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Monitor of Acetochlor Herbicide Residues in Soil Under Maize at Abukebir District, Sharkia Governorate, Egypt

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ABSTRACT

Maize belongs to the most important crop in Egypt. All parts of the crop can be used for food and non-food products. Maize is largely used as livestock feed and as a raw material for industrial products. The maize is infested with weeds. The chloroacetamide herbicide acetochlor is used for pre-emergence control of annual grasses and broadleaf weeds in maize. The experiment was carried out at the private farm Abukabier districts, Sharkia Governorate, Egypt, during April 2020 summer season. The soil samples were taken from the soil, thenceforth transferred to the laboratory experiments, at plant protection research station, Qaha, Qaliobia Governorate, to extraction and clean-up procedures. The residues were determined using HPLC. The purpose of this work was to monitor acetochlor herbicide residues in soil under maize at Sharkia Governorate, Egypt. The results showed residues of acetochlor in the soil after 24 hrs of spray, 5,10,15,20,25 and 30 days, respectively. The data illustrated that acetochlor residues recorded 0.12 ppm after 24 hrs such amount decreased gradually by time, recorded 0.1, 0.04, 0.03, 0.02, 0.01 and 0.005 after 5, 10, 15, 20, 25 and 30 days, respectively. Dissipation percentages of acetochlor were recorded at 16.66 % after 5 days. while after 10,15,20, 25 and 30 days recorded 66.7 % ,75.00 %, 83.3 %, 91.7 and 95.8 dissipation % , respectively. the highest dissipation percentages were noticed in the 20^{th} 25^{th} and 30^{th} days from the spray. Also, the results showed that the slope of acetochlor was 0.04, the rate of degradation was 0.09 and the half-life of acetochlor was recorded 7.7 days after spray.

INTRODUCTION

Maize belongs to the most important crop in Egypt. All parts of the crop can be used for food and non-food products. Maize is largely used as livestock feed and as a raw material for industrial products. Protection of maize against weeds is equally important (Gołębiowska 2008). The chloroacetamide herbicide acetochlor [2-chloroN-(ethoxymethyl)-N-(2-ethyl-6-methylphenyl)- acetamide] is used for pre-emergence control of annual grasses and broadleaf weeds in maize. Acetochlor is a common herbicide used worldwide. Previous studies based on sorption and degradation experiments showed that acetochlor presents a risk of soil contamination (Zhou et al. 2012, Chao et al. 2007). The pollution of plant, soil, surface and groundwater by herbicides involves a serious risk to the environment and also to human health due to direct exposure or through residues in food and

drinking groundwater. The use of agricultural chemicals inevitably raises questions about the fate of the active substance and its degradation products in the environment as well as their effects on ecologically sensitive areas close to agricultural fields (Triantafyllidis et al. 2009, Łozowicka et al. 2012). Processes like chemical degradation, degradation by soil microorganisms, sorption and binding by organic and mineral components, uptake by plant roots and volatilization determine pesticide behavior in soil. Evaluation of the persistence in topsoil is fundamental in the assessment of the fate and behavior of all chemical substances, including active ingredients in plant protection products. The t 1/2 (dissipation time; time required for 50% of the initial pesticide concentration to dissipate) under field conditions should be less than 3 months unless there are no unacceptable effects on terrestrial organisms and plants (Boesten 2000). The purpose of this work was to monitor acetochlor herbicide residues in soil under maize at Sharkia Governorate, Egypt.

