyl is given in Table 1.

The persistance of the insecticide was more or less similar in both seasons. When the residue determined in tomato fruits and leaves grown for the two seasons, it was noticed that in both plant organs there was an initial period of rapid loss in the first 2.5days in summer crop and 6 days in winter crop. After that, the rate of deterioration was slowed down (Fig 3).

In fruits, the largest difference was found to be between the first and the third day, after which the difference became small indicating a gradual type of residues loss somewhat different from the patterns observed for malathion and pirimiphos methyl. In leaves, high differences between subsequent readings were persistent up to the 6th day. Then came the gradual fall in differences.

The loss in residues in winter crop was slightly less than summer. This may indicate that the differences in weather had little effect. On the other hand, difference in rate of degradation were of a more pronounced nature between fruits and leaves.

By refering to Codex Alimentarius published in 1989 by FAO and WHO Food Standard Program no reference was found to tolerance limit of profenofos. Accordingly, it is recommended, not to use this insecticide on tomatoes until the time required for the complete disappearance of residues of this insecticide was determined.

Forecasting of Residual Behavior:

The graphs plotted in figures 1,2 and 3 were obtained by using the Application System (AS) package on IBM (Main frame) computer model 4381.

As shown, and after statistical manipulation, the degradation pattern of Malathion and pirimiphos-methyl follow a linear relation with a suitable correlation coefficient. First degree equations with different constants, correlation coefficient and residual standard deviation for each treatment are presented in Table (2). The degradation behavior of profenofos in fruits a Gompertz curve. A logisitic curves represent profenofos elimination pattern in leaves.

The presented results of statistical analysis coincide

Table (2): Numerical analysis for residue data of malathion and pirimphos - methyl and profenofos in tomato leaves and fruits cultivated as summer and winter crop.

TITLE	MALATHION	PIRIMIPHOS-METHYL	PROFENOFOS
FRUITS IN SUMMER CURVE	$x = 52.65 - (10.69 \cdot t)$	$x = 60.48 - (12.71 \cdot t)$	$x = 44.07 \cdot 0.803^{(1.56)^t}$
STANDARD DEVIATION	2.9	3.87	3.47
CORRELATION COEFFICIENT	-0.989	-0.986	0.986
LEAVES IN SUMMER CURVE	$x = 78.46 - (14.54 \cdot t)$	$x = 85.09 - (16.2 \cdot t)$	$1/x = .017 \cdot 0.00188^{(2.05)^t}$
STANDARD DEVIATION	2.91	2.75	1.82
CORRELATION COEFFICIENT	-0.994	-0.996	0.997
FRUITS IN WINTER CURVE	$x = 52.82 - (10.23 \cdot t)$	$x = 60.37 - (12.22 \cdot t)$	$x = 136.76 \cdot 0.355^{(1.25)^t}$
STANDARD DEVIATION	2.75	3.76	1.61
CORRELATION COEFFICIENT	-0.989	-0.986	0.995
LEAVES IN WINTER CURVE	$x = 78.14 - (13.93 \cdot t)$	$x = 84.95 - (15.63 \cdot t)$	$1/x = .013 \cdot 0.00323^{(1.81)^t}$
STANDARD DEVIATION	2.51	2.86	1.58
CORRELATION COEFFICIENT	-0.995	-0.995	0.997

x = Residue in ppm ± Residual standard deviation.

