Egyptian Veterinary Medical Society of Parasitology Journal

Original Article

Effect of herbicide , Acetochlor on population of oribatid mites (Cyrptostigmata) and its residues in soil

Amal A. Abbas[1]; Yassin, E. M.A.[1]; El-Sharabasy, H.M.[2] ; El-Bahrawy, A. F.[2] & Marwa S. Kamel [2]

1, - Plant Protection Research Institute, A.R.C., Dokki, Giza, Egypt.
2-Department of Plant Protection, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt

Corresponding author:
Dr. Marwa Samir kamel

E-mail: Marwa.samir@yahoo.com

Abstract:

The aim of this study was to assess the effect of herbicide, acetochlor on population of soil orbited mites in soil and residues of Acetochlor in soil after application. The experiment was carried out at a private farm at Diarb Nagim district, Sharkia Governorate during summer seasons 2018 and 2019,respectively. Where acetochlor (Harness 84% EC) was applied to the soil surface of rate1L/fed. For controlling of annual weeds. The percent reduction of oribatid mites numbers were 8.6, 30.67, 61.6, 50.98, 31.75, 18.55 and 12% after 1, 5, 10, 15, 20, 25 and 30 days in summer season 2018. In summer season 2019, reduction percentages reached 0.17, 20.22, 52, 40.59, 24.12, 4.86 and 4.05% after 1,5,10, 15, 20, 25 and 30 days. Dissipation % recorded gradually increasing by time. The residues of acetochlor in soil recorded 0.058 ,0.05, 0.038, 0.030, 0.016, 0.012 and 0.009 ppm after 1hr., 5, 10, 15, 20, 25 and 30 days, respectively The effect of the herbicide residue was observed on collected soil mites with Berlese funnels showed that acetochlor herbicide has played a great role in decreasing the activity of oribatida group. Our result indicated that acetochlor herbicide reduced population of oribatid mites group, which collected with Berlese funnel after application of acetochlor in corn system for a period of 30 days through 2018 and 2019 . This reduction may be as a result of less food availability (e.g. plant roots) and decreased green plant cover .

Keywords: *Oribatid mites*; Herbicide; Soil ; Cyrptostigmata & Acetochlor

INTRODUCTION

Group of Oribatid mites is one of the most important mites groups in soil. This group play roles in fragmentation of litter, soil formation, nutrient cycling and dispersal of microbes and stimulation of soil micro flora by grazing (Klompen, 2006) .Also micro arthropods, in such, The oribatid mites and Collembolans are the most abundant and diverse arthropods living in soil and litter environments (Sarath and Gupta, 1986 & Cockfield and Potter, 1983)..,Herbicides are causing public concern because of their implied short and long term risks for ecosystems and for human health (Pogăcean et al., 2009). Acetochlor is the active ingredient in several selective herbicides used for control of annual grasses and certain broadleaf weeds in corn (Zea mays L.) and it may have negative effects on non-target organisms such as oribatid mites. Hutangkabadee and Uyvirat, (1996). Furthermore different herbicides have different effects on the

abundance and diversity of soil micro arthropods. Stevenson,(1994) reported that micro arthropods populations were different under different types of herbicide treatments. Its mode of action of glyphosate is inhibiting the activity of enzymes that are necessary for the synthesis of proteins of the primary and secondary metabolism (Carlisle and Trevors, 1988). Other herbicide such as glyphosate (herbicide) mixed with surfactants detrimental, effects such as i.e., repellent, or neurotoxic to non-target organisms (Tsui and Chu, 2003). The aim of this study was to investigate effect of herbicide (acetochlor)on population of Oribatid mites and residues of acetochlor in soil after application.

MATERIALS AND METHODS

1. Herbicide

Acetochlor herbicide(2-cholor-n-(ethoxymethyl) –N-(2-ethyl-6-methylphenyl) actamide)

commen name: Acetochlor

Trade name: Acetop

Chemicalname:2-cholor-n-(ethoxymethyl)–N-(2-ethyl-6-methylphenyl) actamide. At a rate of 1 litre/Faddan (84%Ec).

2-Experimental design.

a-Effect of herbicide (acetochlor) on Populations of oribatid mites.

