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Residues of Chlorpyrifos Insecticide in Date Fruits after Controlling of Red Palm Weevil in New Valley, Egypt

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ABSTRACT

The objective of this study was to determine the pesticide residues of chlorpyrifos-ethyl in date fruits after using two controlling methods (trunk injection, foliage spray). In addition, some food processing methods (washing followed by exposure to water vapor) were used to reduce the residues of insecticide after 30 and 300 days of applications. Results showed that the highest significant deposit of chlorpyrifos-ethyl residue was 11.5 $\mu g kg^{-1}$ for injection treatment, while it was 0.9 $\mu g \cdot kg^{-1}$ for foliage spray treatment. The detected chlorpyrifos residues at intervals were reduced by 95.2% after 300 days of application. As well as the using of food processing methods that were reduced chlorpyrifos residues by 45.8 %, which presented a safe level below the hazard index (HI) values.

Keywords: date fruits, chlorpyrifos residues, trunk injection, foliage spray, pesticide removal

INTRODUCTION

Date palm (*Phoenix dactylifera*) is one of humankind's oldest and the most important plants in the numerous different countries and desert areas of Egypt especially in New Valley. It was the most producing countries with 1.5 million metric tons (MMT) in 2014 (FAOSTAT 2017). The importance of the date palm for human nutrition mainly due to its high amounts of phytochemicals, proteins, vitamins, minerals and other nutrients that have abundant health benefits (El-Juhany 2010; Vayalil 2012).

Decimation of palms by the red palm weevil, *Rhynchophorus ferrugineus* Oliver (Coleoptera: Curculionidae), is a critical insect in New Valley zones, Egypt. It's considered to be an important factor affect the economical production of date palms and it's one of the most devastating pests of palms in the world (EPPO, 2008, 2009, 2010).

Chemical control of red palm weevil is the major controlling practice used in Egypt area and many regions all over the world. One of the most commonly applied insecticides is chlorpyrifos- ethyl. It has shown acceptable results for achieving a successful control of the red palm weevil. Recent research indicated that human health was affected by chlorpyrifos residues specially children. Also, a strong correlation to chronic illness associated with autoimmune disorders after exposure to chlorpyrifos (Jack *et al*, 2002).

Therefore, the pesticide residues in food have been strictly regulated by governments all over the world to determine whether the concentration of pesticides used exceeds their MRLs (European Commission directive, 1993; FAO, 2010). Consequently, the aim of the present study is to (1) determine the residue of chlorpyrifos-ethyl insecticide in date palm fruit at El-Kharja, New Valley, Egypt after various times using two applications of methods. In addition (2) determine the effectiveness of post-harvest wash with exposure to water vapor for reducing the chlorpyrifos residues in fruit under conditions of the area under examined. And (3) estimate the potential health risk for human after consumption of contaminated date palm fruits that also a matter of concern.

MATERIALS AND METHODS

1- Insecticide and chemicals

Chlorpyrifos ethyl (O, O-diethyl O-3, 5,6-trichloro-2-pyridyl phosphorothioate) was used in the experimental field as recommended (3ml/L of Tafaban® 48% EC) by the manufacturers that kindly provided by the Egyptian Ministry of Agriculture. Acetonitrile (HPLC, assay >99%), methanol 99.9% HPLC grade and ammonia solution 33% were purchased from Sigma – Aldrich, USA. The Agilent QuEChERS extraction kit was used for extraction of chlorpyrifos.

2- Experimental field

The study was conducted at EL-Kharja City and (Sherka 8, Sherka 55 and Monera villages) in the New Valley governorate, Egypt. The experiment was performed, lasting ten months from November to September during seasons, (2014/2015–2015/2016) under chemical control as directed by the ministry of agriculture against the red palm weevil, *Rhynchophorus ferrugineus* Oliver.

3- Field treatment techniques

The Bartomoda cultivar palms, Phoenix dactylifera with nearly similar height of 2-3 meter in the same age, was treated by chlorpyrifos using two different application methods, trunk injection and foliage spray treatments. The two groups date palms were subjected for application of chlorpyrifos before two times of harvest. The date palm trees that have fruits treated in the first time (30 days before harvest) and the fruits were absent for treating trees in the second time (300 days before harvest). Each treatment had three replicates of trees. Control trees treatment (un-amended) was initiated beside the above-mentioned treatments.