t = Day after treatment

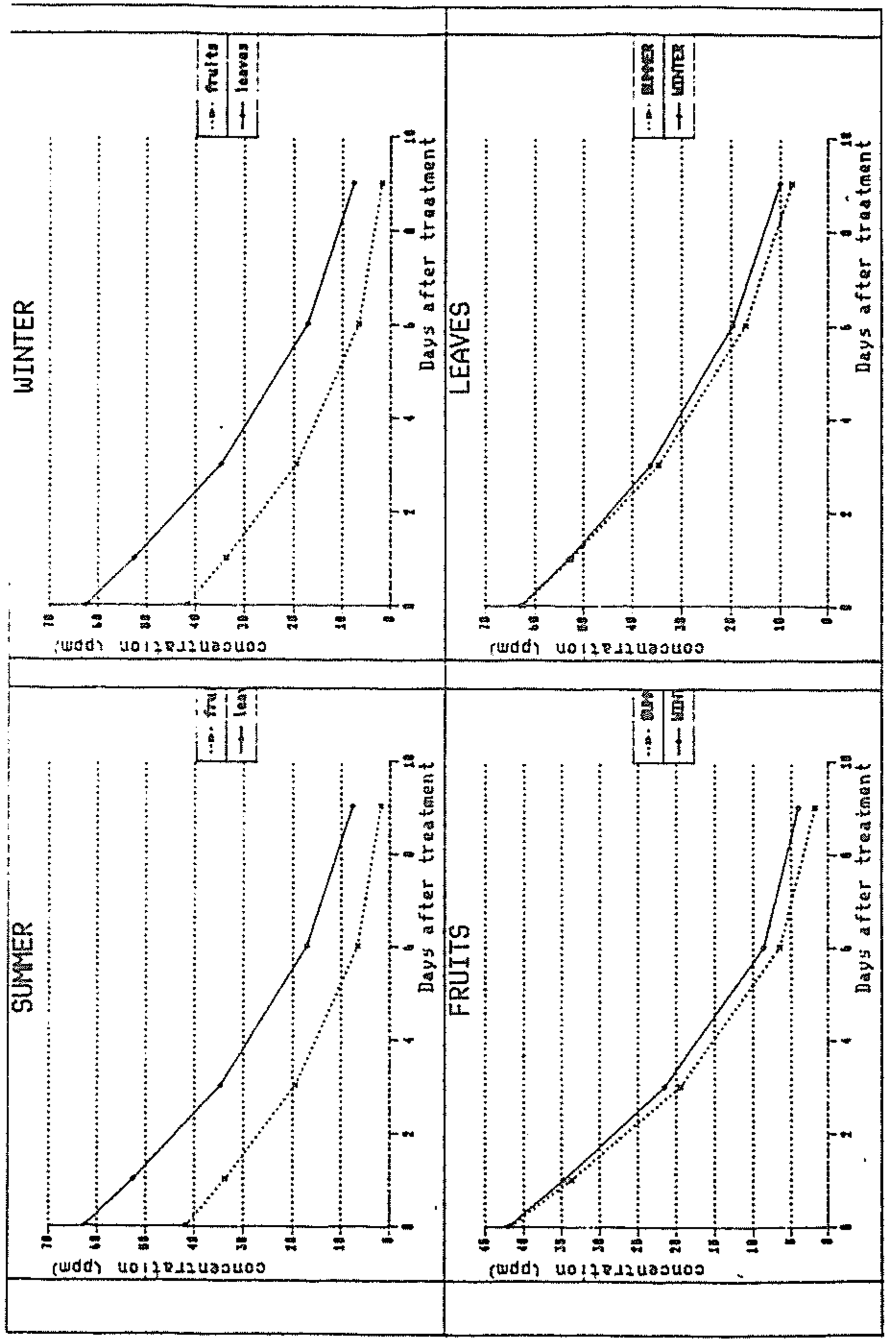
