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RESIDUES OF TWO INSECTICIDES ON SQUASH *(CUCURBITO PEPO)* AND THEIR EFFECT ON QUALITY AND QUANTITY OF CROP

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ABSTRACT

Squash plants were sprayed two times with actellic and selecron at two rates; the recommended and half the recommended rate to detemine the residue of the two insecticides and their effect on quantity and quality of sqush yield. Gas liquid chromatography (G.L.C) equipped with flame photometric detector (FPD) with phosphorous mode (P-mode) for selecron were used for determination.

The initial deposite of actellic at the recommended rate was (21.421 ppm), the fruits could be marketed safely for human consumption after 11 days as they had residues below the allowable tolerance level (2 ppm) on edible plants and its residue half life (T½) was 2.259 days.

The initial deposit of selecron at the recommended rate was (22.116 ppm). No detectable residue were obtained after 14 days of application.

Results also revealed that, there were significant differences between treatments and as compared with untreated control in number of fruit / plot, and the best weight was obtained by selecron at the half recommended rate. It was also found that all the tested insecticides had no effect on physical characteristic and chemical constituents of squash fruits.

INTRODUCTION

There is no doubt that summer squash *(Cucurbita pepo, L.)* is one of the most important vegetable crops in Egypt. It occupied 66353 feddan in 1996, which yielded 498322 tons squash fruits required all the year round in Egyptian markets (Ministry of Agriculture, A.R.E., 1997).

Several pests are known to attack squash and other cucurbit crops leading usually serious reduction in their productivity. In the last few years, whitefly *Bemisia tabaci* (Genn.) and the cotton aphid, *Aphis gossypii* (Glov.) have taken their place as important pests on the agriculture map in A.R.E. Besides the direct damage they cause by sucking juices of the plants, also able to transmit viral diseases. (Zied and Herakly 1972 and Darwish et al., 1989).

Insecticides have played a role in increasing the yield of agricultural crops, in the mean time their residues must not be exceed the maximum residues limits (MRLs) in food and other commodities recommended by the joint FAO/WHO meeting.

The aim of this study was summarized to determine of actellic and selecron residues in fruit of squash and to investigate their effect on quantity a quality of squash yield.

MATERIALS AND METHODS

Residues of two insecticides with recommended and half the recommended rate of spray (actellic 50% E.C and selecron 72% EC) were determined after second spray by using gas chromatograph shimadzn model 4 CM (PEE) equipped with flame photometeric detector (FPD).

A. Insecticides used:

1- Actellic 50% E.C. 1200 (ml/fed).
Common name : Pirimiphos – methyl
Chemical name : O – (2–diethylamino– 6 – methyl pyrimidine –4– yl) – 0,0 dimethyl phosphorothioate.

2- Selecron 72% E.C. (750 ml/fed).
Common name : Profenofos.
Chemical name : O– (4–bromo–2–Chlorophenyl)–0–ethyl– S – propyl – phosphorothioate.

B. Field experiments:

The experiments were conducted at the farm of Baramoon Horticulture Research, Dakahlia Govermorate, to evaluate the residue of two insecticides in squash plants.

The field is cultivated with squash (*cucurbita pepo, L.)* on May 5, 1997. Squash field was subjected to normal agricultural practice. Five treatments were used in including the control (check). Four replicates (25 m^2 each) were used/treatment. Treatments were arranged in completely randomized blocks design. Plots were isolated from each other by unplanted corridors (one m. width).

A knapsack sprayer provided with one nozzle delivering (200 liters water/fed.) has proved to be sufficient to give good coverage on the tested squash plants. Spraying was applied for two times. The first and second spraying were done; June, 2 and June, 17 of 1997, respectively.

C. Sampling methods:

Samples of fruits were collected from the different treatments at intervals of 3 hours, 1, 4, 7, 11 and 14 days after the last application, to form representative gross sample and the border plants were avoided. Samples were placed in polyethylene bags and transferred into the laboratory for residues evaluation.

D. Analysis of insecticides residues:

1- Extraction and clean-up procedures:

The extraction and clean-up procedures were carried out according to the method of Magdy (1995). Fifty grams of each sample were macerated for 5 minutes at high speed with 100 ml of acetone or acetonitrile for actellic and selecron respectively. The mixture was filtered through anhydrous sodium sulphate and filter paper on a Buchner funnel. The blender and funnel were washed with 20 ml portion of the same solvent. The filtrate was then transferred to a 500 ml separatory funnel and partitioned with 25, 25 and 25 ml chloroform, respectively. After shaking the funnel vigorously for one minute, the chloroform layer drawn off and dried by adding anhydrous sodium sulphate. The dried extract was cleaned-up by passed through a column of activated charcoal, then evaporated to complete dryness by using a rotary evaporator at 40°C, and then the residue was dissolved in 10ml acetone and stored in a refrigerator until the residues were determined by G.L.C.