The experiment was carried out at Diarb–Nagm district, Sharkia Governorate, during two summer seasons of 2018 and 2019 respectively. Area of maize about 300 m2 ,divided into 6 plots distributed on two treatments i.e, acetochlor and control at a private farm. Each plot was 1/100 from faddan, three rows were left among each two plots as barrier or belt to prevent drift between treatments. where acetochlor 84% EC was applied to the soil surface at 1L./fed for controlling of annual weeds. acetochlor was applied to the soil surface. Kanabsac sprayer used to application (dorsal motor), application by using acetochlor beginning after seedling and before irrigation directly. Soil samples were 1kg / plot were taken before spray , while after spray by 24 hrs., 5, 10, 15, 20, 25 and 30 days from spray for mite extracting . Soil samples were transferred to the laboratory in polyethylene bags with rubber band to prevent mites escape and to avoid any loss in soil moisture each sample was exposed to a light source of 60 watt for 24hrs in the modified Berlese funnel and mites were caught in Perti-dish with water. Most of mite species were singly mounted directly in Hoyer's medium (Krantz, 1978) on microscope glass slides. The slides were gently heated to stretch mite individuals and hasten clearing process, then they were put for three days in a laboratory oven at 30ºc .Oribatid mites were separated, counted and preserved occur in 70% ethyl alcohol , after then lactic acid was used to clear the specimens before the slide mounting. The classification and identification of oribatid mites were carried out according to Balogh and Balogh (1992).

B-Residues of Acetochlor in soil after spray during 2019 summer season till maize crop. For determination of acetochlor residues soil samples was taken at the above mentioned intervals were collected and transferred to the laboratory in a polyethylene bags secured tightly with rubber band. Then soil samples were keeping in deep-freezer under -18 ºC until carried out extraction and clean – up.

3- Extraction and clean- up of acetochlor from soil samples.

soil samples were extracted and cleaned up according to(Đurović et al.(2008), Soil samples 3k g. soil / treatment was taken from

soil surface at depth 5, 10 and 15 cm, respectively. Soil samples were good mixing, thence forth thirty grams of soil were taken to the extraction and clean- up procedures at laboratory of Qaha, plant protection research station . A soil sample (30g) was soaked overnight in a 250 ml conical flask with a 90 ml acetone subsequently, the extracts were shaken for 10 minute on shaker apparatus and filtrated through watman paper 1 with 5 g anhydrous sodium sulphate . The extracts volume was calculate and evaporated with a vacuum rotary evaporator at 45 ºC on a water bath until dryness. The diluent was diluted by adding 6 ml aceton to clean up procedure .

clean- up:

Clean up procedure conducted using thin layer chromatography (TLC), used 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 ºC for one hour. An aliquot of the concentration 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 (7 : 3 V./V.) with ascending method, then exposed to U.V. light in order to detect the spots acetochlor and calculate the RF values of the tested herbicide. RF values of acetochlor were 0.5 cm. 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 were dilutes 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) was obtained from the following equation: t 1/2 = 0.693 / k (Gomaa and Belal , 1975) .

RESULTS

1-**Residues of Acetochlor in soil after spray during 2019 summer season till maize crop.**

Data in table (1) and Fig. (1), show residues of acetochlor in soil after 24 hrs of spray, 5,10,15,20,25 and 30 days , respectively . The data illustrated that acetochlor residues recorded 0.058 ppm after 24 hrs such amount decreased gradually by time , recorded 0.05, 0.038, 0.030, 0.016, 0.012 and 0.009 after 5, 10, 15, 20, 25 and 30 days, respectively. Dissipation percentages of acetochlor recorded 13.4% after 5 days. while after 10,15,20, 25 and 30 days recorded 34.48% ,48.27% , 72.41% , 79.31and 84.48 , respectively. The highest dissipation percentages noticed in 20th 25th and 30th days from spray. From the table and the same Fig. the results showed that slope of acetochlor was 0.04, Rate of degradation 0.09 and half-life of acetochlor recorded 7.7 days after spray. Maximum residue limites according to Eu was 0.05ppm, and from Table,noticed that maximum residue limit to acetochlor recorded 0.05 after5th day from spary, these results were agreement with(Mills et al. (2001), Xiao et al. (2006) and Cara et al. (2017).

