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Assessment of OCPs Residues in Agricultural Crops in Southern Governorates of Jordan in 2020 and 2021 Using QuCHERS Method and LC/MS/MS

Tawfiq M. Al Antary[1], Mahmoud A. Alawi[2*], Faisal T. Nimer[3], Nizar Haddad[4]

[1]School of Agriculture, University of Jordan, Amman-11942, Jordan
[2]School of Science, Department of Chemistry, University of Jordan, Amman-11942, Jordan
[3]Ministry of Agriculture Amman-11942, Jordan
[4]Ministry of Environment, Amman-11942, Jordan

***Corresponding author**
Prof. Dr. Mahmoud A. Alawi
E-mail address: alawima@ju.edu.jo
ORCHID: https://orcid.org/0000-0002-9063-1951

Abstract

Nine hundred sixty imported and three hundred and eighty three agricultural crop samples were gathered from regions in southern Jordan and analyzed for pesticide residues in 2020 and 2021. The results for both local and imported samples showed that there were no detected pesticide for the banned organochlorine pesticides. There were 6.53% and 7.92% of local and imported crop samples, respectively, contained residues more than the adopted maximum residue limits (MRLs). In addition, there were 12.53% and 10.73% of the monitored local and imported samples, respect-tively contained residues less than the MRLs. There were 80.94% local and 81.35% imported samples of the remained analyzed ones without detect detectable residues. It is recommended to keep monitoring the pesticide residues in all environmental components including the agricultural crops locally and imported ones to protect human health of the citizens and the environment, and to assess the decision makers to take the right decisions concerning pesticide handling and registration.

Key words: Monitoring, Pesticides, Residues, Crops, Jordan.

Introduction

Different kinds of pesticides are widely applied to control pests to protect cultivated crops. Crops provide a favorable medium to be infested kinds by several of pests. Tremendous amount of pesticides are being applied on crops globally and in Jordan [1,2] leaving residues on imported, exported and locally consumed sprayed ones [1-3], posed a real threat to citizens and human beings in general [1-3], particularly in prolonged intake. Several studies have indicated that consumers and farmers exposed to direct pesticides or their long time are more likely to have several adverse diseases such as leukemia's, brain and prostate cancers compared with non-exposed population [4,5]. Jordan Valley is an agricultural regions using pesticides regularly to control different kinds of pests, in addition to the other rural areas [1, 6- 8]. In 2020, Jordan imported 1653859 units (kg/L) from different countries in addition to pesticides products from 30 local manufacturers to be used on agriculture- al cultivated crops including the southern regions of Jordan[1, 9]. The regulations of the pesticides in Jordan are under the responsibility of Ministry of Agriculture through the appointed Registration Committee [1,6, 9]. A representative of the Ministry of Health is an important member in the Committee to guide them about the hazardous impact of the pesticides on human health. Ministry of Environment has financed this study which is carried out by the Ministry of Agriculture.

It is the aim of this monitoring study to evaluate the residues of different pesticides in local and imported crop samples collected from the southern part of Jordan in 2020 and 2021 to improve the data base to minimize environmental pollution and citizens safety through the developing of pesticides regulations and taking the right decision concerning the misuse of pesticides on agricultural crops.

1. Materials and Methods

1.1 Sampling

1.1.1 Local samples*:*

383 samples from different vegetable and fruit trees were collected randomly and separately from four governorates in the southern regions of Jordan in 2020 and 2021. The governorates were Karak (202 samples), Tafelah (1 sample), Ma'an (61 samples) and Aqaba (119 samples). The size of collected samples was according to the Ministry of Agriculture recommendations concerning type and fruit size [1, 9]. The collected samples were placed in labelled bags separately in ice boxes and then sent immediately to the specific laboratory in Baqa'a which belongs to the Ministry of Agriculture named "Center for Pesticides and their Residues [1, 9].

1.1.2 Imported samples:

960 samples from different agricultural crops were collected randomly and separately from the imported crops through the various boarder centers located in different parts of Jordan particularly Aqaba port in 2020 and 2021. These boarders were aqaba port (420 samples), Amman custom (290 samples), Al-Omary customs (19 samples), Queen Alia Airport custom (28 samples), North pass Agriculture center (20 samples) King Hussein Bridge center (13 samples) and Jaber custom (170 samples). Sample size and residue analysis as mentioned previously in the "local samples" [1, 6, 9, 10].