- **Injection treatment**

The infested palm trees were injected 3-time every 5-7 days through the palm trunk as recommended for chlorpyrifos insecticide (3ml/l). The insecticide was injected into 3 holes that drilled in the palm trunk around the infested point with of dimension 2.5 cm diameter and 15 cm depth drilled in horizontal angle 45o at a high of 1.5 meters above the ground. The injection apparatus was locally adapted using 4-liter plastic Jerrycan which connected to canola by rubber tubes. The syringes were inserted into the holes and flow rate was adjusted inside the

holes with a low-pressure injection. The plastic Jerrycan fixed on the trunk one meter above the injection hole (Al Samarrie and Abo-Akela 2011). Then the holes were closed by a paste of cement and gypsum. All treated date palms were inspected within the interval time from treatment until stopped the infestation. Other farming practices were done as that followed the recommendations of the Ministry of Agriculture.

- **Foliage spray treatment**

Another palm trees that closed of the infested palms were sprayed 3 times at a rate once per week by the recommendation of chlorpyrifos insecticide dose (3ml/l) using a hydraulic sprayer (Knapsack power sprayer).

4- Residue analysis

- **Sampling collection and preparation**

The present random samples were collected from the different experimental locations after 30 and 300 days post treatment (DPT). Three replicates for each sample of the treated and untreated (control) date palm were collected approximately 1 Kg from all bunches of fruit randomly. The samples were kept in the plastic net bags until transferred to the laboratory. Samples of homogeneous dates were divided into two portions, first is about 200 g and the other about 800 g, the last weight was exposed to some food processes. Both samples were crushed after seeds were discarded; then stored in 100 g plastic cups at -20 ^{o}C until analysis.

- **Extraction procedure**

The QuEChERS pesticide extraction was performed following the description of Anastassiades *et al.* (2003). A sample of 10 g of crushed date was extracted with 10 ml acetonitrile into 50 ml Falcon tubes (PFTF) and shaken for 1 min. Then Buffer (1) that content (4 g of magnesium sulfate; 1 g of sodium chloride; 1 g of trisodium citrate dihydrate and 0.5 g of disodium hydrogen citrate sesquihydrate) were added and shaken for 1 min. Samples were centrifuged for 10 min at 4000 rpm and 4 ^{o}C. The sample was filtrated using a syringe filter and directly injected into the LC-MS/MS system.

- **Analysis of chlorpyrifos insecticide**

Quantitative chlorpyrifos residue was analyzed by LC-MS/MS system, LC–MS/MS was performed using Agilent 1200 Series HPLC instrument coupled to an API 4000 Qtrap MS/MS from Applied Biosystems with electrospray ionisation (ESI) interface. Separation was performed on a C18 Agilent column ZORBAX Eclipse XDB-C18 4.6 x 150 mm, 5 µm particle size. The injection volume was 5 µl. A gradient elution program at 0.3 mL/min flow, in which one reservoir contained 10 m mol. ammonium formate solution in a methanol-water (1:9) and the other contained methanol was used. The ESI source was used in the positive mode, and N_2 nebulizer, curtain, and other gas settings were optimized according to recommendations made by the manufacturer; the source temperature was 300 ^{o}C, ion spray potential, 5500 V. The recovery of chlorpyrifos insecticides was determined and ranged between 70-120 %.

5- Semi-food processes

The freshly fruit sample (approximately 800 g) was washed with water as a postharvest wash treatment for 5 min, followed by exposure to water vapor for 10 min. The samples were left to dry under room temperature for 24 hours.

6- Human health aspect

Hazard evaluation of human health was assessed to determine the level of exposure to the residual chlorpyrifos insecticide effect on people living in the area via direct ingestion of contaminated date palm fruits. The non-carcinogenic contaminants exposure rates (chronic exposure rates) were calculated according to the following equations (USEPA, 1997; Lee *et al*., 2006; Zheng *et al*., 2010):

ADD of date palm fruits ingestion = (C × IR × ED× Ef) / (BW × AT)

Where ADD is the average daily dose of specific contaminants. The parameters in the ADD formulas and the toxicity indices of the residues of chlorpyrifos ethyl insecticide are presented in opposite Table 1 of Hazard Index (HI) values of date palm fruit.

Table 1. The parameters in the ADD formulas and the toxicity indices of the residues of chlorpyrifos ethyl insecticide

PARAMETER	DESCRIPTION	VALUE	UNIT
C	Contamination level	--	mg kg^{-1}
IR	Ingestion rate per unit time	27.7*	g day^{-1}
EF	Exposure frequency	365	days $year^{-1}$
ED	Exposure duration	60	Years
BW	Body weight	70	Kg
AT	Average time	30×365	days
TOXICITY PARAMETERS	chlorpyrifos ethyl		
RfD	0.005 mg Kg^{-1} (BW)**		
MRL	50 µg·Kg^{-1}***		

RfD: reference dose MRL: maximum residual level

*** Egyptian food balance sheet issued by economic affairs sector, central administration for agricultural planning, ministry of agriculture, 2008**