1-1-Impact of Acetochlor on oribated mites .

a-Impact of herbicide (acetochlor) application on (non- target) population of oribatid mites in the summer season 2018:

Data tabulated in Table (2), show impact of acetoclor on population of oribatida group. The results of the statistical analysis showed that was a high significant difference between the acetolchlor treatment and the control in 10 and 15 days while the results showed low significant in 5 and 20days, but in the other days' rest, the results showed non-significant. The results recorded in 10 day (10±1.15) & (25±1.73) and Value of L.S.D was 5.779 , also, the results recorded 24±1.15& 47±3.21 of mites individuals in 15th day and L.S.D value was 9.483.The data illustrated that in 5th and 20th days, the results were as follows (13±0.57, 18±1.57& 4.533) and (34±2.30, 53±4.16 &14.096). In the case of acetolchlor treatment, control and L.S.D. value between them. The average number of oribatid mites were (68±1.15&71±4.93),(56±2.08&66±3.05)And (66±7.02&72±6.42) after 24 hrs. , 25th and 30th days from application, respectively.

B-Impact of herbicide (acetochlor) application on reduction percentage of oribatid mites in summer season2018:

The present results in Fig. (2) Shown impact of acetochlor on reduction percentages in population of oribatid mites during the summer season 2018. The results from Fig (1) show that reduction percentage recorded gradually increasing after application with 24 hrs,5 and 10th days, then recorded gradually decreased beginning 15 till 30th days from application. The results shown highest reduction percentage after application of acetochlor recorded 61.6% followed by 50.98%, 31.17%, 30.76%, 18.55%, 12% and 8.6% after 10,15, 20, 5, 25, 30 days and 24 hrs after application . The highest reduction peresentages of oribatida after 10,15, 20, 5, 25 and 30 days, while the lowest reduction peresentages after 24 hrs. of spray.

C-Impact of herbicide (acetochlor) application on (non- target) population of oribatid mites in the summer season 2019 : Data presented in Table (3) revealed that the average numbers of oribatid mites during 2019 summer season to acetoclor treatment and control. Interestingly, the results recorded high significant after 10th and 15th days from Acetochlor application, the data recorded (14±1.52 & 30±2.30) , (31±3.78 &54.3.05) individual and values of L.S.D were 7.687 & 12.506 respectively . On the other hand, there was low significant in the number of oribatid mite after 5th days from post treatment,where the number recorded 17±1.25& 22±0.57individual and L.S.D. was 4.533 after treatment , But, the statistical analysis recorded not significant 20,25,30 and 1th day as follow: (45±3.78 & 61±3.05) , (77±3.05 & 80±2.88) , (125±5.77&134±3.78)and(66±7.21& 68±3.51) after 20, 25, 30 and 1 days ,respectively, where noticed non-significant .

D-Impact of herbicide (acetochlor) application on reduction percentage of oribatid mites in summer season 2019 :

The results clarifier in Fig. (3) indicated that, after 24h from actochlor spray, results recorded grievous declining in reduction percentages 0.17%, thenceforth reduction percentage increased gradually until 10th days recorded 52.0% post treatment; while after,15, 20, 25 and 30 days the reduction percentages of oribatid mites decreased

gradually recorded 40.95, 24.12, 4.86 and 0.05%, respectively.

DISCUSSION

The findings of this study is supported by many previous studies, which indicated that herbicide (Acetochlor) on soil surface could effect on the soil mites (Zhon et al., 2012). This study detect an effect of acetochlor on oribatid mite populations in soil maize, Where the reduction % recorded 61.6% followed by 50.98%, 31.17%, 30.76%, 18.55%, 12% and 8.6% after 10,15, 20, 5, 25, 30 days and 24 hrs after application during 2018 and in 2019 summer season, reduction % recorded 0.17%,52.0% , 40.95, 24.12, 4.86 and 0.05%,after 24h, 10, ,15, 20, 25 and 30 days, respectively. Similar results were also observed by other authors, who reported that herbicide acetochlor used in the soil resulted in both qualitative and quantitative changes in soil animals by acetochlor transportation through soil , which directly influenced soil function, where Soil biological properties were an important index in indicating soil quality(LI Tao et al. 2009). Agree with (Minor and Norton, 2008) that reported that the effect of herbicide application on non-target (soil mites) cannot be generalized, with groups being differentially effect. Overall, Orbited mites were most influenced by herbicides, where explained that The cover crop residue had positive influence on both Gamasina and Oribatida; the negative impact of herbicides on Oribatida was an greatly mitigated by cover crop. Agree with(Al-Daikh et al ,2016)found that glyphosate herbicide was reduced on population of mites with 80% , also in insects caused in-48.8%, other arthropods -66.7% and total numbers-23.3% reduction. The herbicides significantly reduced of the oribatid mites. It non similarly with(Hoy and Shea, 1981) reported that chlorpyrifos generally had no significant effect on oribatid mites in pine forest litter. From my results I can concluded that acetochlor herbicide reduced in population of oribatida group. Whereas, it is noteworthy mentioning that considerable reduction effect was observed in mite populations collected with Berlese funnel after application of acetoclor in corn crop of this reduction may be as a result of reduced food availability (e.g. plant roots) and decreased plant cover. (Fox, 1964) who indicated that the abundance of soil invertebrates was affected primarily by decreases in vegetative cover from application of herbicides rather than acute toxicity or changes in floristic composition.

