Detection of post-harvest insecticide Flash 10% EC residues in wheat seeds and soil after its degradation by the UV-C

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DOI: https://doi.org/10.36077/kjas/2023/v15i2.3679

Received date: 5/6/2022

Accepted date: 14/7/2022

Abstract

This study aimed to test the effect of the physical factor (UV-C) in degrading insecticide Flash residue in post-harvest wheat seeds and soil. As for Flash residual in the soil, the highest concentration (3.10 ppm) was detected in seeds produced from plants treated with UV-C untreated Flash, while the lowest concentration (below the detectable level) was in the wheat seeds from plants sprayed with UV-C treated Flash. As for Flash residual in the soil, the highest concentration was 12.50 ppm detected in uncultivated soil treated with Flash untreated, while the lowest residue (0.00 ppm) was in wheat-planted soil treated with UV-C treated Flash. Findings also showed that exposing the insecticide to UV-C for 20 min resulted in the best degradation rate.

Keywords: Detection, post-harvest, Flash, UV-C

Introduction

Estimating pesticides in food and products is extremely important in the success of successful trade strategies in developed countries and developing countries alike (6). As for Iraq, the study of the remains of chemical pesticides is a very important issue, and in most developing countries, most farmers do not adhere to the recommended concentrations or the waiting period after treatment to ensure the eligibility of the product for consumption (1). Despite the efficiency of pesticides in controlling pests, the remains of these pesticides in the soil may affect the subsequent crops, low growth and, production of crops (4). Also, the information on modern pesticides in this regard may not be sufficient or unconfirmed unless they are studied in independent research institutions.

Ultraviolet ray is an electromagnetic wave with a wavelength shorter than visible light. The wavelength of violet is the shortest among the colors of the spectrum with a length ranging from 100 - 400 nm. In regards to the environment, UV radiation has been suggested as an effective means for removing residual herbicides from water (7). Most pesticides absorb relatively short visual ultraviolet radiation, and direct radiation leads to the electronic excitement of the organic matter in the pesticide. This excitement leads to a transformation from the intruded individual state through internal systems to True let State, which is more likely to decompose. The absorption can be obtained by the wavelength (250-300) nm. The photolysis of the UV rays is determined by some factors including, water molality, polarity, absorption coefficient, violet light absorption, water pH, and water solubility (12). Some studies have indicated the use of direct and indirect optical decomposition of ultraviolet radiology with the aim of reducing pesticide residues such as Diuron and Atrazine (13). However, there is few research on the use of these methods to process the remaining pesticides used widely in agriculture, amitrole (AMT), Fluroxypyr (FLX), or Clopyralid (CLP) (2).

The study (11) indicated that jungle pesticides are initially decomposing into secondary products with low molecular weights, then later turn into carbon dioxide in the presence of UV rays. These results indicate the possibility of completely destroying the pesticide and getting rid of its polluted effect this depends on the type of pesticide and formula. This study aimed to test the effect of the physical factor (UV-C) in breaking down the insecticide Flash 10% EC residues in wheat seeds and treated field soil.

Materials and Methods

The insecticide used in the study

Flash 01% EC insecticide with active substance alphacypermethrin 10% and is from the Synthetic Pyrethriodes Insecticides. The pesticide is used as a foliar spray to control insect pests. The Flash 10% EC (Tagros Chemicals India) was obtained from the Abbasid Agriculture Division in the Najaf Agriculture Directorate and was used by the recommended dose, which is 35 - 40 ml/ 100 liters.

A 10 mL of Flash 10% EC insecticide without dilution was placed in test tubes with a total capacity of 20 mL and then exposed to the UV rays for 10 and 20 minutes. Meanwhile, the control remained without UV exposure. The suitable exposure time was determined based on the results of the spectrophotometer, which in nature depends on the property of the compound to absorb light in the ultraviolet or infrared wavelengths. The light absorption curve was performed based on direct proportion between the duration of absorption (absorption) and pesticide concentration. Then, the sample readings were compared with the samples that contained the pesticide at the recommended dose and were not exposed to radiation to determine the amount of the pesticide self-degrading (3).

Hood has been used with a wavelength candle of 254 nanometers and radiological energy of 99.52 watts/ m2 and with a capacity of 25 watts. The transactions included the use of Flash 10% EC without exposure or UV exposure for 10 or 20 minutes. The results of pesticides exposed to radiology have been adopted for 20 minutes depending on the results of HPLC.

Field experiment

The experiment was carried out on 25.11.2020 in Abbasiya district / Najaf governorate / Iraq in the area of 2 dunums. Each dunum is planted with the wheat plant that is treated with the insecticide Flash10% EC. The insecticide Flash10 % EC residues in the seeds and in the soil after the harvest were compared between the exposed and not exposed to UV-C. The effectiveness of treated and untreated insecticides was also evaluated on wheat aphids based on the rate of infection and severity.