**** Environmental Protection Agency, 1997**

***** Data obtained from (FAO/WHO (1995), EU Scientific Committee for Food ((EU Scientific Committee 1995).**

The obtained ADD values were used to determine the hazard index (HI) as follows (Abdelhafez *et al*., 2012; 2015; Abdelhafez and Li, 2015) where RfD is the reference dose which is defined as the maximum daily intake of contaminant without deleterious according to the following equations: HI = ADD/RfD

7- Statistical analysis

Randomized complete block design using split-split plot arrangement as the industry was arranged in main plot followed by treatment in sub-plot and finally time in sub-sub plot, then combined analysis over seasons was used with three replications after testing the error homogeneity. Analysis of variance (ANOVA) was

carried out using Proc Mixed of SAS package version 9.2 (SAS 2008) and means were compared by Duncan's test at 5% level of significant (Steel & Torrie, 1981).

RESULTS AND DISCUSSION

- **Insecticide residues in dates**

Data presented in fig. 1 showed the residues of chlorpyrifos-ethyl insecticide in date palm fruits using two applications (injection and foliage spray). The highest concentration of chlorpyrifos was 11.5 µg·Kg-1 for injection treatment, which was significantly higher compared to the foliage spray treatment (0.9 µg·Kg-1). However, there were no significant differences between foliage spray and control treatments. The obtained results showed that trunk injection achieved high concentrations of chlorpyrifos in date palms compared to the foliage spray treatment. This could be attributed to the complete addition of chlorpyrifos into cell sap through injection treatment. However, the high temperature may cause high volatilization of the used insecticide by foliage spray treatment; especially the high temperature in the study area. As mentioned above the study area located in a semi-arid region with an average temperature of 37-38 ^{o}C during the experimental periods. Roberts& Hutson (1999) were reached to similar findings, they have observed that most of the added chlorpyrifos was lost through volatilization especially with high atmospheric temperature when its added by foliage method. A point to note that, adding insecticides to plants through trunk injection achieve high transformation into cell sap and plant organs. For example, Sammarie *et al.* (2006) demonstrated that actara insecticides moved at a rate of 2.8m/hrs. in date palm through trunk injection method. Similarly, Al Samarrie and Abo Akela (2011) found that trunk injection has many advantages, i.e., the complete transformation of insecticide into cell sap, protecting environmental by contamination with insecticides and saving man work and costs.

The average residues of chlorpyrifos ethyl after 30 and 300 days of treatment are presented in fig. 2. The highest average concentration of insecticide residue was 14.6 µg·Kg^{-1} after 30 days of treatment, which decreased significantly to reach 0.7 µg·Kg^{-1} after 300 days of applications. These results are in agreement with the findings by Abd Rabou *et al.* (2015) who found that the residue concentration of chlorpyrifos-ethyl in date palm fruits gradually declined with time. Usually, the added insecticides to plants are subjected to a rapid metabolic action; consequently, transformed into another form or completely degraded by the growing plants (Khan *et al*., 1985). Tomlin (2006) reported that chlorpyrifos is mainly absorbed by plants taken up by plant tissues; thereafter, it metabolized to 3,5,6 trichloro-2-pyridinol (TCP), which is then stored as glycoside conjugates

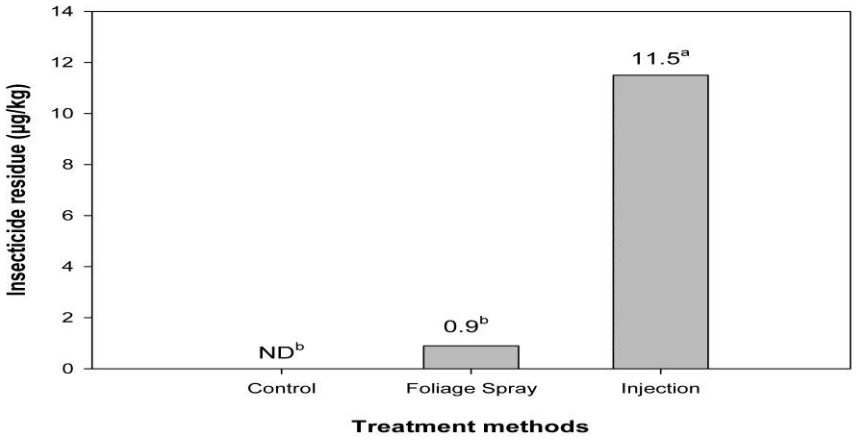

Fig. 1. Comparison of chlorpyrifos residues level in date fruits after two application methods. Means with the same superscript letter are not significantly different at p < 0.05. Abbreviation ND: Not detected