Table (1) :Acetochlor Residues in Soil under maize plants during 2019 summer season .

Treatments	Residues of acetochlor after application													
	24h.		5 Days		10 days		15 days		20 days		25 days		30 days	
	ppm	Dis%	ppm	dis.	ppm	dis.	ppm	dis.	ppm	dis.	Ppm	dis	ppm	dis
Acetochlor	0.058	0.0	0.05	13.4	0.038	34.48	0.030	48.27	0.016	72.41	0.012	79.31	0.009	84.48
MRL	0.05	-	0.05	-	0.05	-	0.05	-	0.05	-	0.05	-	0.05	-

Dis. = Dissipation% **Ppm**= Acetochlor Residue. **MRL**=Maximum residue limit of acetochlor in soil according to European unit and codex alimentary.

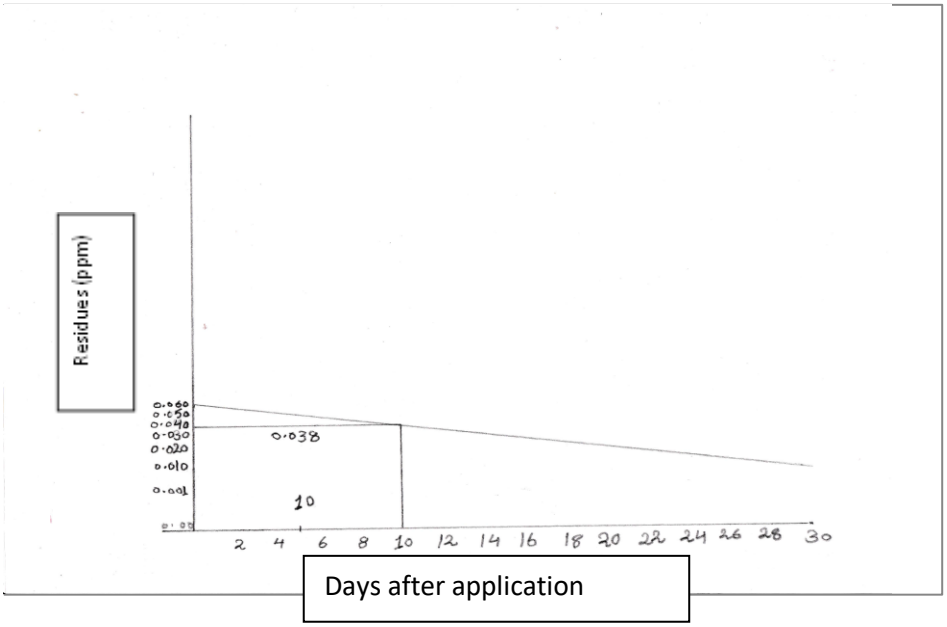

Fig.(1) Residues of acetochlor in soil after days of application.

Table (2) Average number of oribatid mites after acetochlor spray during 2018 summer season.

