Journal

J Biol Chem Environ Sci, 2007, Vol. 2(1): 93-105
www.acepsag.org

ABAMECTIN PESTICIDE RESIDUES IN AND ON CUCUMBER AND GREEN PEPPER FRUITS GROWN UNDER GREEN HOUSE CONDITIONS AND EFFECT OF SOME WASHING PROCESSES ON REDUCING RESIDUES

Ola . M.Y. Emara

Central Agricultural Pesticides Laboratory, Agricultural Research Center, Dokki, Egypt

ABSTRACT

This investigation was carried out to study the persistence of abamectin insecticide acaricide residues on cucumber and green pepper fruits grown under green house condition. The plan of study included the following: Determine persistence and safe period for consuming cucumber and green pepper fruits, and the effect of some washes processes in removing abamectin residues from the above mentioned vegetable crops. The results obtained could be summarized as follows: Residues analysis showed that the initial deposits of abamectin in unwashed cucumber and green pepper fruits were 1.71 and 2.438 ppm, respectively. This amount decreased to 1.2 and 1.964 ppm one day after application, in unwashed cucumber and green pepper respectively. Fourteen days after treatment, the residues become undetected in cucumber fruits and 0.0059 ppm in green pepper fruits. The half life values were 2.212 and 3.338 days on cucumber and green pepper fruits, respectively. While the safe periods for consumption were 14 days on both unwashed cucumber and green pepper fruits. On the other hand, the effect of different washing processes in removing abamectin residues from cucumber and green pepper fruits indicated that washing with tap water was the lowest effective in removal Abamectin residues from cucumber and green pepper fruits as it removed 10.52 and 17.24 % of initial deposits for cucumber and green pepper fruits, respectively. While acetic acid (1) shows spectacular effect in removed abamectin residues as it release

56.72 and 53.12 % of initial deposits for cucumber and green pepper fruits, respectively.

Key words: Abamectin insecticide - Cucumber - Green pepper - pesticide residues - .

INTRODUCTION

Cucumber (*Cucumis sativus*) and green pepper (*Capsicum annuvm* L.) fruits are considered very important fresh eaten vegetable crops and the most popular vegetables grown during the summer and winter time.

In Egypt, these vegetables are highly attacked by several pests throughout their growing season causing serious damages. So pesticides are widely used, therefore, residues of pesticides could affect the ultimate consumers especially when freshly consumed (Abou-Arab, 1999).

Abamectin (Vabcomic 1.8 EC) is a family of pesticide agents that are extracted from the mycelia of the actinomycete, *Streptomyces avermitilis*, which was first isolated from a soil samples collected in Japan (Burg *et al.*, 1979).

Abamectin is insecticide and acaricide with contact and stomach action. It has limited plants systemic activity, but exhibits translaminar movement and it acts by stimulating the release of γ-amino butyric acid, also abamectin uses to control of motile stages of mites, leaf miners, suckers, Colorado beetles, etc on cotton, citrus fruits, pom fruits, vegetables, potatoes, and other crops. (Tomlin, 2004).

The present study was conducted to evaluate the rate of disappearance of abamectin after application to cucumber and green pepper fruits grown under green houses and the effect of washing treated fruits with tap water, acetic acid, sodium carbonate and potassium permanganate to remove the tested pesticide residues.

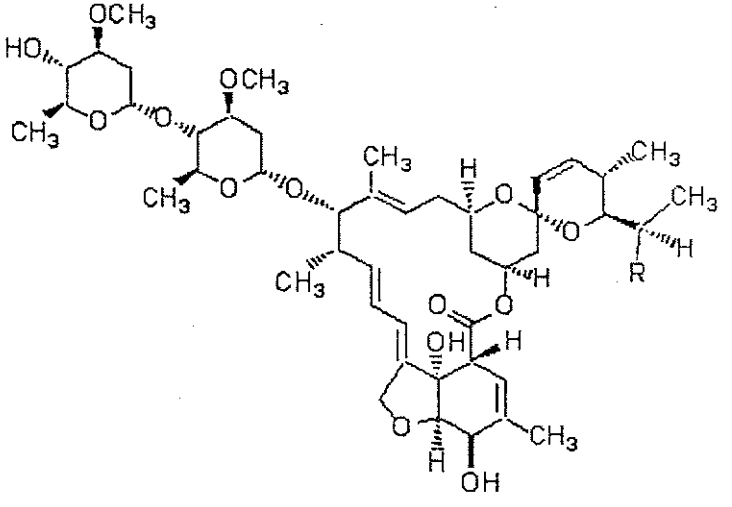
MATERIALS AND METHODS

Cucumber and green pepper were planted separately on May 1st 2006 at the demonstrative plastic green houses of agriculture, Giza governorate.