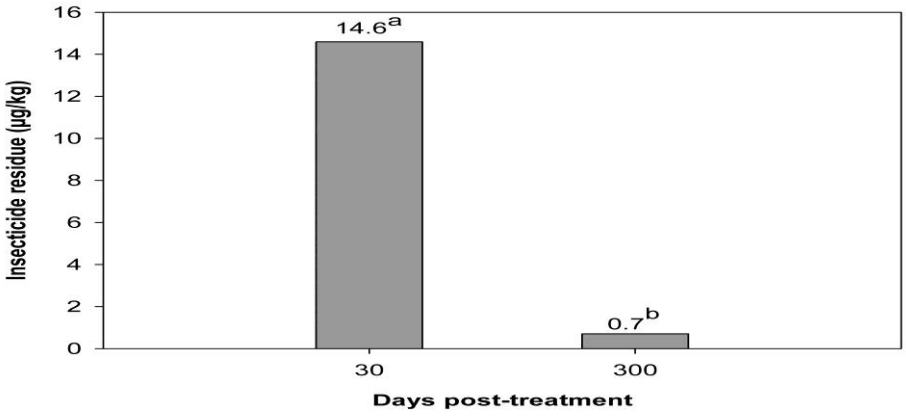

Fig. 2. Main effect of time on chlorpyrifos residue levels in date fruits. Means with the same superscript letter are not significantly different at p < 0.05.

Most nations have built up a Maximum Residue Limits (MRLs) for pesticides as a part of the control of pests and infections to protect human health as well as to limit the existence of these insecticides in the food. The upper limit of the maximum allowed chlorpyrifos residue set by the Codex Committee on pesticides residues under the Joint FAO/WHO Food Standards Program is 50 µg·Kg^{-1} for date palm fruits (FAO/ WHO, 1997). The results in Table 2 showed that the residue concentrations of chlorpyrifos ethyl in date palm fruits at four study locations namely, EL-Kharja city, Sherka 8, Sherka 55 and Monera villages. The highest rates of insecticide residue were recorded for injection treatment after 30 days of application, which was significantly higher than foliage application and control treatments. The highest concentration of chlorpyrifos was 57.5 µg·Kg^{-1} in Sherka 8, which was greater than MRLs for chlorpyrifos insecticide, followed by 36.6, 31 and 25.8 µg·Kg^{-1} in Sherka 55, EL-Kharja and Monera respectively. A point to note that, no significant differences were found between them and all concentrations were lowers the MRLs. The results showed that there was a significant reduction of insecticide residues after 300 days of injection application. The average residue of chlorpyrifos in total of locations after 30 days from injection application on dates was 37.7 µg·Kg^{-1}, which gradually declined with time to reach 2.1 µg·Kg^{-1} after 300 days of applications. Furthermore, the insecticide residue for foliage spray treatment was lower than the injection treatment regardless of sampling time. The highest residue for foliage spray was 8.8 µg·Kg^{-1}, in Sherka 8 village and all means of residues were dropped to below the detection limits (ND) after 300 days of foliage spray treatment. In a market study for pesticide deposits on dates of Riyadh city marketplaces, the outcomes demonstrated the constancy of a few pesticides and the buildups were beneath, or more MRLs, while chlorpyrifos was observed to be the highest remaining identified pesticide (El-Saeid and Al-Dosari, 2010). This indicates that determining the safest postharvest interval (PHI) for the date palm fruits prior to consumption is very important to ensure its safe use. Our finding reveals that under the New Valley conditions and foliage spray treatment, 30 days is prior to consumption is adequate to ensure the safe use of date palms. The amount of chlorpyrifos was 6 µg·Kg^{-1}, and this value was lower than the upper limit (MRLs) as directed by the Codex Committee on Pesticide Residues under the Joint FAO/WHO Food Standards Program (50 µg·Kg^{-1} for date palm fruits) (FAO/ WHO, 1997). However, a period of 300 days after injection treatment, the time was suitable before harvest (PHI), where the amount of chlorpyrifos was 2.1 µg·Kg^{-1} and this value was much lower than (MRLs). A potential risk might be occurred for human consuming the treated date palm by injection after 30 days before harvest (PHI) because the concentration of chlorpyrifos was greater than (MRLs) in one area (Sherka 8: 57.5 µg·Kg^{-1}) and other sites were closer to the MRLs with an average concentration of 31.1 µg Kg^{-1}. These results suggest that additional pre-treatment might be required to overcome the risks of high chlorpyrifos concentrations after 30 days from injection treatment.