2- Measurement of residues by G.L.C.:

Determination of actellic or selecron residues was performed on a shimadzu-4 CM (PFE) Gas chromatograph (GC), equipped with flame photometric detector (FPD) with phosphorus mode (P.mode) for actellic and sulphur mode (S-mode) for selecron. An analytical glass column (3m x 3mm i.d) packed with OV-17 on chromosorb W 100/120 was used for actellic and packed with OV-17 on gas chrom Q 80/100 in case of selecron, respectively. Operating temperature (°C) for both compounds was: column 220°C; gas flow rates (ml/min) for both tested insecticides were: nitrogen 40 ml/min, hydrogen 43 ml/min and air 50 ml/min. Sensitivity settings were 16 for electrometer range, 10 for Attenuator, Chart Speed: 5 mm/min (Gouda 1992 and Shiboob 1995). The retention time values were 4 and 6.8 minutes for actellic and selecron respectively.

3- Recovery experiments:

A series of fortified samples were prepared extracted and cleaned up described the examined in order to evaluate the validation of the method. Fortified samples of squash fruits were done known volume of each insecticide standard solution (1, 2 and 4 ppm). The percent recovery of actellic and selecron were calculated.

Half Life:

The half life period (T ½) for each of the tested insecticides was calculated using the following equation (Moye et al., 1987).

$T½ = Ln_2/K = 0.6932/K$

$$K = \frac{1}{tx} \quad Ln \frac{a}{bx}$$

Where

K = Rate of decomposittion
tx = Time in days.
a = Initaial residue
bx = Residue at x time.

E. Determination of yield and quality Parameters:

All harvest fruit from each plot were used to calculate the following parameters.

1- Total yield:

Total yield was measured and recorded as the total number of the harvested fruits per plot, the total weight of fruits per plot, and the total yield (Ton) of fruit per feddan.

2- Physical characteristics of fruits:

Three fruits were randomly picked from each plot to determine the physical characteristic of fruit such as fruit weight, fruit length, fruit diameter and fruit shape. The ratio between the length and diameter of the fruit was used to determine the shape index.

3- Determination of some internal quality parameters:

Three fruits were randomly picked from each plot to determine some chemical constituent of fruit such as pH value that measured by pH meter, also ascorbic acid was determined in fresh fruit by titration with 2,6 dichlorophenal blue dye according to Anonymous (1965), and the percent of dry matter by dried the fresh fruits in oven with driven hot air at 70°C until constant weight was obtained.

F. Statistical analysis:

Data were statistically analyzed by the analysis of variance means were compared using Duncon's Multiple range test at 5% level (Duncan 1955).

RESULTS AND DISCUSSION

I. Evaluation of Insecticide Residues Levels in Squash Fruits:

A. Recovery of insecticides from fortified samples:

The recovery of actellic and selecron from fortified samples (50 gm) of squash fruits was evaluated. The results in Table (1) showed that the average of percent recovery of actellic was 86.83% whereas, the average of percent recovery for selecron was 79.58% Residues in ppm were all corrected for these values of recoveries.

Table (1): Percent recovery of actellic and selecron from squash fruits:

Actellic			Selecron		
Amount Added ppm	Amount Found ppm	Recovery Percent %	Amount Added ppm	Amount Found ppm	Recovery Percent %
1	0.915	91.50	1	0.800	80.00
2	1.820	91.00	2	1.650	82.50
4	3.120	78.00	4	3.050	76.25
Mean	86.83		**Mean**	79.58	

B. Residues determination:

1. Residues of actellic in squash fruits:

The amount of actellic (at the recommended rate and half the recommended rate) residues detected in squash fruits and their percent loss at different intervals after the second application during 1997 season are tabulated in Table (2) and illustrated in Figs. (1a, 1b and 2a, 2b). The initial deposit of actellic at the recommended rate in squash fruits as determined 3 hours after treatment was 21.421 ppm. This amount was dropped to 15.490 ppm indicating to 27.68% loss after 24 hours of application. Then the residues decreased to 2.764, 2.648, 1.842 and 1.785 ppm in samples analyzed 4, 7, 11 and 14 days after treatment, respectively. The corresponding rates of total loss were 87.09, 87.63, 91.40 and 91.66%, respectively.