1.2 % recovery and detection limits***:***

The analytical method [9, 10] including the extraction was evaluated using spiked blank samples of each type with standard solutions as mentioned in the analytical method [9, 10] which will be described later. Quality control was carried out by analyzing some samples in the laboratories of the Royal Scientific Society, Forensic Research Laboratories, joining Inter-Laboratory Comparison System organized by the German GIZ for quality assurance [9, 10]. The detection limits and the % recoveries were then calculated.

1.3 Subsampling and extraction:

The adopted method of analysis was QuCHERS (quick, cheap, easy, effective, rugged and safe) method [11] to analyze the blended samples, where 10 grams as subsample were weighed into a 50-mL polypropylene (PP) centrifuge tube. 10 µL of the internal standard mixture which contains 0.02 µg/mL Aldrin and 0.03 µg/mL ditalimfos and 10 mL acetonitrile were then added [10 - 12]. After that, a buffer mixture of (4.0 g $MgSO_4$ + 1.0 g NaCl + 1.0 Na_3Citrate. $2H_2O$ + 0.5 g Na_2H-Citrate. 1.5 H_2O) was added, and the centrifuge tune was closed. The tube was then shaken in a Vortex for one minute and centrifuged at 4500 rpm for also one minute [10-12].

1.4 Clean-up of the samples:

Ten mL of the upper acetonitrile layer was transferred to 15 mL centrifuge tube containing 25 mg PSA as sorbent and 150 mg anhydrous $MgSO_4$, then vortexed for 30 seconds. As a final step, the tube was centrifuged at 3000 rpm for five minutes. 2 mL of the upper acetonitrile layer was transferred into 2 mL vial. Acetonitrile after flushing with nitrogen gas was replaced with 2 mL n-hexane. After that, the samples were analyzed using LC/MS [10-12].

1.5 LC/MS/MS**:**

The type of the used LC/MS/MS and its working conditions were mentioned in an early work [13].

1.6 Chemicals and Glassware:

All used chemicals and glassware were mentioned in Al-Antary et al. [13].

2. Results and Discussion

2.1 Local Samples:

48 local samples contained pesticide residues, but less than the adopted MRL, representing 12.53% of the analyzed samples (Table 1). 25 of the analyzed samples contained residues more than the MRL (Table 1), representing 6.53% of the local total analyzed samples. 310 analyzed samples did not contain any residues (Table 1), representing 80.94% of the whole local analyzed samples.

Table 1

Al-Antary et al. [9] found the highest percentage of local samples contained residues more than the adopted MRL which was 10.25% (41 samples out of 400) in the middle governorates of Jordan in 2018 and 2019, while it was in 1993/1994 study in Jordan [14]. They [9] also reported that the highest percentage of local samples contain residues less than the MRL which were 34.5%, while it was 7.1% in 2016/2017 study in Jordan [10]. Bakirci et al. [15] found that 754crop samples out of 1423 in Turkey, contained detectable residues at or below the MRL, and 9.1% contained residues above the adopted MRL. In India, Kumar et al. [16] reported 11.2% of the analyzed samples with pesticides residues above the MRL and 58.34% free, indicating the need to educate farmers concerning the importance of pesticide residues.

Monitored pesticide residues in local collected samples from four governorates in southern Jordan in 2020 and 2021 are shown in Table 2. Twenty five samples contained residues more than the adopted MRL in various crops. Chlorpyrifos from the organophosphates group was 11 times replicated in

Table 2

Replicated in the contaminated local samples in different crops in three governorates (Karak, Aqaba and Ma'an) (Table 2). Oxamyl from the carbamates group was four times replicated in the contaminated local samples in melon crop from Ghor-Esafi in Karak governorate. Four pesticides were two times replicated in the monitored contaminated samples, namely azoxystrobin as a syst-mic fungicide to inhibit spore germination, cypermethrin from the pyrethroids insecticide group, emamectin benzoate from the abamectin insecticide group, and dimethoate from the organophosphate insecticide group (Table 2). Two pesticides were once replicated in the detected contaminated samples, namely hexythiozox as acaracide to control phytophagous mites, and lufenuron as an insecticide (Table 2). In Kuwait, Jallow e,t al. [17] found 16 pesticide residues in the consumed crops. Of the detected compounds were imidacloprid, deltamethrin, cypermethrin, malathion, monocrotophos, chlorpyrifos-methyl and diazinon where all containing residues more than the MRL> In India, cypermethrin and acetamiprid were found in the eggplant samples [18]. Kumar et al. [16] detected 25 samples (13.89%) out of 180 analyzed samples, contained pesticide residues exceeded the adopted MRL. It was reported about similar results in studies conducted in Jordan [10, 14, and 19]