Table 2. Means of residues (µg/Kg) and hazard index (HI) for chlorpyrifos in date fruits at interval times of treatment methods for controlling the red palm weevil

Regions	Insecticide treatment methods	chlorpyrifos residues ± SD[1] (µg/Kg)		HI[2]	
		DPT[3]			
		30	300	30	300
El-Kharja	Control	ND^{c} ± 0.00	ND^{c} ± 0.00	0.00E+00	0.00E+00
	Foliage Spray	7.0^{c} ± 1.80	ND^{c} ± 0.00	1.11E-03	0.00E+00
	Injection	31^{b} ± 11.8	4.3^{c} ± 1.60	4.91E-03	6.81E-04
Sherka 8	Control	ND^{c} ± 0.00	ND^{c} ± 0.00	0.00E+00	0.00E+00
	Foliage Spray	8.8^{c} ± 3.50	ND^{c} ± 0.00	1.39E-03	0.00E+00
	Injection	57.5^{a} ± 12.7	2.0^{c} ± 1.50	9.10E-03	3.17E-04
Sherka 55	Control	ND^{c} ± 0.00	ND^{c} ± 0.00	0.00E+00	0.00E+00
	Foliage Spray	4.5^{c} ± 1.50	ND^{c} ± 0.00	7.12E-04	0.00E+00
	Injection	36.6^{b}± 8.00	ND^{c} ± 0.00	5.75E-03	0.00E+00
El-Monera	Control	ND^{c}± 0.00	ND^{c} ± 0.00	0.00E+00	0.00E+00
	Foliage Spray	3.8^{c}± 0.66	ND^{c} ± 0.00	6.01E-04	0.00E+00
	Injection	25.8^{b}± 5.30	2.1^{c} ± 1.10	4.08E-03	3.96E-04
Means	Control	ND^{B}± 0.00	ND^{B}± 0.00	0.00E+00	0.00E+00
	Foliage Spray	6.0^{B}± 2.20	ND^{B}± 0.00	9.50E-04	0.00E+00
	Injection	37.7^{A}± 11.0	2.1^{B}± 1.40	5.97E-03	3.32E-04

Means with the same superscript letter are not significantly different at $p < 0.05$. **ND: Not Detected**

[1] Standard deviation **[2] Hazard Index =** $\frac{ADD}{RfD}$ **[3] Days post-treatment**

- **Effect of food processing on insecticide residues**

In an attempt for reducing the insecticide residues in the date palm fruits after harvesting periods of 30 and 300 days under different treatments, some food manufacturing processes such as washing processes followed by exposure to water vapor are essential treatment to protect human health. The results in Fig. 3 showed that there was a significant reduction in average residues of chlorpyrifos from 7.65 µg·Kg^{-1} to 4.15 µg·Kg^{-1} forming a reduction percentage of 45.8 % of chlorpyrifos residues. The present outcomes are in parallel with numerous studies (Meijers *et.al.* 1995; Doong and Chang 1998; Wang and Lemley 2002; Wu and Linden 2008; Bajwa and Sandhu 2011; Osman *et al.*

2012); they have found that the washing with water or detergents were profoundly successful in lessening the level of pesticides. Furthermore, in Table 3 illustrated that a significant reduction of chlorpyrifos residues in the date palm fruits after 30 days of injection treatment, which decreased significantly from 37.7 to 22.2 µg·Kg^{-1}, recording a reduction percentage of 41.1%. Whilst, the decrease was insignificant in the date palm fruits after 300 days of injection treatment, which decreased from 2.1 to 0.9 µg·Kg^{-1} by 57.1% loss of residues. As for foliage spray treatment, the decrease was insignificant in the samples of dates collected after 30 days of treatment, which decreased from 6 to 1.8 by 70% loss of residues. Chlorpyrifos residues in samples of dates collected after 300 days of foliage spray treatment were below detection limits (ND). The present study revealed that removing of chlorpyrifos from date fruits depends on the postharvest interval (PHI) and washing process which are in accordance with the results of Osman *et al.* (2012), who reported that the washing by running tap water are effective to decrease the chlorpyrifos by 37.08 %, 42.46 %, 51.77 %, and 51.93 % under washing time of 5, 15, 30 and 60 min, respectively. Additionally, tap water in combination with ozonized water ($p<0.05$) were caused the decreasing of the remained pesticide levels in vegetable, compared with control treatment (Wu *et al.* 2007; Karaca *et al.* 2012). It can be demonstrated that the reduction of chlorpyrifos residues by washing process with water was higher those reported by others Abou-Arab (1999) and Cengiz *et al*. (2006); they have reported that, a reduction percentage of chlorpyrifos by 9–23 % of the underlying pesticide levels were lessened by washing fruits by faucet water. The outcomes are likewise contrasted to those of Krol *et al.* (2000), who found that flushing fruits and vegetables with faucet water for 15–30 caused a critical decline in deposit levels of malathion, iprodione and different pesticides yet not of chlorpyrifos. Also washing rice grains again with water expelled roughly 60 % of the chlorpyrifos deposits (Lee *et al.*, 1991). Cengiz *et al.* (2014) showed that the amounts of chlorpyrifos-ethyl residues were decreased by hot water (90 °C) treatment of tomato fruits for 60 min, and the reduction percentage was 55.8%.

