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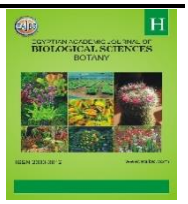

Effects of Pesticide Treatments on The Fatty Acids of Egyptian Cotton Seeds Giza 86 Variety

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ABSTRACT

This investigation aimed to detect the pesticide residues in cotton seeds and effects of these pesticide residues on fatty acids of the organic cotton seeds Giza 86 variety and treated cotton seeds Giza 86 variety harvested from the experimental plots and cultivated during the seasons 2017 and 2018. Gas chromatography (GC) with flame photometry (FPD) was used in determining residual pesticides and changes in fatty acids. Fatty acids were determined using GC/Mass spectrometry. Results indicated the existence of detectable residues of the insecticide Chlorpyriphos in treated cottonseeds Giza 86 variety (conventional samples) in both seasons 2017 and 2018 at the range of 1.11 ppm, and 1.14 ppm for Chlorpyriphos, and 6.51 ppm, and 5.30 ppm for Profenophos. The resulting values were hazardous and toxic according to Maximum residue levels (MRLs). The results revealed an increasing value of Myristic acid in the organic Giza 86 at 2.74% than the treated variety at 1.13% and evanescence of the Pentadecanoic acid (C15:0) in the inorganic variety. Palmitoleic acid (C16:1 w9), Hexadecatrienoic acid (C16:3w4), linoleic acid (C18:3 w3), Arachidic acid (C18:3 w3), and Docosenoic acid (C22:1 w 11) appeared in the treated variety Giza 86 with disappearance in the organic variety. Decreasing the value of Stearic acid (C18:0) from 6.34% in the organic Giza 86 to 3.91% in the treated variety. Vaccinic acid (C18:1 w7) was decreased from 1.68% (organic Giza 86) to 0.93% (treated Giza 86), and oleic acid (C18:1w9) from 31.14% (organic Giza 86) to 24.26% (treated Giza 86). Contrariwise, the fatty acid Linoleic acid C18:2w6 increased from 31.45% in the organic Giza 86 to 42.20% in the treated Giza 86 and also slightly increased the value of Palmitic acid (C16:0) at 24.39% in the treated variety Giza 86 than 24.14% in the organic variety.

INTRODUCTION

Cotton is considered one of the most economical crops in Egypt, Egyptian cotton fiber has been exported worldwide due to its unique properties for the textile industry. The

other consumer product of cotton is edible oil which is extracted from cotton seeds for human consumption. Additionally, the appreciation for its fibers, the extracted seed cake is used for feeding livestock. Several insects specifically cotton leafworms attack cotton crops. The dominant *spodopteralittoralis* is one of the most serious pests of cotton plants. Pesticide control represents a security valve against most cotton pests (Battu, R. S. *et al.*,2009). Obviously, chemical control is an effective trend against both eggs and larvae of leafworms. As mentioned by Hassan *etal.*2014, the detrimental elements in the efficacy of chemical control processes are the form and the rate of the insecticide used for controlling cotton leafworm infestation.

Nowadays, Annually, around 2.5 million tonnes of insecticides are utilized, and more than 500 registered active substances according to Esther Turiel and Antonio Martín-Esteban (2008). Pesticides are known as toxic compounds that may cause adverse effects on the environment, the most important groups of them are Benzoylureas, organophosphorus compounds, and Pyrethroids (Alder, L; K. *et al.*, 2006). According to WHO, up to 2.5 million people globally suffer from acute pesticide poisoning, and more than 0.2 million people die each year. Organophosphorus pesticides account for more than half of all pesticide residues found in the environment. CPF pesticide primarily affects three types of people: workers who make these chemical concoctions, farmers, and consumers. (George, N.; *et al.*, 2014 and Tudi, M.;*et al.*, 2022), and unaware consumers who ingest pesticide-contaminated food, culminating in the declaration of definite restrictions validated through the European Commission (EC), including pesticide authorizations or trade licences being granted or removed from usage. After Chlorpyrifos insecticide, Profenofos is a broad-spectrum non-systemic and foliar organophosphate insecticide used to control Lepidoptera and mites on cotton, maize, sugar beetroot, soya beans, potatoes, tomato, vegetables and other crops (MacBean, C. 2012). It was developed to control a wide range of insect pests that are resistant to Chlorpyrifos and other organophosphate insecticides mentioned by Jabeen H. L.*et al.*(2015). The main aim of this research was to study the Effect of pesticides on fatty acid content in the seed of Giza 86 Egyptian cotton variety.