It is clear from Fig. (1a) that the residues of actellic at the recommended rate in squash fruits decreased sharply within the first 4 days after application followed by slow decrease from the 4th to the 14th day after application.

Results in Fig. (1b) showed the straight line obtained when the logarithms of the concentrations of insecticide residues are plotted against time, and could be fitted with a pseudo first order decay curve. The residue half life (T½) of actellic at the recommended rate in squash fruits was 2.259 days.

Table (2): Residues (ppm) of actellic in squash fruits at day intervals days after the second application, 1997 season:

Days after application	Recommended rate (1200 ml/fed.)				Half recommended rate (600 ml/fed.)			
	Residues In ppm	% Residue Loss	% Total Rasidue Loss	Log Residue ppm	Residues In ppm	% Residue Loss	% Total Rasidue Loss	Log Residue ppm
I.D	21.421	-	-	1.331	12.092	-	-	1.082
1	15.490	27.68	27.68	1.190	3.858	68.09	68.09	0.586
4	2.764	59.41	87.09	0.441	2.879	8.10	76.19	0.459
7	2.648	0.54	87.63	0.423	2.706	1.43	77.62	0.432
11	1.842	3.77	91.40	0.265	1.900	6.66	84.28	0.278
14	1.785	0.26	91.66	0.251	1.612	2.38	86.66	0.207

I.D = Initial deposit after 3 hours.
K= 0.3068 K = 0.4054
T½=2.259 days T½ =1.709 days

Fig. (1) : Persistence of actellic at recommended rate in squash fruits after the second application

Regarding the residues of actellic at half the recommended rate in fruits of squash (table 2) and Fig. (2) it is obvious that the initial deposit was 12.092 ppm. after one day, 3.858 ppm was detected after one day with a 68.09% loss which was gradually decreased to 2.879 ppm after 4 days with 76.19% of loss. Further decrease of actellic residues was observed after 7, 11 and 14 days from application giving the values of 2.706, 1.900 and 1.612 ppm, respectively. The corresponding rates of total loss were 77.62, 84.28 and 86.66%, respectively. The residue half life value of actellic at half the recommended rate as obtained from Fig. (2a) was 1.709 days.

As mentioned before, the amount of residues of actellic at recommended rate and half the recommended rate were 1.842 and 1.900 ppm after 11 days. At that time the squash fruits could be marketed safely for human consumption as they had residues of actellic below the allowable tolerance level of 2 ppm in squash fruits, Anonymous (1986)

The aforementioned results agree with those of Hegazy et al. (1988b) who reported that, the vegetative parts of sugaret plants could be used safely in animal feeding 10 days after application with pirimiphos-methyl. Also, Abbassy et al. (1992) found that when cucumber plants grown under plastic tunnels, were sprayed at fruiting stage with the ecommended rate of pirimiphos-methyl, residue of 1.3 ppm was etermined at 6 days posttreatment. Magdy (1995) found that squash could be safely consumed seven days after treatment with the ecommended rate of pirimiphos-methyl. In contrast, Antonious and Abdel-All (1988) found that the fruits of tomato and squash after three days from application with actellic could be consumed safely.

2. Residues of selecron in squash fruits:

Data presented in table (3) and Figures (3a, 3b and 4a, 4b) show the residues of selecron at the recommended rate and the half recommended rate in squash fruits at 3 hours, 1, 4, 7, 11 and 14 days after the second application.

The results illustrated that the initial deposit of selecron at the recommended rate in squash fruits as determined 3 hours after application was 22.116 ppm. This amount was decreased to 14.878 ppm indicating to 32.72% loss after 24 hours of application. Then the residues of selecron were dropped to 3.619, 2.814 and 2.010 ppm in samples analyzed 4, 7 and 11 days after application, respectively. The corresponding rates of total loss were 83.63, 87.27 and 90.91% respectively.

Fig. (2) : Persistence of actellic at half recommended rate in squash fruits after the second application.