2.2 Imported samples:

Table 3 shows the analyzed imported agricultural crop samples collected from boarder customs in 2020 and 2021. Twenty six samples contained pesticide residues less than the adopted MRL, representing 4.96% of the total imported monitored samples (Table 3). 497 imported crop samples did not contain residues, representing 94.85% of the total analyzed samples (Table 3). One imported sample contained residues more than the MRL, representing 0.19% of the whole analyzed samples (524 samples) (Table 3).

Neff et al. [20] in USA suggested the need for additional investigation and resources for pesticide monitoring to improve import food safety and reduce residues exposure in originating countries. EFAS [21] with the control program randomized sampling strategy in European Union countries they detected 3.9% of the analyzed samples contained pesticide residues more than the MRL. Mageed et al. [22] in the United Arab Emirates reported that residues of 93 compounds, mainly fungecides and insecticides were detected in 3548 imported analyzed samples.

Table 3

Table 4 shows the pesticide residues in the analyzed imported samples contained residues more than the adopted MRL in 2020 and 2021. Residues of carbendazim, from the benzimidazol systemic fungicide group were detected six times in the analyzed samples where the residues exceeded the MRL. This fungicide is banned from use in Jordan. Qin et al. [23] found that carbendazim was one of the most common pesticides in fruits and vegetables in China. Chlorpyrifos from semi systemic organophosphates insecticides were two times detected and exceeding the MRL. Benzidane and Dahamna [24] from Algeria showed that 61.7% of the analyzed samples contained residues more than the MRL including chlorpyrifos in apples, tomatoes, peppers and cucumber. Thiamethoxam residues from neonics insecticides were twice times detected and exceeding the MRL (Table 4). EFAS [25] proposed to raise the existing MRLs from 0.05 to 0.03 mg/kg in strawberries and beans. Cypermethrin from the contact pyrethroids insecticides were once detected and exceeded the MRL (Table 4), Neff et al. [20] showed that one of the pesticides in imported crops to USA was cypermethrin. Thiophenate-methyl from benzimidazole systemic fungicide group which gives carbendazim was three times detected and exceeded the MRL (Table 4) and banned from use in Jordan.