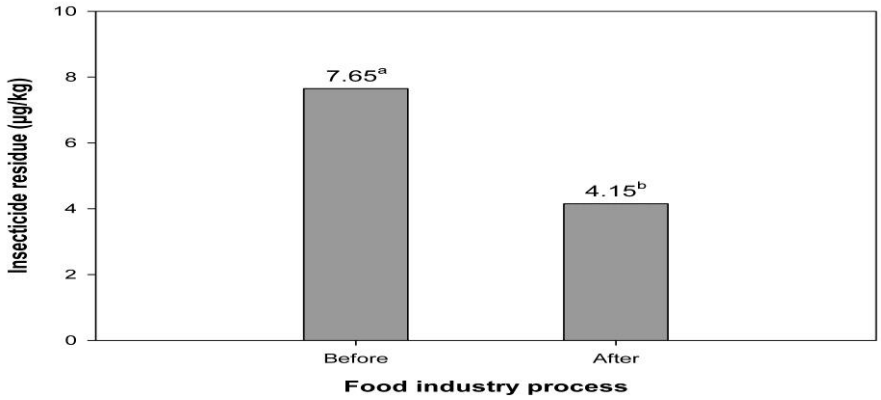

Fig. 3. Shows the effect of the food manufacturing process (washing followed by exposure to water vapor) on chlorpyrifos residue concentration in date fruits. Means with the same superscript letter are not significantly different at $p < 0.05$.

Table 3. Effect of washing and water vapor exposure on removing of chlorpyrifos residues from date palm fruits at interval time of different treatments.

DPT[1]	Food processing[2]	chlorpyrifos residues ± SD[3] (µg/Kg)			
		Insecticide treatment methods			Means
		Control	Foliage Spray	Injection	
30	Before	ND^{d} ± 0.00	6.0^{c} ± 2.20	37.7^{a}± 11.0	14.6^{A} ± 10.4
	After	ND^{d} ± 0.00	1.8^{cd} ± 3.00	22.2^{b}± 9.40	8.00^{B} ± 7.50
300	Before	ND^{d} ± 0.00	ND^{d} ± 0.00	2.1^{cd} ± 1.40	0.70^{C} ± 0.95
	After	ND^{d} ± 0.00	ND^{d} ± 0.00	0.9^{d} ± 1.00	0.30^{C} ± 0.60

Means with the same superscript letter are not significantly different at $p < 0.05$. ND: Not Detected
[1] Days post-treatment [2] washing followed by exposure to water vapor [3] Standard deviation

- **Human risk assessment**

Human are exposed to environmental contaminates through different exposure routes (Abdelhafez *et al.*, 2016). In this study, we aimed to estimate the average daily intake of chlorpyrifos in the treated date palms. In addition, the hazard index (HI) was calculated to predict the potential health risk for human that exposed to the contaminated date palm fruits. Generally, the trunk injection method recorded the highest average daily intake of chlorpyrifos compared to foliage spray and control treatments. In addition, the treatment of date palm by washing followed by exposure to hot water vapor to decrease the levels of chlorpyrifos achieved high reduction of the average daily intake of chlorpyrifos. On one hand, the highest average daily dose of specific contaminants (ADD) was recorded for a trunk injection method with an average value of 2.98E-02 µg kg-1bw day-1. On the other hand, the lowest ADD was recorded for a foliage spray method with an average value of 4.75E-03 µg kg-1bw day-1 for all treatments after 30 days of treatment, all the hazard index (HI) values in Table 2 were below 1, indicating that there is no potential risk for human in the

study areas that exposed to the treated date palms with chlorpyrifos regardless of application methods. These outcomes were similar that of related publication (Abbassy *et al.*, 2017).

CONCLUSION

The residual level of chlorpyrifos- ethyl insecticide was shown to be the highest after the injection treatment than the foliage spray treatment and a gradual reduction of residues was observed over time. The study highlighted that the treatments during the absence of fruits were safer than the transactions in the presence of them. Beside some safe food processes were used to reduce these residues had a significant effect in reducing these residues to a percentage of loss greater than 45% which was below the maximum residue limits (MRLs). In addition, chlorpyrifos residues discovered no human harm, whether implemented as injection and foliage spray treatments.

REFERENCES

Abbassy, M.A.; Y.M.M. Salim, M.S. Shawir and A.M.K. Nassar (2017) Disappearance and hazard quotient of chlorpyrifos-methyl, fipronil, and imidacloprid insecticides from dates. J Consum. Prot. Food Saf. DOI 10.1007/s00003-017-1111-3.

Abdelhafez, A.A.; H.H. Abbas; R.S. Abd-El-Aal; N.F. Kandil; J. Li and W. Mahmoud (2012). Environmental and health impacts of successive mineral fertilization in Egypt. Clean (weinh) 40 (4): 356-363.