Table (3): Residues (ppm) of selecron in squash fruits at intervals days after the second application, 1997 season:

Days after application	Recommended rate (1200 ml/fed.)				Half recommended rate (600 ml/fed.)			
	Residues In ppm	% Residue Loss	% Total Rasidue Loss	Log Residue ppm	Residues In ppm	% Residue Loss	% Total Rasidue Loss	Log Residue ppm
I.D	22.116	-	-	1.344	8.042	-	-	0.905
1	14.878	32.72	32.72	1.172	6.031	25.00	25.00	0.780
4	3.619	50.91	83.63	0.558	3.600	30.23	55.23	0.556
7	2.814	3.64	87.27	0.449	2.211	17.27	72.50	0.344
11	2.010	3.64	90.91	0.303	N.D	27.50	-	-
14	N.D	9.09	-	-	-	-	-	-

I.D = Initial deposit after 3 hours.
N.D= Not detected
K=0.3403 K=0.2243
T½=2.037 days T½ =3.090 days

It is clear from Fig. (3a) that the residues of selecron at the recommended rate in squash fruits were decreased sharply within 4 days after application and then were gradually decreased from 4 to 11 days while after 14 days of spraying, no selecron residues were detected. The residue half life value of selecron at the recommended rate as obtained from Fig. (3a) was about 2.037 days.

Regarding the residues of selecron at half the recommended rate in squash fruits in (table 3 and Fig. 4a), the initial deposit was 8.042 ppm, and the residues were gradually decreased to 6.031, 3.600 and 2.211 ppm after 1, 4 and 7 days of application, respectively. The corresponding rates of loss were 25.00, 55.23 and 72.50%, respectively. Undetectable residues were took place after 11 days of treatment.

Also, the results in table (3) and Fig. (4a) indicated that the half life value of selecron at half the recommended rate was 3.090 days.

The maximum residue limit (MRL) of selecron in squash fruits is 0.5 ppm as established by Anonymous (1988). This means that, the squash fruits sprayed with selecron are not suitable for human consumption before 14 days of spraying for the recommended rate and 11 days for half the recommended rate.

Fig. (3) : Persistence of selecron at recommended rate in squash fruits after the second application

Fig. (4) : Persistence of selecron at half recommended rate in squash fruits after the second application

Similar results were obtained by Shahin et al. (1985), who treated soybean plants with profenofos, the initial deposit was 28.50 ppm on and in the green pods, whereas residue half life was 2.35 days. Ahmed and Moursy (1991) found that profenofos residues detected two weeks after application were 0.27, 0.23 and 0.52 mg/kg for strawberry, tomato and garlic, respectively. Ramadan (1991) reported that, the initial deposits of profenofos and pirimiphos-methyl on and in unwashed tomatoes were 13.71 and 14.24 ppm, respectively. Tomato juice and paste could be used safely if processed from tomato fruits picked after 3 and 6 days of spraying with pirimiphos-methyl, respectively. El-Nabarawy (1992) found that, the total residues of profenofos and pirimiphos-methyl were safely consumed at 7^{th} day after spraying on broad bean plants.

Badawy et al. (1995) found that, the initial deposits of profenofos and pirimiphos-methyl after one hour of application in unwashed tomato fruits were 3.20 ppm and 4.411 ppm, respectively. Magdy (1995) mentioned that, the compound profenofos at the recommended rate was completely dissipated after 10 days of application. Shiboob (1995) reported that, the tolerance level of profenofos on cucumber obtained after 6 days at the half recommended rate, 12 days at the recommended rate and 8 days at twice the recommended rate.

II. Determination of yield and quality parameters:

A. Yield and yield components:

This study included the number of fruit/plot and total yield. Data in table (4) showed that, there were significant differences among treatments, as compared with untreated squach plants. The heighest number of fruit per plot was recorded in plots treated by selecron (375 ml/fed.), followed by selecron (750 ml/fed.), whears the lowest number of fruit per plot was recorded in the control.

Also, it is evident that there were significant differences among treatment as compared with control in total yield, the best yield was obtained by selecron (375 ml/fed.) followed by selecron (750 ml/fed.), the lowest yeild was obtained from untreated plots.

It has long been known that the yield of any plant is closely related to genetic, endogenous hormone status and nutrition, as well as the biophysiological aspects and processes, i.e., nucleic acids, proteins, carbohydrate, pigments, hormones and synthesis processes. All these processes are involving in the regulatory action that closely associated with the induction and differentiation process of reproductive organs, which in turn led to increase the yielding potential of plant. In addition exposing organisms to high temperature could increase thermotolerance owing to the induction of heat shock proteins (Key et al. 1981; Schuster et al., 1988; Chaou et al., 1989 and Vierlary 1991).

Table (4): Effect of insecticides on totally yield during 1997 season.

Insecticides	Rate/fed.	No. of fruits/ plot 1997	Total yield (Kg/plot) 1997	Total yield (ton/fed.) 1997
Actellic 50% E.C.	1200 ml	71.000D	13.172D	2.107D
	600 ml	72.500D	13.025D	2.084D
Selecron 72% E.C.	750 ml	95.500B	17.627B	2.820B
	375 ml	107.000A	18.981A	3.037A
Control		68.500D	11.006E	1.760E

Values within a same column followed by the same letter are not significant using Duncan's multiple range tests.