Table 4

Veneziano et al. [26] from Italy mentioned that two samples contained carbendazim exceeding the MRL in imported banana from South America. λ-cylaothrin from the pyrethroids insecticide group was six times detected and exceeded the MRL (Table 4). Mebdoua et al. [27] from Algeria, found 12.5% of the analyzed samples contained pesticide residues such as ƛ-cylaothrin and chlorpyrifos exceeded the MRL. Lufenuron is benzoylphenylurea insecticide was once detected and exceeded thw MRL (Table 4). Hanafi et al. [28] reported that Lufenuron residues were above the MRL on onion samples in Egypt and azoxystrobin, a systemic fungicide was once detected and exceeded the MRL (Table 4). Horska et al. [29] detected the highest amount of azoxystroben residues in carrot and parsley leaves after several days of treatment. Propargite is an acaricide banned in Jordan, was twice detected and exceeded the MRL (Table 4) in the imported samples; one from Lebanon and the second from an unknown origin. Yu et al. [30] found that Propargite did leave toxic residues on fruits and leaves when controlling the mite in India. Omethoat is a systemic organophosphate was 10 times detected on apples from Lebanon and exceeded the MRL (Table 4). Bhandari et al. [31] from India reported that Omethoate, chlorpyriphos, triazophos and carbandazim posed the greatest hazard exceeding the MRL in tomatoes and chilies. Dimethoate is a systemic organophosphate insecticide was 9 times detected on apples, jujube, persimmon and soursap fruits from Lebanon and exceeded the MRL (Table 4). Marasinghe et al. [32] declared that dimethoate in the process of being phased out in Srilanka due to several reasons; of these their residues appeared in local and imported crops. Boscalid is a broad spectrum carboximide fungicide was once detected on apples from Italy and exceeded the MRL (Table 4). Chen et al. [33] in Taiwan found that the boscalid residues in cucumber found 6 days after the last application. Carbofuran is a systemic carbamate insecticide, which is banned from use in Jordan, was twice times detected on apples from Greece and exceeded the MRL (Table 4). Sim et al. [34] found that the use of carbofuran has become an issue after several incidents of detection in vegetables, higher than the MRL in Malaysia. Ryndaben is a pyridazinon insecticide from the organochlorines was 3 times detected on date from Saudi Arabia and on persimmon from Lebanon, and exceeded the MRL (Table 4). Badawy et al. [35] found that the presence of pesticides in the food including pyridaben will have a negative inpact on human health. Imidacloprid is a systemic neonic insecticide was once detected on dates from Saudi Arabia and exceeded the MRL (Table 4). Singh et al. [36] found that the cooked cabbage and tomato samples treated with imidacloprid, thiomethoxam and carbendazim, showed no breakdown of the parent compounds. Bifenthrin is a pyrethroids insecticide was twice detected on date from Saudi Arabia and exceeded the MRL (Table 4). 15 pesticides including bifenthrin from 5560 analyzed imported crop samples to the United Arab Emirates were detected above their MRLs in more than 50 samples [37]. Thiabendazole is a systemic benzimidazol fungicide was once detected in Mandarin from Egypt and exceeded the MRL (Table 4). Thiabendazole converts to carbendazim which was found in two banana samples imported from Ecuador, Panama and Cost Rica to Italy that exceeded the MRL [26]. Pyrmethanil is Anilinopyrimidine contact fungicide was twice detected on orange from Egypt and exceeded the MRL (Table 4). Pyrimethanil which is not registered in Kasakhstan was detected in two imported crop samples of tomatoes in concentration of 0.07 and 0.01 mg/kg [38]. Lactofen is a selective herbicide and act as fungicide was six times detected on barley from Romania and on mango from Egypt and exceeded the MRL (Table 4). The rsidues of lactofen showed great phytotoxicity and damage in crop rotation [39]. Triclopyris is a systemic foliar herbicide and may act as fungicide was twice derected on barley from Romania and mango from Egypt and exceeded the MRL (Table 4). Triclopyris is recommended for use in natural area because of low mobility and short residual activity during cold storage [40]. 2,4-D (2,4-PA) is a systemic broad leaf weeds herbicide was once detected in barley from Romania and exceeded the MRL (Table 4). 2,4-D is a systemic anxin herbicide used widely to control broad leaf weeds without significant residues due to its high polarity. Nicarbazin is a coccidiostat used on meat chicken was four times detected on barley from Romania and mango from Egypt and exceeded the MRL (Table 4). Feed additives and veterinary medicines may also contaminate animal feed such as nicarbazin [41]. Cafenstrole is a triazole herbicide has residual activity lasting up to 50 days was three times detected on barley from Romania and from Egypt and exceeded the MRL (Table 4). This herbicide has residual activity lasting up to 50 days in baddy fields and 90 – 150 days in turf [42]. Dithianon, a protectant fungicide was twice detected on barley from Romania and mango from Egypt and exceeded the MRL (Table 4). Ticha et al. [43] reported that several fungicides were detected in apple samples. Few of them including dithianon did not exceed the MRL due to successive decrease during cold storage. Clodinafap-proper is a herbicide for annual grass weeds was twice detected on barley from Romania and exceeded the MRL (Table 4). Clodinafor-proper was increased due to volatilization from deeper to soil surface [44]. Pinoxaden is a systemic herbicide was once detected on barley from Romania and exceeded the MRL (Table 4). Sun et al. [45] reported that pinoxaden remained stable during the storage period and the degradation was only 6.5% at the end of the storage period. Flamprop-isopropyl is a benzimidazole herbicide was once detected on mango from Egypt and exceeded (Table 4). This compound was discontinued due to risk of leaching to ground water. Acephate is a systemic organophosphate insecticide was once detected on pears from Syria and exceeded the MRL (Table 4). Osali et al. [37] reported 15 pesticides including acephate were detected exceeding the MRLs in more than 50 samples out of 5560 imported analyzed vegetable samples in the United Arab Emirates. Acetamiprid is a neonicotinoid insecticide was once detected in soursap from Lebanon and exceeded the MRL (Table 4). Jallow et al. [17] found that 16 pesticides including acetamiprid were detected exceeding the MRL in imported fruit and vegetable analyzed samples in Kuwait. Spirodiclofen is a tetronic acid miticide was twice detected on soursap from Lebanon and exceeded the MRL (Table 4). Residues of spirodiclofen were found concentrated on peel of citrus [45].