Cucumber and green pepper plants were sprayed after 45 days from planted with Abamectin (Vabcomic 1.8% EC).

Pesticide used and their application.

Abamectin (Vabcomic 1.8% EC). Chemical name: 5-o-dimethyl avermectin A1a(i) mixture with 5-o-dimethyl-25-de(1-methylpropyl)-25-91-methylethyl) avermectin A1a(ii).



(i) R=-CH2-CH3

(ii) R=-CH3

Abamectin was used at the rate of 10.7cm/21.5 L/plastic green house i.e.900 m^2 for cucumber plant and 4.3 cm /8.5 L/plastic green house i.e. 360m^2.for green pepper plants.

The amount of abamectin (Vabcomic 1.8%EC) sprayed on targeted plants by using knapsack hand sprayer fitted with one nozzle boom.

Sampling for residue analysis:

Fresh fruit samples 4 kg of cucumber and green pepper were collected at random from treated plants after one hour from pesticide application to determine the initial deposit and then after 1,3,5,7,14,21 and 28 days for residue determination. Each of the representative samples was divided into six subsamples, the fruits were left unwashed, while the other subsamples was left to some washing processes on the sample collected one hour, one and three days after treatment only to study how to decrease the residues by some additives such as acetic acid at different concentrations, sodium carbonate and potassium permanganate.

The whole samples of washed and unwashed were kept in polyethylene bags. The samples were stored in deep freezer until analysis.

Methods of washing processes:

1- Rinsed with tap water for 5 minutes and left to dry.
2- Soaking in one liter diluted acetic acid [600 ml acetic acid 5% in one liter water) for 5 minutes, then rinsed with tap water and left to dry (Acetic 1).
3- Soaking in one liter diluted acetic acid [50 ml acetic acid 5% in one liter water] for 5 minutes, then rinsed with tap water and left to dry. (Acetic 2).
4- Soaking for 5 minutes in sodium carbonate solution prepared by dissolved one g sodium carbonate in one liter water, then rinsed with tap water and left to dry (Na2 CO3).
5- Soaking for 5 minutes in potassium permanganate solution prepared by dissolved one gram of potassium permanganate in one liter water, then rinsed with tap water and left to dry (KMnO4).

Residue analysis techniques:

Extraction and cleanup:

Residues were extracted from the collected cucumber and green pepper samples according to the methods of Fytianos *et al.* (1998). 25 g of samples were homogenized with 75 ml acetone using warring blender. The extract was filtered. The filtrate was transferred into a separator funnel for extraction with n-hexane. The n-hexane phase was dried over anhydrous sodium sulfate and then evaporated at 40°C using a rotary evaporator near dryness. The resulting extracts of cucumber and green pepper were cleared by C18 column chromatography (Low *et al.*,1988). The abamectin extracts were evaporated at 40°C to dryness. Residues were dissolved in 1 ml methanol and then determined by HPLC apparatus as follows.

Chromatographic techniques:

Abamectin residues were determined according to the method of Wehner *et al.* (1993) with some modification using high pressure liquid chromatography HPLC Agilent serious 1100 quartary pump with ultra violet (U.V) detector, a C18 stainless steel column 2.6 mm x 25 cm was used and the mobile phase was a mixture of methanol: acetonitril: water (80:10:10 v/v). The flow rate was 0.9 ml/min. At these conditions the retention time of abamectin was 3.328 min. The

averages of recoveries were 92.00 and 94.78 for cucumber and green pepper, respectively.