Abdelhafez, A.A.; M.H.H. Abbas and T.M.S. Attia (2015). Environmental monitoring of heavy-metals status and human health risk assessment in the soil of Sahl El-Hessania area, Egypt: Pol. J. Environ. Stud. 24 (2): 459-467.

Abdelhafez, A.A. and J. Li. (2015). Environmental monitoring of heavy metal status and human health risk assessment in the agricultural soils of the Jinxi River Area, China. Ecol. Risk Assess. 21 (4): 952-971.

Abdelhafez, A.A.; M.A.M. Ali; A.I. El-Tokhy and M.E. Amer (2016). Effects of nitrogen and herbicides on onion production in a newly reclaimed soil and their potential health risks. Egypt. J. Desert Res. 66 (1): 115-135.

Abd Rabou. E.H.; S.F. Elsharabasy and W.L. Abouamer (2015) Estimation of insecticide residue in date palm fruits after controlling the red palm weevil. Int. J. Food Nutr. Sci. 4 (5): 27–31.

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

Al Samarrie, I.A., and A.A. Akela (2011) Distribution of injected pesticides in date palm trees. *Agric.* Biol. J. N. Am 2(12); 1416-1426.

Anastassiades M.; S.J. Lehotay; D. Stajnbaher and F.J. Schenck (2003) Fast and easy multiresidue method employing acetonitrile extraction/ partitioning and dispersive solid phase extraction for the determination of pesticide residues in produce. J. AOAC Int. 86(2): 412-431.

Bajwa, U. and K.S. Sandhu (2011) Effect of handling and Processing on pesticide residues in food- a review. J. Food Sci. Technol. 48, 1–2.

Cengiz, M.F.; M. Certel; B. Karakas and H. Gocmen (2006) Residue contents of DDVP (Dichlorvos) and diazinon applied on cucumbers grown in greenhouses and their reduction by duration of a pre-harvest interval and post-harvest culinary applications. Food Chem. 98, 127–135.

Cengiz, M.F.; M. Catal; F. Erler and K. Bilgin (2014) The effects of heat treatment on the degradation of the organophosphate pesticide chlorpyrifos-ethyl in tomato homogenate. Qual. Assur. Saf. Crop. 7, 537-544.

Doong, R. and W. Chang (1998) Photoassisted iron compound catalytic degradation of organophosphorus pesticides with hydrogen peroxide. Chemosphere 13, 2563–2572.

El-Juhany L.I. (2010) Degradation of date palm trees and date production in Arab countries: causes and potential rehabilitation. Aust. J. Basic A ppl. Sci. 4, 3998–4010.

El-Saeid, M.H. and S.A. Al-Dosari (2010) Monitoring of pesticide residues in Riyadh dates by SFE, MSE, SFC and GC techniques. Arab. J. chem. 3, 179-186. EPPO (European and Mediterranean Plant Protection Organization) (2008) Data sheets on quarantine pests. Rhynchophorus ferrugineus. Bull. OPPE 38, 55–59.

EPPO (European and Mediterranean Plant Protection Organization). (2008). Data sheets on quarantine pests. Rhynchophorus ferrugineus. EPPO Bulletin. 38: 55–59.

EPPO (European and Mediterranean Plant Protection Organization) (2009) EPPO Reporting Service, 2009/002. First record of Rhynchophorus ferrugineus in Curacao, Netherlands Antilles.

EPPO (European and Mediterranean Plant Protection Organization) (2010) EPPO Reporting Service, 2010/176. First record of Rhynchophorus ferrugineus in the USA.

European Commission directive (1993) *Official J. of the European Communities L.* 211, 6–39.

FAO (1993) Agriculture towards (2010), in Proceedings of the 27th Session of the FAO Conference, Rome, Italy, C 93/24.

FAO/WHO. Joint FAO/WHO Food Standards Program, Codex Committee on Pesticide Residues, CX/PR 97/9; 1997: 159.

FAOSTAT (Food and Agriculture Organization). (2017). http://faostat3. fao. Org / search / date/E. (Accessed April 2017).

Jack D.T.; G. Heuser and A. Broughton (2002) Broughton Immunological abnormalities in humans chronically exposed to chlorpyrifos. Arch. Environ. Occup. Health 57(3):181-187.

Karaca, H.; S.S. Waleb and J.L. Smilanick (2012) Effect of continuous 0.3µL/L gaseous ozone exposure on fungicide residues on table grape berries. Postharvest Biol. Technol. 64, 154–159.

Khan, P.; A.A. Barakat; A.M. Alabdulkarim and A.A. Wahdan (1985) The residual distribution of organophosphorus insecticides in dates, potato, and cucumber crops. Arab J. pl. prot.3, 33-37.