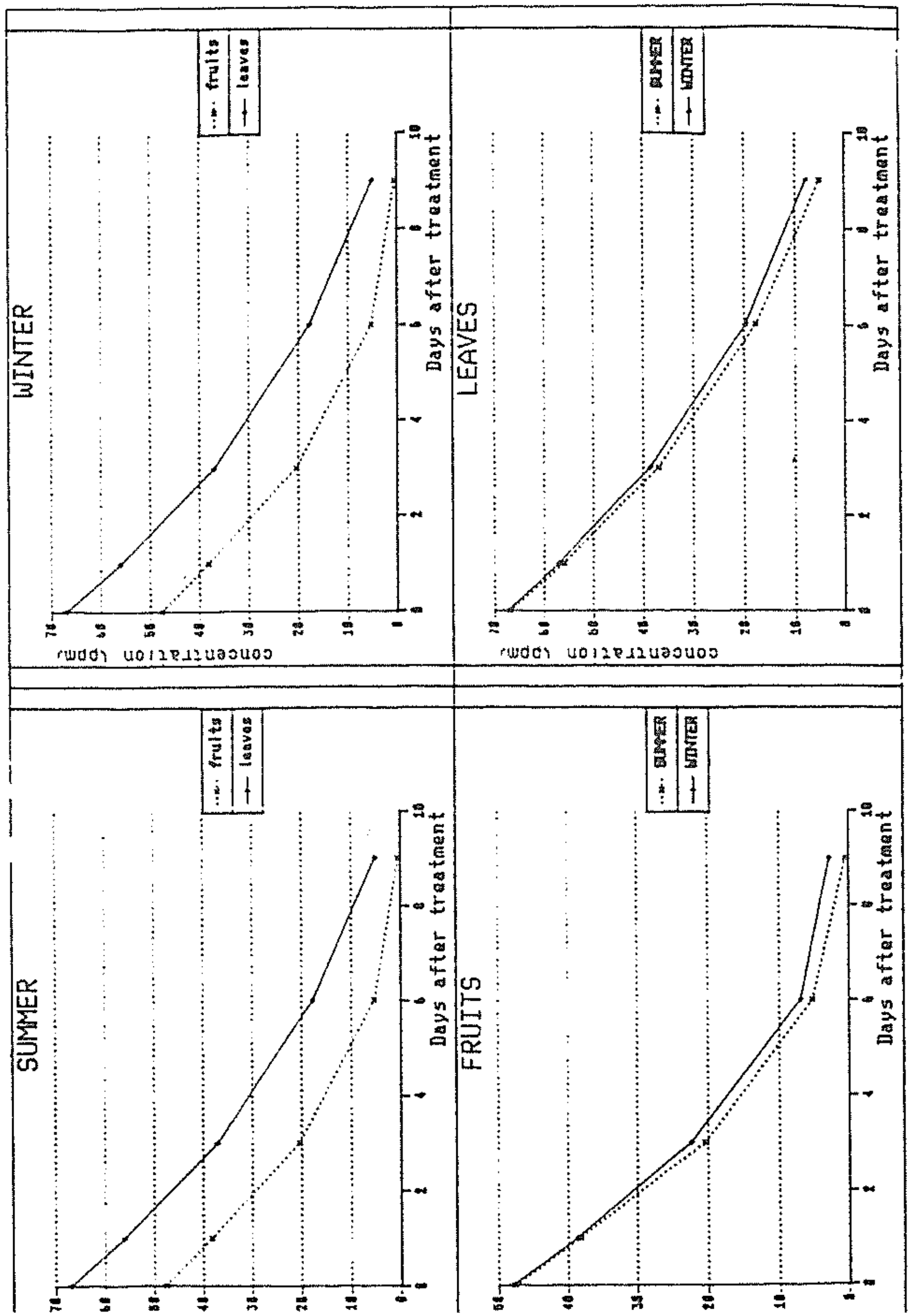
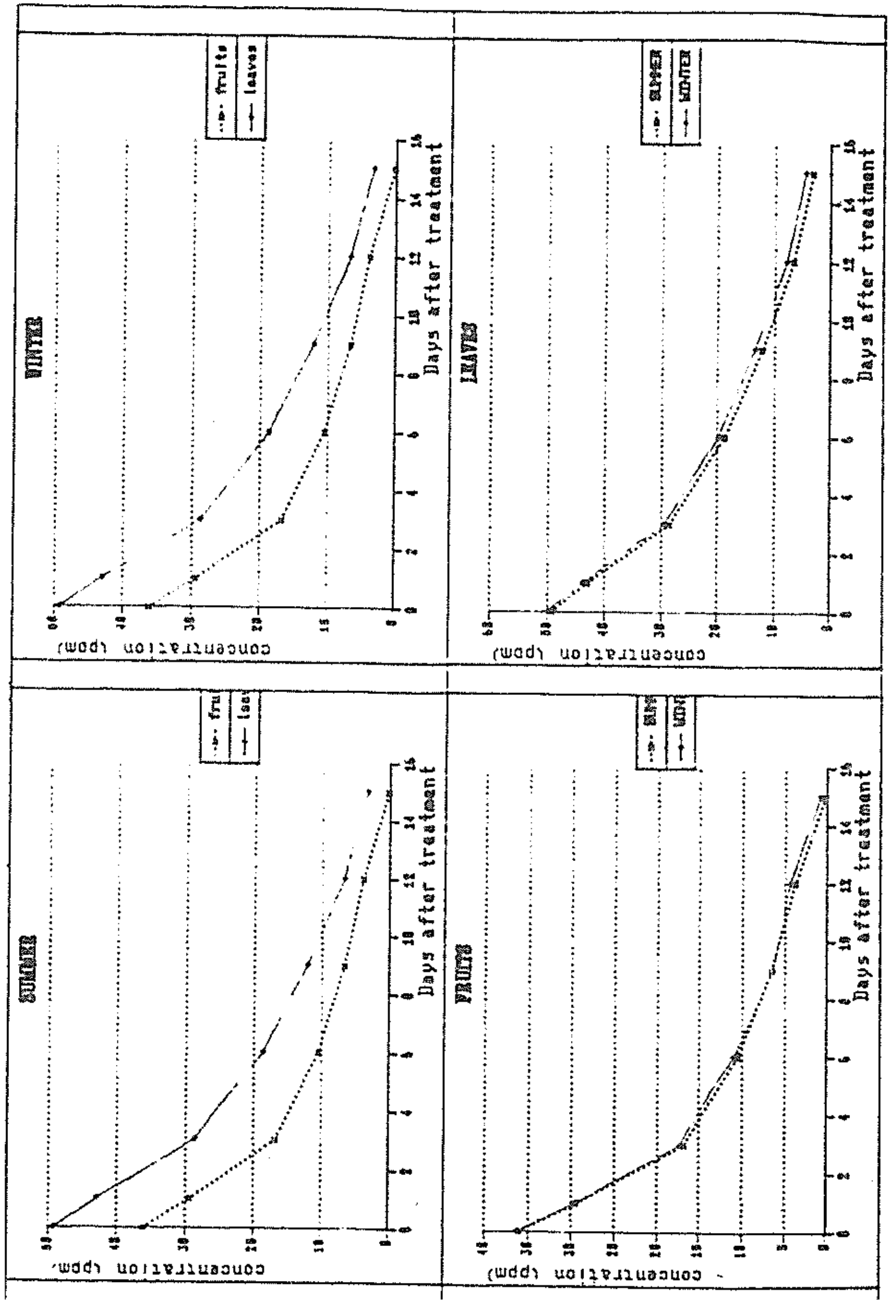