MATERIALS AND METHODS

1.Plant Samples:

Egyptian cotton seed variety Giza 86 was cultivated during the season 2017-2018. The samples were obtained from the cotton research institute, in Giza, Egypt, and organic cotton cultivated at the same season from Gemeza station, Delta, Egypt. The official spraying program of the Ministry of Agriculture against cotton pests was achieved.

2.Methods:

2.1. Pesticide Residues Using Gas Chromatography-Mass Spectrometery (GCM):

Determination of pesticide residues in seeds was carried out at the Pesticide Residues and Environmental Pollution Department., Central Pesticides Laboratory, Agricultural Research Center, Giza, Egypt, using (GCMS) according to the method described by Nguyen, *et al.* (2008). The gas chromatography used was a Hewlett Packard GC Model 6890 equipped with a Ni 63 electron capture detector.

2.2 Determination of Fatty Acids:

Saturated, unsaturated and total fatty acids determinations were carried out at the Regional Center for food & feed, Agricultural Research Center by GC/Mass spectrometry. The oil of organic cottonseeds and treated cottonseeds of Giza 86 variety were extracted and saturated, unsaturated and total fatty acids were determined by using methyl esters boron trifluoride method (AOAC 2000). The oil is saponified with sodium hydroxide in methanol. The fatty acids are methylised with boron trifluoride in methanol, extracted with heptane and determined on a Gas chromatography with FID detector (PE Auto System XL) with auto

sampler and Ezchrom integration system. Carrier gas (He); ca. 25 Psi-air 450 ml/min – Hydrogen 45 ml – split 100 ml/min. oven temperature 200° C injector and detector 250° C.

RESULTS AND DISCUSSION

In this study, the long-staple Egyptian cotton variety Giza 86 was used selectively for its advantages. Known as the most common variety used in Egyptian agriculture. The moisture content of Giza 86 ranged from 9.98 %to 12.68 %, the fat percentage was 19.23 %, the protein percent of Egyptian cottonseed Giza 86 was 25.55 %, the Crude fibers content was 14.36 % and the Ash content was 4.19 %, and the Total carbohydrates percent was 25.71 according to the previous study by (Othman *et al.*,1985 and Lukonge, *et al.*,2007).

1. Pesticides Residues in Cottonseeds:

This investigation aimed to detect the insecticide residues in cottonseeds of organic Giza 86 and treated Giza 86 which were harvested from the experimental plots and cultivated during the seasons 2017 and 2018. The results in Table 1 showed the residue levels in cottonseeds. The results detected the residues of Chlorpyriphos in conventional samples in both seasons 2017 and 2018 at the range of 1.11 ppm, and 1.14 ppm and residues of Profenophos in the range of 6.51 ppm and 5.30 ppm. These results consented with those obtained by Abd-El Rahman *et al.* (2015) recorded Profenofos residues in cottonseed samples. Gas chromatography (GC) with flame photometry (FPD) was used in that study. The groundwater-contaminating organophosphorus insecticide Profenofos is slightly soluble in water (20.0 mg/L), and its half-life in the soil is about one week according to Tomlin 1994, due to that it is a better choice for spray compared to organochlorines, which are more persistent in the environment. The other insecticide residues (Lambda Cyhalothrin, Deltamethrin, Cyopermithrin, Prothiophos, Imidacloprid, Ethion Chlorpyriphos-methyl and Lufenuron) were not found in the treated cottonseeds. These values were hazardous and toxic according to MRLs (Maximum residue levels). On the other side, concerning the seed of the organic cotton no detectable residues of the insecticide were observed in both seasons 2017, and 2018. These results are in agreement with those reported by FAO/WHO (1998). The toxic effects of Chlorpyrifos on food and the environment made the organizations (United States Environmental Protection Agency (US EPA), the European Food Safety Authority (EFSA), and European Commission (EC)) that work on the regulation of human risk assessment publish several reports for warning. Notably, the risk profile data for Chlorpyrifos was analyzed. Only 1% of the Chlorpyrifos reaches the target pest and the remainder comes into contact with soil (Lu, C.; *et al.*, 2020). Chlorpyrifos is absorbed by soil and leached poorly from soils because of its difficult solubility in water as mentioned by Jaiswal *et al.* (2017) and Huang *et al.* (2020). Furthermore, it has affected the soil microflora population and inhibited the cycling of important soil nutrients, especially nitrogen fixation by bacteria (Sarnaik, S.S.;*et al.*, 2006 and , John, E.M.; Shaike, J.M. 2015).

Table 1: Pesticide residues in organic and treatment cottonseeds Giza 86 cotton, (Seasons 2017 - 2018).