3. Conclusions

There were 6.53% and 7.22% of local and imported crop samples, respectively, contained residues more than the adopted MRLs. Furthermore, there were 12.53% and 10.73% of the monitored local and imported samples, respectively contained residues less than the MRL. There were 80.94% local and 81.35% of the remained imported analyzed ones without detectable pesticide residues. Banned organochlorine pesticides in Jordan were not detected neither in the local nor in the imported samples. It is recommended to keep monitoring the pesticide residues in all environmental components including the agricultural crops locally produced and imported ones to protect human health of the citizens and the environment, and to assist the decision makers to take the right decision concerning pesticide handling and registration.

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Table 1: Number of analyzed local samples contained residues in agricultural crops in southern Jordan in 2020 and 2021

Total Analyzed Samples	Samples without residues	Samples contained residues < MRL	Samples contained residues > MRL
383	310	48	25

Table 2: Samples contained pesticide residues more than the MRL, collected from different Locations in the four governorates in Southern Jordan in 2020 and 2021

Sample No.	Crop	Governo-rate	Pesticide	Residues (mg/kg)	No. of samples Contained >MRL	MRL
4	Squash	Karak (GhorEsafi)	Chlorpyrifos	0.018	11	0.01
4	Tomato	"	"	0.054		
5	Melon	"	"	0.310		
3	Parsley	Aqaba	"	0.049		
4	Faba bean	"	"	0.250		
8	Tomato	Ma'an	"	0.034		
6	Sweet pepper	Karak (GhorEsafi)	Azoxystroben	0.138	2	0.05
1	Thyme	"	Cyper,methrin	4.949	2	2.00
5	Melon	"	Oxamyl	0.240	4	0.01
1	Melon	"	Emamectin	0.029	2	0.01
6	Sweet potato	Aqaba	Hexythiazox	0.550	1	0.5
1	Tomato	Ma'an (Jafr)	Dimethoate	0.166	2	0.01
4	Mint	Aqaba	Lufenuron	0.977	1	0.05

Table 3: Number of analyzed samples contained pesticide residues in imported agricultural crop samples in Jordan in 2020 and 2021

Total analyzed Samples	Number of samples without residues	Number of samples contained residues < MRL	Number of samples contained residues > MRL
524	497	1	26

Table 4: Imported samples contained pesticide residues exceeded the MRL collected from different boarder customs centers in Jordan in 2020 and 2021

Crop	Exporting country	Pesticide	Residue (mg/kg)	Samples Contained >MRL	MRL
Grape	Oman	Carbendazim	0.260	1	0.03
Grape	Oman	Carbendazim	0.230	1	0.03
Grape	Oman	Carbendazim	0.411	1	0.03
Soursop	Oman	Chlorpyrifos Triamethoxam Cpermethrin	0.390 0.056 0.114	1 1 1	0.01 0.01 0.05
Grape	Oman	Carbendazim Thiophenate-methyl	0.031 0.366	1 1	0.03 0.01
Grape	unknown	ƛ-cyhalothrin	0.133	1	0.08
Grape	unknown	ƛ-cyhalothrin	0.324	1	0.08
Grape	unknown	Lufenuron	0.043	1	0.01
Apple	unknown	Azoxystrobin	0.108	1	0.01
Strawberry	unknown	Propargite	0.130	1	0.01
Grape	Lebanon	Thiophenate-methyl	1.854	1	0.01
Apple	Lebanon	Thiophenate-Methyl Omethoate Dimethoate Dimethoate Dimethoate Omethoate Omethoate Dimethoate	3.524 0.232 0.422 0.021 0.054 0.024 0.022 0.063	1 1 1 1 1 1 1 1	2.0 0.01 0.01 0.01 0.01 0.01 0.01 0.01
Apple	Turkey	Thiophenate-Methyl	0.600	1	0.50
Apple	Italy Greec Greec Turkey	Boscalid Carbofuran Carbofuran Thiophenate-Methyl	0.258 0.028 0.022 0.600	1 1 1 1	0.20 0.001 0.001 0.500
Dates	Saudi Arabia Saudi Arabia Saudi Arabia Saudi Arabia	Pyridaben Imidacloprid Bifenthrin Bifenthrin	0.026 0.151 0.028 0.068	1 1 1 1	0.01 0.05 0.01 0.01
Mandarin	Egypt Egypt	Thiabendazole ƛ-cyhalothrin	7.713 0.279	1 1	7.00 0.20