Days	Mean number of oribatid mites±S.D	control	L.S.D	F	P
1	68 ±1.15a	71±4.93a	14.06	0.350	0.585 ns
5	13 ±0.57a	18 ±1.57b	4.533	9.375	0.0376 *
10	10 ±1.15 b	25 ±1.73a	5.779	51.92	0.002 **
15	24 ±1.15 b	47 ±3.21 a	9.483	45.34	**0.002
20	34 ±2.30 b	53 ±4.16 a	14.096	13.038	*0.0225
25	56 ±2.08a	66 ±3.05a	10.26	7.31	0.053 ns
30	66 ±7.02a	72 ±6.42a	26.44	0.397	0.562 ns

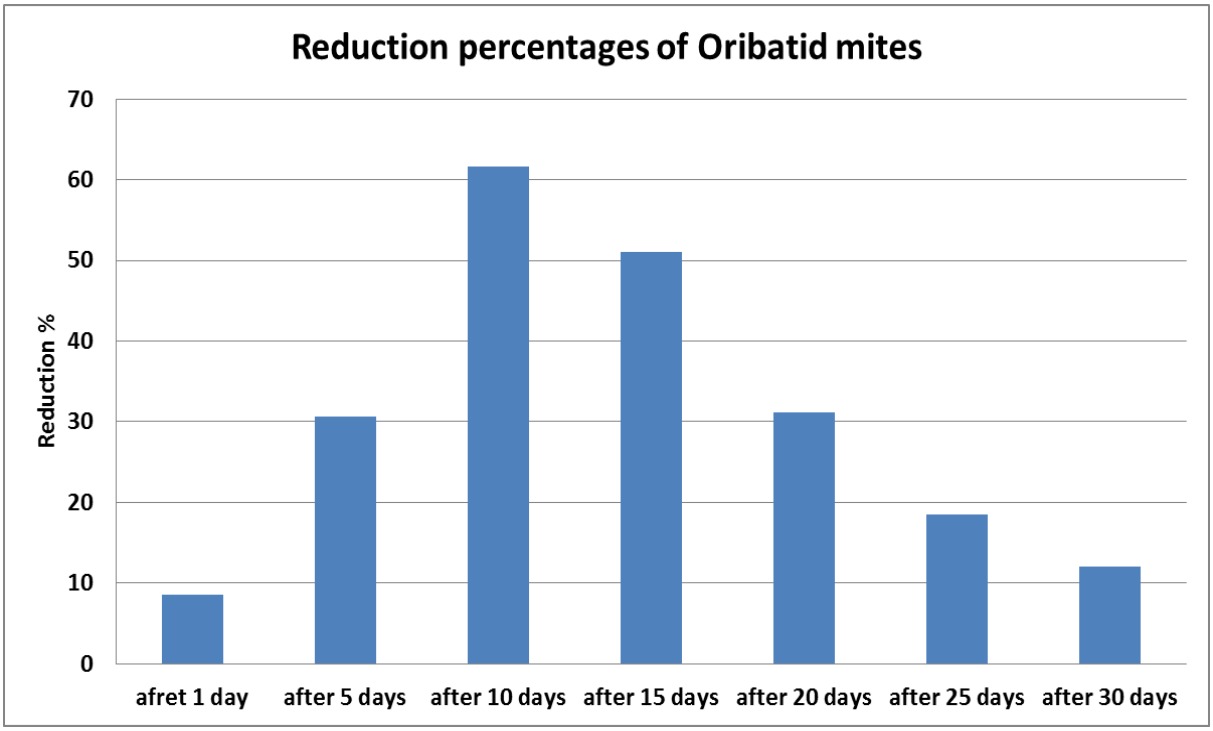

Fig (2) Reduction percentage of oribatid mites during 2018 summer season after acetochlor spray.

Table (3) Average number of oribatid mites during 2019 summer season after acetochlor spray .

Day	Mean number of oribatid mites	control	L.S.D	F	P
1	66±7.21a	68±3.51a	22.26	0.0621	0.8154 ns
5	17±1.52 b	22±0.57 a	4.533	9.375	0.0376 *
10	14±1.52 b	30±2.30 a	7.687	33.391	0.0045**
15	31±3.78 b	54±3.05 a	13.506	22.35	0.091 **
20	45±3.78a	61±3.05a	17.71	6.295	0.066 ns
25	77±3.05a	80±2.88a	17.76	2.037	0.226 ns
30	125±5.77a	134±3.78a	14.15	3.11	0.152 ns