Krol, W.J.; T.L. Arsenault; H.M. Pylypiw and MJ.I. Mattina (2000) Reduction of pesticide residues on produce by rinsing. J. Agric. Food Chem. 48, 4666–4670.

Lee, S.W.; B.T. Lee; J.Y. Kim; K.W. Kim and J.S. Lee (2006) Human risk assessment for heavy metals and as contamination in the abandoned metal mine areas, Korea. Environ. Monit. Assess. 119, 233–244.

Lee, S.R.; C.R. Mourer and T. Shibamoto (1991) Analysis before and after cooking processes of a trace chlorpyrifos spiked in polished rice. J. Agric. Food Chem. 39, 906–908.

Meijers R.T.; E.J. Oderwald-Muller; P.A.N.M. Nuhn and J.C. Kruitof (1995) Degradation of pesticides by ozonation and advanced oxidation. Ozone Sci Eng. 17, 673–686.

Osman K.A.; A.I. Al-Humaid; K.N. Al-Redhaiman and R.A. El-Mergwai (2012) Safety methods for chlorpyrifos removal from date fruits and its relation with sugars, phenolics and antioxidant capacity of fruits. J. Food Sci. Technol. 49, 1–11.

Roberts, T.R. and D.H. Hutson (1999) "Metabolic Pathways of Agrochemicals - Part 2: Insecticides and Fungicides" The Royal Society of Chemistry: Cambridge, UK, pp. 235-242.

Sammarie D.I.; A.A. Ali; A.I. Emad; N.H. Abas and E.T. Yousif (2006) The translocation, distribution and concentration of thiamethoxam (actara) in date palm.: Fourth date palm conference KSA.

Steel, G.D. and J.H. Torrie (1981) "Principles and Procedures of Statistics" 2nd ed., McGraw-Hill Book Company. Inc. N. Y. pp. xxi – 633.

Tomlin, C. D. S. (2006) The Pesticide Manual, A World Compendium, 14th ed.; British Crop Protection Council: Alton, Hampshire, UK, p. 186-187.

USEPA (U.S. Environmental Protection Agency) (1997) In "Exposure Factors Handbook", General Factors Vol. I and II, Chap. (1-4-7-12), U.S. Environmental Protection Agency (USEPA), Washington, DC.

Vayalil P (2012) Date fruits (Phoenix dactylifera Linn): an emerging medicinal food. Crit. Rev. Food Sci. Nutr. 52, 249–271.

Wang Q.Q. and A.T. Lemley (2002) Oxidation of diazinon by anodic Fenton treatment. *Water Res.* 36, 3237–3244.

Wu J.G.; T.G. Luan; C.Y. Lan; W.H. Lo and G.Y.S. Chan (2007) Efficacy evaluation of low-concentration of ozonated water in removal of residual diazinon, parathion, methyl-parathion and cypermethrin on vegetables. J. Food Eng. 79, 803–809.

Wu C. and K.G. Linden (2008) Degradation and byproduct formation of parathion in aqueous solutions by UV and UV/H2O2 treatment. Water Res 42:4780–4790.

Zheng, N.; J. Liu; Q. Wang and Z. Liang (2010) Health risk assessment of heavy metal exposure to street dust in the zinc smelting district, Northeast of China. Sci. Total Environ. 408, 726–733.

متبقيات مبيد الكلوروبيرفوس فى ثمار البلح بعد مكافحة سوسة النخيل الحمراء بمحافظة الوادى الجديد، مصر

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الهدف من هذه الدراسة هو تقدير بقايا مبيدات الآفات من الكلوربريفوس-إيثيل في ثمار البلح بعد استخدام طريقتين من المكافحة لسوسة النخيل الحمراء (حقن الجذع، الرش الورقى). وبالإضافة إلى ذلك، استخدمت بعض عمليات التصنيع الغذائى (الغسيل ثم التعرض لبخار الماء) للحد من مخلفات مبيد الكلوروبيرفوس إيثيل بعد ٣٠ و ٣٠٠ يوما من التطبيق. وأظهرت النتائج أن أعلى متبقيات من الكلوربيرفوس-إيثيل كانت ١١,٥ميكروجرام / كجم لمعاملة الحقن، في حين كانت ٠,٩ ميكروجرام / كجم لمعاملة الرش الورقى. وتم خفض متبقيات مبيد الكلوربيريفوس المكتشفة خلال الفترات الزمنية بنسبة ٩٥,٢٪ بعد ٣٠٠ يوم من تطبيق المعاملات. فضلا عن استخدام طرق التصنيع الغذائى التي أدت الى أنخفاض متبقيات مبيد الكلوربيريفوس بنسبة ٤٥,٨٪، والتي ظهرت بمستوى آمن أقل من قيمة مؤشر الخطر (HI).