MATERIALS AND METHODS

Field Experimental:

The experiment was carried out at the private farm, Abukabier districts, Sharkia Governorate, Egypt, during April 2020 summer season. The area of maize was 1/2 faddan (2100 m^2), the area was divided into 10 plots, two treatments distributed on area, the first treatment acetochlor and the second treatment control at a private farm. Each plot was 200 m^2, area of 1 m^2 left among every two plots as a barrier or belt to prevent drift between treatments. where acetochlor (Harness 84% EC) was applied to the soil surface at a rate of 1L./fed for controlling annual weeds. acetochlor (Harness 84% EC) was applied to the soil surface at 1.7 Litre /Fadden. , according to the recommended rate of the ministry of Egyptian agriculture. knapsack sprayer used to the application (dorsal motor), application by using acetochlor beginning after direct seeding and after irrigation about three days. Soil samples were 1000g / plot were taken before spray and after spray by 24 hrs., 5, 10, 15, 20, 25 and 30 days from the spray. The soil (medium silt loam) was collected from the private farm and transferred to the laboratory experiments, at plant protection research station, Qaha, Qaliobia Governorate from the upper soil layer (0–15 cm depth) from 5 sites / replicate from the soil. Soil (control) was free from acetochlor residues (not detected) and is representative of the maize-growing regions. The soil was irrigated with Nile water. Soil samples were transferred into 90 mm diameter and 85 mm height pots that were placed in deepfrizer at – 18 O^c until extraction and clean-up.

Laboratory Studies:

Extraction Procedure:

Soil samples (1000g) were extracted and cleaned up according to (Đurović et al.2008) Soil samples were 5 kg. soil/treatment was taken from the soil surface at depths 5, 10, and 15 cm, respectively. Soil samples were good mixing thenceforth 20 grams of soil were taken to the extraction and clean-up procedures at the laboratory. A soil sample (20g) was put into a 250 ml conical flask with a 90 ml acetone subsequently, the samples were shaken with shaker apparatus for 10 minutes, henceforth filtrated through watman paper 1 with 5 g anhydrous sodium sulphate. The extracts volume was calculated and evaporated with a vacuum rotary evaporator at 45 ^oC on a water bath until dryness. The diluent was diluted by adding 5 ml acetone to clean up the procedure.

Clean-up of Acetochlor from Soil Samples:

Clean-up procedure conducted using thin-layer chromatography (TLC) glass plates (20 × 20 cm.) which coated with silica gel GF 254. After the silica gel was dispersed in distilled water at 1: 2 w. / v. fribos applicator was used for coating the glass plates with a thin layer (0.25 mm thickness), then the plates were put in an oven adjusted 110 $^{\circ}C$ for one

hour. An aliquot of the concentrated extract was spotted on the plate at a distance of 3 cm from the lower edge. The standard active ingredient from acetochlor was also spotted on the same plate in order to define the flow rate (RF) values. The plates were developed in hexane: acetone (12: 4 V./V.) with ascending method then exposed to U.V. light in order to detect the spots of the authentic sample to calculate the RF values of the tested acetochlor. The spots were scraped from the plate and the acetochlor residues were extracted by acetone using a centrifuge. The solvent was then decanted and evaporated to dryness. The residues were determined using HPLC.

HPLC Conditions:

Supernatant per samples transferred with acetonitrile before HPLC in Mobile phase acetonitrile :water (60:40 ml), flow rate 210 nm, Injection value = 10ul, Detector C18)Hypersil BDs) (250 mm× 4.6 mm), RT= 9.6-9.7 .

Rate of degradation (K) = 2.303 × slope .

Half –life period (t 1/2) = 0.693 / k (Gomaa and Belal, 1975).

RESULTS AND DISCUSSION

Residues of Acetochlor in the Soil After Spray During 2020 Summer Season till Maize Crop:

Data in Table (1) and Figure (1), show residues of acetochlor in the soil after 24 hrs of spray, 5,10,15,20,25 and 30 days, respectively. The data illustrated that acetochlor residues recorded 0.12 ppm after 24 hrs such amount decreased gradually by time, recorded 0.1, 0.04, 0.03, 0.02, 0.01 and 0.005 after 5, 10, 15, 20, 25 and 30 days, respectively. Dissipation percentages of acetochlor were recorded at 16.66% after 5 days. while after 10,15,20, 25 and 30 days recorded 66.7 % ,75.00 %, 83.3%, 91.7 and 95.8, respectively. the highest dissipation percentages were noticed in the 20th 25th and 30th days from the spray. From the same table and Fig. the results showed that RF value was 0.55, the slope of acetochlor was 0.04, Rate of degradation was 0.09 and the half-life of acetochlor was recorded 7.7 days after spray, these results were agreement with (Mills *et al.* (2001), Xiao *et al.* (2006) , La zic *et al.* (2013), Oliveria *et al.* (2013), Tan *e al.* (2014), Cara *et al.* (2017), Saleh *et al.* (2017) and Li *et al.* (2018).

Table 1: Acetochlor Residues in soil under maize, slope, rate of degradation (K), 1/2 and rate flow during 2020 summer season.

Treatment	Residues of acetochlor after application														Slope	K	T 1/2	RF
	Hr.24		5 Days		10 days		15 days		20 days		25 days		30 days					
	ppm	Diss %	ppm	Diss %	ppm	Diss %	ppm	Diss %	Ppm	Diss %	Ppm	Diss %	ppm	Diss %				
Acetochlor	0.12	0.0	0.1	16.66	0.04	66.7	0.030	75.0	0.02	83.3	0.01	91.7	.005	95.8	0.04	09	7.7	0.55
MRL	0.05	-	0.05	-	0.05	-	0.05	-	0.05	-	0.05	-	0.05	-	-	-	-	-

Ppm= part per million

MRL = Maximum residue limit

Diss % = Dissipation

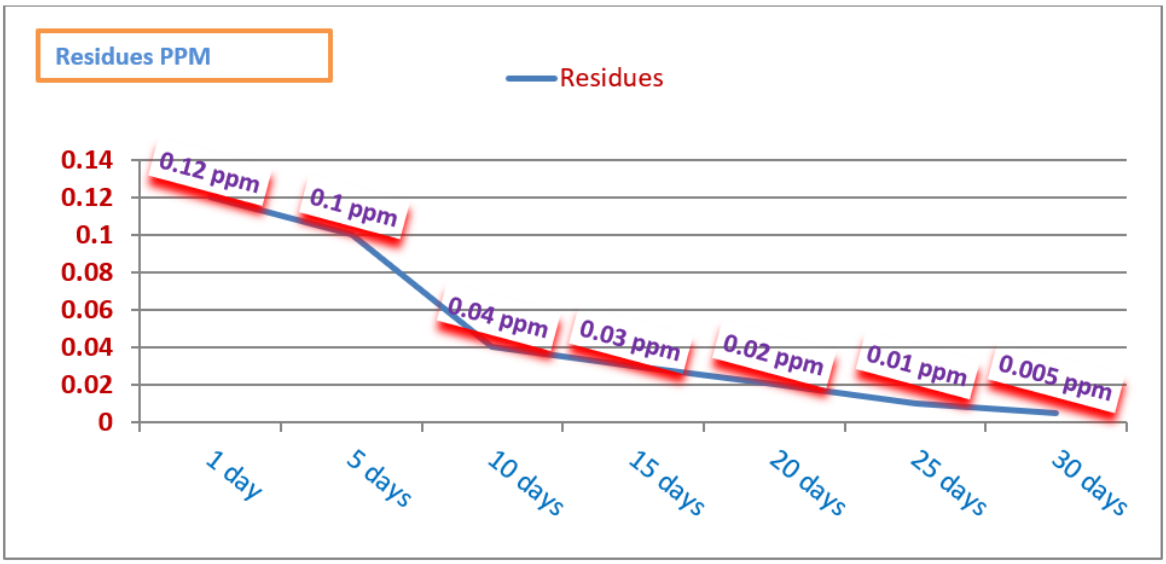

Fig.1: Acetochlor Residues in Soil under maize during 2020 summer season.

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