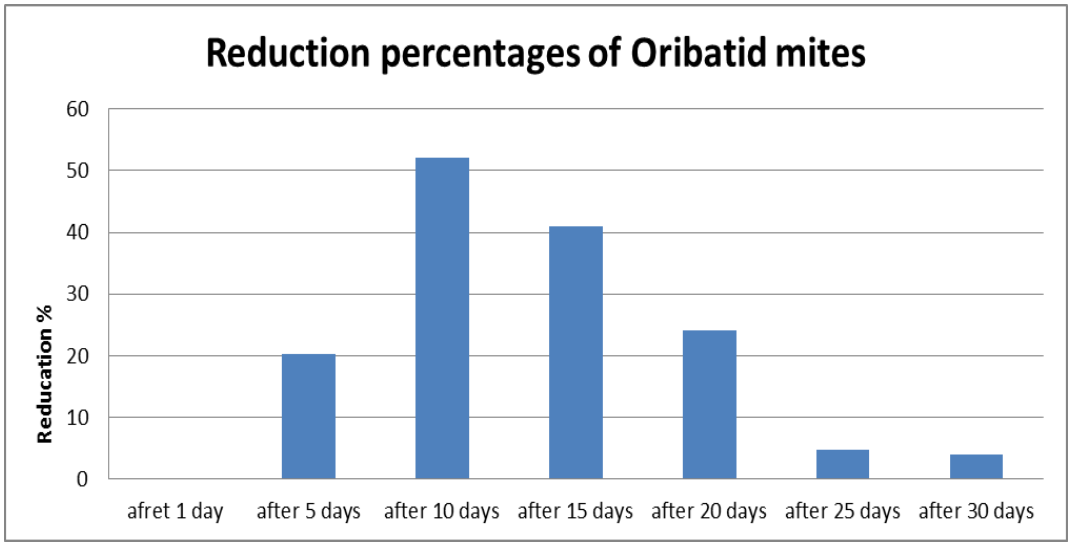

Fig (3) Reduction percentage of oribatid mites during 2019 summer season after acetochlor spray.

REFERENCES

AL-Daikh, B. E.; EL-Mabrouk, A. and H EL Roby, S.M. A. (2016): Effect of glyphosate herbicide on the behavior of soil arthropods in non-organic tomato system. Adv. Agric. Biol.5 (1), 2016: 14-19.

Balogh, J. and P. Balogh. (1992): The Oribatid Mites Genera of the World. Vol. I. Hungarian Natural History Museum Press, Budapest.

Cara, G. I. ; Lipșa, D. F.; Cara, S. M.; BURTAN L.; ȚOPA, D. and Jităreanu, G.(2017): Dissipation of acetochlor and residue analysis in maize and soil under field conditions. AgroLife Scientific Journal – 6,1.

Carlisle, S.M and Trevors J.T. (1988): Glyphosate in the environment. Water, Air, and Soil Pollution 39, 409–420.

Cockfield, S.D. and Potter, D.A. (1983): Short-term effect insecticidalapplications on predaceous arthropods and oribatid mites in Kentuckyblugrass turf. Environ. Entomol. 12: 1260-1264

Fox, C.J.S. (1964):The effects of five herbicides on the numbers of certain invertebrate animals in grassland soil. Can. J. Soil Sci., 44:405-409.

Gomaa, E.A.A and M.H. Belal (1975): Determination of dimethoate residues in some vegeTables and cotton plants. Zag. J. Agric. Res., 2: 215– 219.

Hoy, J. 8" and P. J. Shea. (1981): Effects of lindane, chlorpyrifos. and carbaryl on a pine forest soil arthropod community. Environ. Entomol. 10: 732-740.

Hutangkabadee, B. and Uyvirat, A. (1996): AgrochemicalImportation of Thailand. Department of Agriculture. (in Thai)

Klompen,H. (2006): Mites. In: Lal,R.(ed.) Encyclopedia of soil science 2nd ed. Taylor & Francis,New York, pp.1096.

Krantz, G.W. (1978): A manual of Acarology, Oregon state Univ. Book stores. Inc. Corvallis. 509 pp.

LI Tao et al(Institute of Ecology,Zhejiang Normal University,Jinhua,Zhejiang 321004) .(2009): Effects of acetochlor on community structure of soil animals in farmland soil. Jour. of Anhui Agricultural Sciences.20 .