Kinetic study:

In order to study the rate of degradation of tested pesticides and the half lives period (t1/2) for the tested pesticides on cucumber fruits were calculated according to equation (Moye *et al.*, 1987)

$$t1/2 = Ln2 / K = 0.693/K.$$

$$K = 1/Tx. Ln\ a/bx$$

Where

K=Rate of decomposition.

Tx = Time in days.

a= Initial residue.

bx = Residue at time.

RESULTS AND DISCUSSION

The increasing use of pesticides to control the economic pests which attack field and greenhouse crops has increased the pollution of the environment with their toxic residues. Therefore, the need for efficient treatments to reduce or remove such residues has become urgent.

Data summarized in Tables (1 and 2) represent the amount of abamectin residues in unwashed cucumber and green pepper fruits collected from the experiments at different intervals after treatment and the effect of some washing processes on reducing residues.

1- Residues of abamectin on and in unwashed cucumber fruits grown under green house conditions:

Results in Table (1) show that the concentration of the initial deposits of abamectin in unwashed cucumber fruits was 1.71 ppm one hour after treatment, and then gradually decreased to 1.2 ppm one day of application revealing 29.82% loss. This value declined to 0.656, 0.171, 0.0855 ppm recording the rate of loss 61.98, 90.00 and 95.0% at 3, 5 and 7 days after treatment respectively. No detectable residues of abamectin were observed after fourteen days from treatment, the short persistence of abamectin in cucumber fruits could be due to a variety of environmental factors such as temperature (Liechetenstein, 1972).

From the above results, the level of pesticide residue is affected by many factors i.e. applied dosage, meteorological and biological

factors when depend on the kind and properties of the plant surface (Shady *et al.*, 2000). Growth also may be responsible to a certain extent for decreasing the pesticide residue concentrations due to growth dilution effect (Walgenbach *et al.*, 1991).

Data also indicat that the calculated half-lives (t1/2) of abamectin were 2.212 days in unwashed cucumber fruits.

On the other hand, the maximum residual limit (MRL) was 0.05 mg/kg for abamectin in cucumber fruits (CAC/PR, 1997). Comparing this level with the amount of abamectin residues found in cucumber fruits, it is clear that cucumber fruits could be safely used for human consumption after 14 days in case of unwashed fruits.

2- Influence of some washing processes in reducing abamectin residues from cucumber fruits grown under green house condition:

The results in Table (1) show the residue level in ppm and the percent removal of abamectin after different washing processes. The residues of abamectin on unwashed cucumber fruits collected one hour, one and three days after treatment were 1.71, 1.20 and 0.656 ppm, respectively. The washing process with tap water reduced the residues to 1.53, 0.9 and 0.413 ppm representing removal of 10.52, 25.0 and 34.29 % of the abamectin residues on cucumber fruits. But, soaking in acetic (1) and acetic (2), then washing with tap water removed 56.72, 40.35 % of the initial residues of abamectin found on unwashed cucumber fruits, respectively. The percentage losses reached 62.5 and 73.47 % by soaking in acetic (1) after one and three days of treatment, respectively, and reached 36.08 and 42.07 by soaking in acetic (2) at the same period. So, it is clear that wash cucumber fruits with acetic acid (1) was the best for decontamination of abamectin from cucumber fruits than acetic acid (2).

On the other hand, soaking in sodium carbonate then rinsed with tap water removed 24.56, 24.16 and 23.62 % of the initial residues, one and three days of treatment ,respectively. Also, soaking in potassium permanganate then rinsed with tap water removed 25.73, 26.66 and 27.28% of abamectin residues found in cucumber fruits at the same periods.

The obtained results are in agreement with those found by Zidan *et al.* (1997) who reported that washing process proved to be a very effective method for decontamination of cucumbers.

Table (1): Persistence of abamectin on and in cucumber fruits grown under green house condition and effect of some washing processes in reducing abamectin residues from cucumber fruits.