B. Physical characteristics of squash fruits:

Data in table (5) reveald that all treatments had no effect on average fruit weight, fruit length, diameter and shap index.

Table (5): Effect of insecticides on squash fruit characters during 1997 season.

Insecticides	Rate/fed.	Average fruit Weight (gm) 1997	Average fruit Length (cm) 1997	Average fruit Diameter (cm) 1997	Shape index (L/D) 1997
Actellic 50% E.C.	1200ml	124.808A	11.867A	3.230A	3.703A
	600 ml	119.643A	11.668A	3.123A	3.780A
Selecron 72% E.C.	750 ml	119.165A	11.598A	3.192A	3.653A
	375 ml	115.765A	11.572A	3.250A	3.580A
Control		122.685A	11.920A	3.270A	3.687A

Values within a same column followed by the same letter are not significant using Duncan's multiple range tests.

C. Chemical Constituent of fruits:

Table (6) illustrated that there were no significant effect of each treatment on Vitamin C, no significant effect of each treatment on PH value, and also no significant differences were observed in fruit dry weight between all treatment as compared with untreated squach fruits.

Table (6): Effect of insecticides on chemical constituents of squash fruits during 1997 seasons.

Insecticides	Rate/fed.	Vitamin C 1997	pH value 1997	Fruit dry Weight 1997
Actellic 50% E.C.	1200 ml	1.400A	6.800A	4.415A
	600 ml	1.500A	6.800A	4.582A
Selecron 72% E.C.	750 ml	1.300A	6.550A	4.107A
	375 ml	1.400A	6.800A	3.560A
Control		1.200A	6.750A	4.225A

Values within a same column followed by the same letter are not significant using Duncan's multiple range tests.

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متبقيات إثنان من المبيدات علـــى ثمار الكوسة وتأثيرهم على صفـــات المحصول الكمية والوصفية

تناول هذا البحث تقدير متبقيات كل من مبيدي الأكتيليك والسيلكرون بالمعدل الموصى به ونصفه في ثمار الكوسة الصيفي وقد تم تقدير المتبقيات علـــى فترات (3 ساعات، 1، 7، 11، 14 يوم) بعد الرشة الثانية ـ وقد تم التقدير بواسطة جهاز التحليل الكروماتوجرافي.

- وجد أن متبقى الأكتيليك بالمعدل الموصى به بعد 3 ساعات 21.421 جزء في المليون ثم انخفض بعد يوم إلى 15.49 جزء في المليون ووصلت نسبة الفقدان في اليوم 14 إلى 91.66% (حوالي 1.785 جزء في المليون) وقدرت فترة نصف العمر للأكتيليك بالمعدل الموصى به 2.259 يوم وبنصف المعدل الموصى به 1.709 يوم ـ ومن النتائج أتضح أن محصول الكوسة يكون مأمون الاستعمال بعد 11 يوم من المعاملة.
- كذلك وجد أن كمية المتبقى من السيليكرون بالمعدل الموصى به بعد 3 ساعات من الرش (22.116 جزء في المليون) ثم انخفضت في اليوم (4، 7، 11) إلى 3.619، 2.814، 2.010 جزء في المليون ـ كما لم تظهر أي متبقيات في اليوم الرابع عشر ـ لذلك لا تعتبر الثمار مأمونة الاستهلاك قبل 14 يوم من المعاملة ـ وكانت فترة نصف عمر المبيد 2.037 يوم وفي حالة الرش بنصف المعدل الموصى به ـ يكون المحصول مأمون للاستهلاك الأدمي بعد 11 يـــوم من المعاملة.
- أجريت أيضًا الدراسة لمعرفة التأثير على بعض صفات المحصول وأظهرت النتائج بالنسبة لعدد الثمار في الوحدة التجريبية أن هناك فروق معنوية بين الوحدات التجريبية المعاملة والمقارنة وتم الحصول على أكبر عدد من الثمار عند استخدام السيليكرون بنصف المعدل الموصى به كذلك أعطى هذا المعدل أكبر كم من المحصول.
- كذلك بينت النتائج عدم وجود فروق معنوية بين المعاملات وكذلك المقارنة في وزن، طول، قطر وشكل الثمار.
- أيضًا أظهرت النتائج عدم وجود فروق معنوية بين تأثير المعاملات وتجربة المقارنة في قيم pH ، فيتامين ج ونسبة المادة الجافة الموجودة بالثمار.