Table 4: Continue

Crop	Exporting country	Pesticide	Residue (mg/kg)	Samples Contained >MRL	MRL
Orange	Egypt	Pyrimethanil	7.713	1	7.0
Orange	Egypt	Pyrimethanil	7.800	1	7.0
Orange	Egypt	Carbendazim	0.346	1	0.2
Orange	Egypt	ƛ-cyhalothrin	1,155	1	0.2
Orange	Egypt	Carbendazim	1.080	1	0.2
Orange	Egypt	ƛ-cyhalothrin	0.210	1	0.2
Orange	Egypt	ƛ-cyhalothrin	0.362	1	0.2
Orange	Egypt	ƛ-cyhalothrin	0.448	1	0.2
Orange	Egypt	Pyrimethanil	8.411	1	7.0
Barley	Romania	Lacofen	0.01	1	0.01
Barley	Romania	Triclopyr	0.02	1	0.01
Barley	Romania	2,4-D(2,4-PA)	0.02	1	0.01
Barley	Romania	Nicarbazin	0.01	1	0.01
Barley	Romania	Cafenstrole	0.01	1	0.01
Barley	Romania	Nicarbazon	0.01	1	0.01
Barley	Romania	Dithianon	0.02	1	0.01
Barley	Romania	Clodinafop-propar	0.02	1	0.01
Barley	Romania	Pinoxaden	0.02	1	0.01
Barley	Romania	Clodinafop-propar	0.01	1	0.01
Barley	Romania	Nicarbazin	0.02	1	0.01
Mango	Egypt	Lactofen	0.092	1	0.01
Mango	Egypt	Flampro-iso-prop	0.062	1	0.01
Mango	Egypt	Cafenstrole	0.258	1	0.01
Mango	Egypt	Lactofen	0.092	1	0.01
Mango	Egypt	Flampro-iso-prop	0.062	1	0.01
Mango	Egypt	Cafenstrole	0.250	1	0.01
Mango	Egypt	Lactofen	0.300	1	0.01
Mango	Egypt	Fluoroglycofen	0.010	1	0.01
Mango	Egypt	Dithianon	0.030	1	0.01
Mango	Egypt	Lactofen	0.030	1	0.01
Mango	Egypt	Lactofen	0.030	1	0.01
Mango	Egypt	Triclopyr	0.140	1	0.01
Mango	Egypt	Nicarbasin	0.020	1	0.01
Jujube	Lebanon	Dimethoate	0.076	1	0.01
Jujube	Lebanon	Omethoate	0.060	1	0.01
Jujube	Lebanon	Dimethoate	0.080	1	0.01
Jujube	Lebanon	Omethoate	0.055	1	0.01
Jujube	Lebanon	Dimethoate	0.016	1	0.01
Jujube	Lebanon	Omethoate	0.021	1	0.01
Dates	Saudi Arabia	Pyridaben	0.064	1	0.010.
Dates	Saudi Arabia	Carbendazim	0.012	1	01

Table 4: Continue

Crop	Exporting country	Pesticide	Residue (mg/kg)	Samples Contained >MRL	MRL
Pears	Syria	Acephate	0.067	1	0.02
Pears	Lebanon	Propargite	0.024	1	0.01
Mango	Egypt	Omethoate	0.022	1	0.01
Mango	Egypt	Omethoate	0.025	1	0.01
Mango	Egypt	Omethoate	0.038	1	0.01
Barley	Romania	Chlorpyrifos	0.036	1	0.01
Banana	Lebanon	Thiophenate-methyl	6.177	1	2.00
Persimmon	Lebanon	Pyradaben	0.014	1	0.01
Persimmon	Lebanon	Omethoate	0.091	1	0.01
Persimmon	Lebanon	Dimethoate	0.379	1	0.01
Soursop	Lebanon	Thiamethoxam	0.071	1	0.02
Soursop	Lebanon	Acetamiprid	0.057	1	0.01
Soursop	Lebanon	Spirodiclofen	0.026	1	0.02
Soursop	Lebanon	Omethoate	0.012	1	0.01
Soursop	Lebanon	Methomyl	0.232	1	0.01
Soursop	Lebanon	Dimethoate	0.044	1	0.01
Soursop	Lebanon	Acetamiprid	0.094	1	0.01
Soursop	Lebanon	Spirodiclofen	0.032	1	0.02