Time after application (days)	Unwashed		Tap water		Acetic (1)		Acetic (2)		Na_2CO_3		$KMnO_4$	
	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss
Initial*	1.71	0.0	1.53	10.52	0.74	56.72	1.02	40.35	1.29	24.56	1.27	25.73
1	1.20	29.82	0.9	25.00	0.45	62.5	0.767	36.08	0.91	24.16	0.88	26.66
3	0.656	61.98	0.431	34.29	0.174	73.47	0.380	42.07	0.501	23.62	0.477	27.28
5	0.171	90.00										
7	0.0855	95.00										
14	UND**	100										
21	UND**	100										
28	UND**	100										
t1/2	2.212											

Initial* = One hour after application.
UND** = Undetectable

From the above results we can observed that washing processes with acetic acid (1) was the more effective in reducing residues levels of abamectin on cucumber fruits than other washing processes, these may be due to that abamectin is stable to hydrolysis in aqueous solutions at PH 5, 7 and 9 (Tomlin, 2004), also abamectin is low water solubility (7-10 µg/l water) (Lasota and Dybas 1990).

3- Residues of abamectin on and in unwashed green pepper fruits grown under green house conditions:-

Data in Table (2) show that the initial deposit of abamectin in unwashed green pepper fruits was 2.438 ppm one hour after treatment. The initial deposits revealed that the amounts of deposits depended on the nature of the treated surface and the relation between the surface treated and its weight (El- Sayed *et al.*, 1976). The initial deposit residues then gradually decreased to 1.964, 0.976, 0.239, 0.0355 and 0.0059 ppm indicating the rate of loss were 19.17, 59.83, 90.16, 98.54 and 99.75% 1, 3, 5, 7 and 14 days after treatment, respectively. No residues of abamectin could be detected in green pepper fruits after 21 and28 days after treatment.

The estimated half –life (t1/2) of abamectin in unwashed green pepper was 3.338 days.

On the other hand, the maximum residual limit (MRL) was 0.02 mg/kg for abamectin in green pepper fruits (CAC/PR, 1997). Comparing this level with the amount of abamectin residues found in green pepper fruits, it is clear that green pepper fruits could be safely used for human consumption after 14 days in case of unwashed fruits

Generally these findings are similar to those obtained by El-Bouze (2001) and Osman *et al.* (2004).

4- Influence of some washing processes in reducing abamectin residues from green pepper fruits grown under green house condition:-

Data shown in Table (2) demonstrate the effect of some washing processes on reducing abamectin residues from green pepper fruits grown under green house condition.

Data proved that washing with tap water remove 17.24,12.37 and 22.23% of abamectin residues found in unwashed green pepper fruits collected one hour, one and three days of treatment. Also data show that soaking in acetic acid (1), then washing with tap water giving 53.12, 53.51 and 73.05 % loss, while soaking in acetic acid (2), then washing with tap water giving 25.30,20.82 and 29.09% loss at the

Table (2): Persistence of abamectin on and in green pepper fruits grown under green house condition and effect of some washing processes in reducing abamectin residues from green pepper fruits.

Time after application (days)	Unwashed		Tap water		Acetic (1)		Acetic (2)		Na_2CO_3		$KMnO_4$	
	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss	ppm	% loss
Initial*	2.438	0.00	2.011	17.24	1.139	53.12	1.815	25.30	1.983	18.39	1.756	28.97
1	1.964	19.17	1.721	12.37	0.913	53.51	1.555	20.82	1.515	22.9	1.408	27.39
3	0.976	59.83	0.759	22.23	0.263	73.05	0.692	29.09	0.792	18.85	0.693	28.99
5	0.239	90.16										
7	0.0355	98.54										
14	0.0059	99.75										
21	UND**	100										
28	UND**	100										
t1/2	3.338											

Initial* = One hour after application.
UND** = Undetectable

same period. The trends of the data indicated that the loss of abamectin depends on the concentration of acetic acid.

Soaking in sodium carbonate, then rinsed with tap water removed 18.39, 22.9 and 18.85% of the initial residues, one and three days, respectively.

On the other hand, soaking in potassium permanganate, then rinsed with tap water giving 28.97, 27.93 and 28.99% loss of abamectin at the same periods. Thus, the residues that may be present are subject not only physical removal by washing but also acid or base hydrolysis (Chin, 1991). Also removal of pesticide residues by washing depend on several factors: character of the surface of plant (smooth or youth, waxy or non waxy) surface to volume ratio washing is effective for bigger fruits: reference point of residues levels (higher levels easier to remove), chemical and physical properties of the applied pesticide, the length of time that the application and penetrability of pesticide into fruit tissues (El-Kins, 1989 and Tag El-Din, 1993).