Pesticides	Giza 86				LD50 oral (ppm)	MRL (ppm)
	Season 2017		Season 2018			
	O (ppm)	T (ppm)	O (ppm)	T (ppm)		
Chlorpyriphos	ND	1.11	ND	1.14	64	0.05
Profenophos	ND	6.51	ND	5.30	358	3
Lambda Cyhalothrin	ND	ND	ND	ND	5-50	0.2
Deltamethrin	ND	ND	ND	ND	87	0.5
Cyopermithrin	ND	ND	ND	ND	287	0.2
Prothiophos	ND	ND	ND	ND	925	-
Imidacloprid	ND	ND	ND	ND	424	1.0
Ethion	ND	ND	ND	ND	208	0.02
Chlorpyriphos-methyl	ND	ND	ND	ND	2814	0.5
Lufenuron	ND	ND	ND	ND	208	0.02

ND = Non-detectable, O (Organic) and T (Treated).

LD50: the standard measure of the toxicity of a material that will kill half of the sample population of a specific test animal in a specified period through exposure via ingestion, skin contact, or injection.

2.**Fatty Acids of Cottonseed of Giza 86 Variety**:

The prevalent saturated fatty acids of cottonseed oils of Giza 86 variety were palmitic acid (C16:0) and stearic acid (C18:0) Concerning unsaturated fatty acids of cottonseed oils, linoleic acid C18:2, and oleic acid C18:1 are the predominant unsaturated fatty acids in cottonseed oils (Lukonge, *et al.,* 2007). According to Isaac and Ekpa(2013), cottonseed oil contains fatty acids such as Palmitic acid (22.9 %), Myristic acid (0.6 %), stearic acid (2.2 %), linoleic acid (49.7 %), and Oleic (24.7 %). Remarkable changes in the fatty acids values were recorded in Table 2, showing an increase in the value of Myristic acid in the organic Giza 86 at 2.74% than the treated variety at 1.13%. The disappearance of the Pentadecanoic acid (C15:0) in the inorganic variety. Obviously, the other fatty acids appeared as Palmitoleic acid (C16:1 w9), Hexadecatrienoic acid (C16:3w4), linoleic acid (C18:3 w3), Arachidic acid (C18:3 w3) and Docosenoic acid (C22:1 w 11) in the treated variety Giza 86 with disappearance in the organic variety. Notably, the value of Stearic acid (C18:0) decreased from 6.34% in the organic Giza 86 to 3.91% in the treated variety. Also, vaccinic acid (C18:1 w7) was decreased from 1.68% (organic Giza 86) to 0.93% (treated Giza 86), and oleic acid (C18:1w9) from 31.14% (organic Giza 86) to 24.26% (treated Giza 86). Conversely, the fatty acid Linoleic acid C18:2w6 increased from 31.45% in the organic Giza 86 to 42.20% in the treated Giza 86 and also slightly increased the value of Palmitic acid (C16:0) at 24.39% in the treated variety Giza 86 compared than 24.14% in the organic variety. Some pesticides significantly affected the chemical components of some plants after use as reported by several authors Radwan (1988); Habiba *et al.* (1992); Ismail *et al.* (1995); Radwan *et al.* (2004); and Shalaby (2016).

Table 2: Effect of pesticide treatment on fatty acids content of Giza 86 cotton variety

Fatty Acids	Name	Relative distribution	
		Giza 86 Organic	Giza 86 Treatment
C12:0	Lauric acid	-	-
C14:0	Myristic acid	2.74%	1.13%
C15:0	Pentadecanoic acid	2.51%	-
C16:0	Palmitic acid	24.14%	24.39%
C16:1 ω9	Palmitioleic acid	-	1.54%
C16:3 ω4	Hexadecatrienoic acid (hexagonic)	-	0.23%
C18:0	Stearic acid	6.34%	3.91%
C18:1 ω9	Oleic acid	31.14%	24.26%
C18:1 ω7	Vaccinic acid	1.68%	0.93%
C18:2 ω6	Linoleic acid	31.45%	42.20%
C18:3 ω3	Linoleic acid	-	0.34%
C20:0	Arachidic acid	-	0.32%
C22:0	Behenic acid	-	-
C22:1 ω11	Docosenoic (cetoleic)	-	0.62%
Non-identified fatty acid		Zero	0.13%

Conclusion

This study was conducted to provide important information about the contamination of cottonseed Giza 86 with pesticides collected from the experimental plots and cultivated during the seasons 2017 and 2018. Although there were significant levels of pesticides specifically Chlorpyriphos and Profenophos, the estimated samples exceeded the Maximum residue levels (MRLs). These results were reflected in the changes in fatty acid contents in cottonseed, based on this study, the application of conventional pesticide programs must be constantly monitored and guide the farmers to increase their awareness of the safe use.

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