A 100 g sample was taken randomly for individual units to study the pesticide residues. The process of collecting samples was carried out according to a set schedule and in coordination with the Sample Analysis Laboratory of the Food Contamination Research Center / Ministry of Science and Technology. Special gloves were used for each sample to avoid contamination with additional amounts of pesticide from other samples. The samples were placed in completely closed paper bags and sent for analysis and detection of pesticide residues inside the wheat seeds by HPLC device.

Results and Discussion

UV-C efficiency in degrading the insecticide Flash 10% EC measured by Spectrophotometer

The results showed that treatment of the pesticide with UV-C significantly affected the number of breakdown residues of the used pesticides compared to the pesticide without exposure to radiation (Table 1). The exposure of the pesticide to radiation for twenty minutes

Table 1. Effect of UV-C exposure for different periods on active compounds concentration of insecticide Flash 10% measured by spectrophotometer

Treatment	Exposure period	
	10 mn	20 mn
UV-C	0.01	0.005

Control	1.55

This led to higher destruction of the pesticide compared to exposure for ten minutes. The photolysis process is one of the most important factors that determine the fate of pesticides, and pesticide breakdown processes may lead to the formation of compounds that are less or more toxic than the original compounds when pesticides are exposed to ultraviolet rays. The results were taken based on thin-layer chromatography and gas chromatography. Photo-lysis is one of the factors that determine the fate of pesticides and leads to the formation of less or more toxic compounds than the original compounds. It was found that pesticides can be degraded when exposed to UV rays, according to the results of HPLC. Four types of pesticide degradation have been identified, which are either due to chlorine loss, chemical bonds split, salt removal, or because of the opening of the ring in the last stages (9).

Determination of the flash residues in the wheat seeds and soil

The results indicate (Table 2) that the highest concentration of the active substance in the seed was 3.10 ppm and reached the plant soil at 10.6 ppm. From the results, there was a higher significance in the control treatments (Flash untreated with UV-C) compared to the lowest concentrations (below the detection level) have been shown in the treatments of UV-C treated insecticide.

Table 2. Effect of UV-C on insecticide Flash 10% EC residue in wheat seeds and soil

Treatments	Flash 10% EC concentration ppm	
	UV-C+Flash	Flash
Wheat seeds	0.00	3.1
Soil	0.00	10.6

Kiss and Virág (10) reported that the pesticide residues were reduced by 57% on apple and pear fruits by using ultraviolet radiation at a wavelength of 253 nm for one minute. Ultraviolet and infrared rays are also used to destroy various pesticide residues by 89-99% in pesticide - contaminated water (8). It was confirmed (14) that Photo-stimulation is suitable for the decomposition of pesticides in aqueous solutions and in general on three groups of pesticides: herbicides, insecticides, and fungicides. As shown by the study applied by Al-Ghazi *et al.*(5) they confirmed that the decomposition of five chemical pesticides in underwater treatment conditions, treating polluted water with ultraviolet radiation for 80 minutes led to an increase in the toxicity reduction rate from 33.7% to 74.8%.

Effect of UV-C treatment on the efficiency of the pesticide in controlling aphids (infestation and severity) in the field

The results (Table 3) showed that the UV-C-treated Flash led to a higher mortality rate in wheat aphids than the untreated Flash treatment. Plants treated with UV-C

treated insecticide showed an infection rate of 34 % and severity of 19.75, compared to 15.15 % and 9.75 from plants treated with the untreated Flash. The results also showed a decrease in infection and severity rates over time after treatment. As a result of the widespread and large spread of these species in the irrigated wheat fields of central Iraq and southern Iraq, pesticides must be used, observance of adherence to safety conditions and the recommended dosage, and study of the impact of their residues on the environment.

Table 3. Effect of UV-C treatment on the efficiency of the pesticide in controlling aphids (infestation and severity) in the field

Treatments (Insecticide Flash 10% EC)	Infection rate (%) at different sampling dates					Infection severity (%) at different sampling dates				
	Pre-spraying	1 DPT	3 DPT	6 DPT	Average	Pre-spraying	1 DPT	3 DPT	6 DPT	Average
Flash only	37.00	35.00	33.00	31.00	34.00	21.00	13.00	4.00	1.00	9.75
UV-C treated Flash	30.00	16.28	9.14	5.21	15.15	20.00	14.00	6.00	2.00	10.5
Average	33.50	25.64	21.07	18.10		20.33	15.33	9.66	8.00	
L.S.D. ($P \leq 0.05$)	Treatments	Dates		Interaction		Treatments	Dates		Interaction	
	1.090	0.771		2.180		14.150	10.010		28.300	

*Values are means of 3 replications (ten plants each), DPT is referring to day's post-treatment

Conflict of Interest

The authors have no conflict of interest.

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