Generally from the data in Tables (1and 2) it could be concluded that.

1- The residue amount of abamectin in green pepper fruits was the highest than that in cucumber fruits. This might be due to the big surface exposure to pesticide in green pepper fruits than in cucumber fruits.
2- Soaking in acetic acid (1) and then rinsed with tab water was the important for decontaminated of abamectin residues from cucumber and green pepper fruits. Acetic acid (2), sodium carbonate and potassium permanganate washing came next in importance to washing by acetic acid (1) solution, while washing by tap water proved the least effective. This could be attributed to that abamectin is low water solubility.

REFERENCES

Abou-Arab, A.A.K. (1999). Behavior of pesticides in tomatoes during commercial and home preparation. Food chemistry 65: 509-514.

Burg, R.W.; Miller, B.M.; Baker, E.E.; Birnbaum, J.; Currie, S.A.; Hartman, R.; Kong, Y.L.; Monaghan, R. L.; Olson, G.; Putter, I.; Tunac, J.B.; Wallich, H.; Stapley, E.O.; Oiwa, R.; Omura, S. (1979). Avermictin, a New Family of Potent Anthelmintic Agents;

Production Organism and Fermentation. Antimicrob. Agents Chemother. 15: 361.

Chin, H.B. (1991). The effect of processing on residues in foods. In pesticide Residues and Food Safety; Tweedy, B.,G.,Dishburger, H.J., Ballatine, L.G., McCarthy, J. Eds.; American Chemical Society: Washington, DC1991: Chapter, 19: 175-181.

Codex Alimentarius Commission for Pesticide Residues (CAC/PR) (1997). List of maximum residue limits for pesticides in food and animal feeds. Part-1.

El-Bouze, M.F.R. (2001). Plastic green house cucumber fruits pollution with insecticides (1) in Egyptian markets. J. Agric. Sci. Mansoura Univ., 26(8): 5025-5039.

El-Kins, R.E. (1989). Effect of commercial processing on pesticides in selected fruits and vegetables. J.A.O.C., 55(3): 526-531.

El-Sayed, M.M.; Doghiem, S.M.; Hindi, S.A.; Shahin, A. and Abd el-Salam, M. (1976). Persistence of certain organophosphours insecticide on some vegetables. Bull. Ent. Soc. Egypt., Econ. Ser. 10: 41-49.

Fytianos, K; Konstantinou, J.; Kaidatzis, J. and Albanis, T. (1998). Myltiresidue determination of insecticides and fungicides in fruits and vegetables by gas chromatography. Bull.Environ. Contam. Toxicol., 61: 684-689.

Lichtenstein, E.P. (1972).Environmental factors affecting fate of pesticides. Nat. Acad. Sci, Nat. Res. Coune. Report USA.

Lasota, J.A. and Dybas, R.A. (1990). Abamectin as a pesticide for agricultural use. Acta Leiden 59(1-2): 217-225.

Low, R.J.; Filwman, T.W. and Portnman, J.E. (1988). Method of analysis of hydrocarbons in marine and other samples (report no.2).Lowest OFT ,U.K., Ministry of Agriculture, Fisheries and food, 25 pp.

Moye, H.A.; Malogodi, M.H.; Yoh, J.; Leibee, G.L.; Ku, C.C. and Wislocki, P.G. (1987). Residues of Avermectin B1a; rotational crop and soils following soil treatment with (C14) Avermectin B1a. J. Agric. Food Chem., 35: 859-864.

Osman, M.A.; Radwan, O.A. and Nasr, M. (2004). Determination of Chlorophenapyr and Abamictin residues in Cucumber fruits. The Second Conference on The Role of Biochemistry in Environment and Agriculture. 450-458.

Shady, M.F.A.; Hegazy, M.E.A.; Adam, F.A.; Abd El-Baki, M.A. and Shoker, A. Shoker (2000).Persistence of malathion and prothiofos organophosphorus insecticide on and in some vegetable crops. Egypt.J.Agric. Res., 78(2):605-621.