Figure (1): Degredation pattern of malathion in tomato leaves and fruits cultivated as summer and winter crop at different days after treatment.



ure (2): Degredation pattern of pirimiphos-methyl in tomato leaves and fruits cultivated as



ure (3): Degredation pattern of profenofos in tomato leaves and fruits cultivated as summer and winter crop at different days after treatment.

fields using only practical analytical point. This type of calculated fore cast may be of value when exporting fruits to countries where legislation prevents the presence of residue above certain levels.

By the application of the above mentioned equations it was found that residues of malathion and pirimiphos-methyl completely disappeared from fruits before twelve days, while they persisted in leaves beyond that period and disappeared before 15 days. However, up to 21 day after application residues of profinofos were calculated in both plant organs.

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دراسات على متبقيات بعض المبيدات الحشريه الفوسفوريه العضويه على نباتات الطماطـــم

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حسن قاسم خليل

تم استعمال الجرعات الموصى بها من المبيدات الحشريه ، ملاثيون بيرميفوس ميثيل وبرفينوفوس على نباتات الطماطم وتقدير متبقيات تلك المركبات وذلك فى الثمار والأوراق وفى خلال فترتى الصيف والشتاء.

تم اجراء التحاليل اللازمه باستخدام جهاز الغاز كروماتوجرافى وقدأوضحت النتائج أن الكميه المتساقطه من المبيدات على النبات كانت أكبر فى حالة البيريموفوس ميثايل عن نظيرتها فى كل من المبيدين الآخرين.

وقد كانت الكميات المتخلفه من المبيد على الأوراق أكبر منها على الثمار، والآثار المتبقيه للبيريميفوس ميثايل أقل ثباتا يليها الملاثيون بينما البروفينوس كان أكثر ثباتا وهذا كان جليا سواء بالنسبه للثمار أوالأوراق.

وتستعرض الدراسه مقارنة بين منحنيات تناقص متبقيات المبيدات الثلاثه ، كذلك المعادلات الرياضيه الممثله لمنحنيات وزال المركبات ومن ثم اقتراح امكانية استخدام المعادلات المعروفه بثوابتها لتوقع التركيزات المختلفه المتبقيه مستقبليا عند استخدام هذه المبيدات الحشريه على نبات الطماطم.

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