Mills, M.S.; Hill, I.R.; Newcombe , A.C. ; Simmoms, N.D.; Vaughan, P.C. and Verity, A.A. (2001): Quantification of acetochlor degradation in the unsaturated zone using two novel in situ field techniques: comparisons with laboratory generated data and implications for groundwater risk assessments, Pest Management Science, 57, p. 351-359.

Minor, M.A. and Norton, R.A. (2008): Effects of weed and erosion control on communities of soil mites (Oribatida and Gamasina) in short-rotation willow plantings in central New York. Can. J. For. Res. 38: 1061–1070.

Pogăcean Manuela Olga, Maria Gavrilescu, 2009. Plant protection products and their sustainable and environmentally friendly use, Environmental Engineering and Management Jou., 8(3), p. 607-627.

Sarath, B.B. and Gupta, G.P. (1986): Effect of systemic insecticides on the population of soil arthropods in cotton field. J Soil Biol Ecol 6: 32-41.

Stevenson, F.J. (1994): Humus chemistry genesis, composition,

Tsui, M.T.K. and Chu, L.M. (2003): Aquatic toxicity of glyphosate-based formulations: comparison between different organisms and the effects of

environmental factors. Chemosphere 52, 1189–1197.

Xiao, N.; Jing, B.; Ge F. and Liu X. (2006): The fate of herbicide acetochlor and its toxicity to Eisenia Fetida under laboratory conditions. Chemosphere, 62, p. 1366-1373.

Zhou, Q.X.; Zhang, Q.R. and Liang, J.D.; (2012): Toxic effects of acetochlor and methamidophos on earthworms Eisenia fetida in Phaeozem, Northeast China. Journal of Environmental Scinces, 18(4), p. 741-745.

الملخص العربي

تأثير مبيد الحشائش ، أسيتوكلور على تعداد اكاروسات الاوربيتيدا(Cryptostigmata) ومتبقياته فى التربة

أمل عبدالعزيز عباس[1]- عصام محمد عبدالسلام ياسين[1]- حمدى محمود الشرباصى[2]- عوض فرحات البحراوى[2] - مروة سمير كامل[2]

1- معهد بحوث وقاية النباتات- الدقى- جيزة- مصر

2- قسم وقاية النبات - كلية الزراعة – جامعة قناة السويس- الإسماعيلية- مصر

كان الهدف من هذه الدراسة هو تقييم تأثير تطبيق الأسيتوكلور على تعداد اكاروسات الاوربيتيدا فى التربة ومتبقياته فى التربة بعد الرش. نفذت التجربة فى مزرعة خاصة فى مركز ديرب نجم- محافظة الشرقية خلال الموسم الصيفى 2018و2019 على التوالى . حيث تم تطبيق الأسيتوكلور (Harness 84٪EC) على سطح التربة بمعدل1 لتر/ فدان لمكافحة الحشائش السنوية. بلغ% الانخفاض فى اعداد اكاروس الأوريباتيدا 8.6 و 30.67 و 61.6 و 50.98 و 31.75 و 18.55 و 12٪ بعد 1 و 5 و 10 و 15 و 20 و 25 و 30 يومًا في موسم الصيف 2018. في موسم الصيف 2019 وبلغت نسب التخفيض 0.17 و 20.22 و 52 و 40.59 و 24.12 و 4.86 و 4.05٪ بعد 1،5،10 و 15 و 20 و 25 و 30 يومًا. حيث متبقيات مبيد الاسيتكلور فى التربة سجلت: 0.058 ، 0.05 ، 0.038 ، 0.030 ، 0.016 ، 0.012 و 0.009 جزء فى المليون بعد ساعة واحدة ، 5 ، 10 ، 15 ، 20 ، 25 و 30 يومًا على التوالي %الاختفاء للمبيد سجلت زيادة عالية بالوقت . وقد لوحظ تأثير بقايا مبيدات الاعشاب على عث التربة المجمعة مع قمع Berlese ، أظهر أن مبيدات الأعشاب(أسيتوكلور) لعبت دورًا كبيرًا في تقليل نشاط مجموعة oribatida.. أوضحت نتائجنا أن مبيد الأعشاب أسيتوكلور قلل من تعداد مجموعة سوس oribatid ، والتي تم جمعها باستخدام قمع Berlese بعد تطبيق الأسيتوكلور في نظام الذرة لمدة 30 يومًا خلال 2018 و 2019.