Tag El-Din, M.H. (1993). Persistence of oxamyl insecticide and dithane-90 fungicide on some vegetable crops grown in open fields and under plastic tunnels.5th Nat. Conf. of Pest & Dis. of Veg. & Fruits in Egypt, Ismalia 254-260.

Tomlin, C.D.S. (2004). The pesticide Manual, 13 ED. Version 3.1 .P.1. Puplished by British Crop Protection Council (BCPC) London UK.

Walgenbach, J.F.; Bleidy, R. and Sheets, T.J. (1991). Persistence of insecticides on.tomato folige and implications for control of tomato fruits worm. J. Econ. Entomol., 84: 978-986.

Wehner, T.; Lasota, J. and Demchak, R. (1993). In Comprehensive Analytical Profiles of Important Pesticides, ed. J. Sherma & T.Cairns. CRC, Press, Boca Roton,Florida Ch 4, pp 73-106.

Zidan, Z.H.; Selim, A.A.; Afifi, F.A.; Abdel-Daim, Y.A.and Mohamed, K.A. (1997). Decontamination of insecticide residues from vegetables through laboratory processing. Arab Universities J. of Agric. Sciences, 5: 1,121-134.

متبقيات الاباميكتين في و على ثمار الخيار و الفلفل الأخضر المزروع في الصوب الزراعية و تأثير بعض معاملات الغسيل علي خفض المتبقي

علا محمد يوسف عمارة

المعمل المركزي للمبيدات- قسم بحوث تحليل المبيدات - مركز البحوث الزراعية - الدقي- الجيزة- مصر

أجرى هذا البحث لدراسة مدى تلوث الخيار والفلفل الأخضر المزروع تحت ظروف الصوب الزراعية بمتبقيات الاباميكتين

وتتضمن خطة الدراسة النقاط التالية :-

١- تقدير متبقيات الاباميكتين فى ثمار الخيار والفلفل الأخضر على فترات زمنية مختلفة وحساب قيم زمن نصف العمر وتحديد فترة الأمان للاباميكتين لكل محصول

٢- دراسة تأثير بعض عمليات الغسيل المختلفة على إزالة متبقيات هذا المبيد من على ثمار الخيار والفلفل الأخضر.

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:-

١- أوضحت النتائج إن كميات المتبقي من مبيد الاباميكتين بعد ساعة من الرش كانت ١,٧١، ٢,٤٣٨ جزء فى المليون على ثمار الخيار وثمار الفلفل الأخضر على الترتيب ثم تناقصت هذه الكمية من المتبقي بعد يوم واحد من الرش إلى ١,٢، ١,٩٦٤ جزء فى المليون على الترتيب ثم أخذت هذه الكميات من المتبقي تقل تدريجيا إلى أن اختفت بالنسبة لثمار الخيار وأصبحت ٠,٠٥٦ جزء فى المليون بالنسبة للفلفل وذلك بعد ١٤ يوم من الرش. وكانت فترتي نصف العمر لمتبقيات الاباميكتين على ثمار الخيار والفلفل الأخضر ٢,٢١٢، ٣,٣٣٨ يوم على التوالي وأمكن تحديد فترة الأمان لهذا المبيد بعد الرش حيث كانت ١٤ يوم لكل من الخيار والفلفل الأخضر.

٢- ومن جهة أخرى تم دراسة تأثير بعض عمليات الغسيل على إزالة متبقيات الاباميكتين من على ثمار الخيار والفلفل الأخضر وقد وجدا أن الغسيل بواسطة ماء الصنبور كان اقلهم تأثيرا على إزالة متبقيات هذا المبيد حيث أزال ١٠,٥٢، ١٧,٢٤ % من متبقيات الاباميكتين على ثمار الخيار والفلفل الأخضر على الترتيب بينما الغسيل بواسطة حمض ألخليك (١) كان له دور واضح فى إزالة متبقيات الاباميكتين حيث عمل على إزالة ٥٦,٧٢، ٥٣,١٢ % من متبقيات الاباميكتين ساعة واحدة بعد الرش من على ثمار الخيار والفلفل الأخضر على الترتيب.

قام بتحكيم هذا البحث: أ.د / رفعت الغباشى و أ.د/ عبد القادر مرسى عبد الصمد