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FIELD EXPERIMENTS OF THREE INSECTICIDES AGAINST SUBTERRANEAN TERMITE *Psammotermes Hypostoma* (DESN.)

El-Bassiouny, A. R.
Agric. Res. Center, Plant Protection Res. Inst. Dokki, Giza., Egypt

ABSTRACT

The catched termites of untreated areas at first year 2009 showed highly population of subterranean termites *Psammotermes hypostoma* (Desn.), when compared with population catched at second year 2010 in soil treated with insecticides in the location A and B of all tested insecticides. In 2nd year data showed in location A (insecticides treated with water solvent), the insecticides were more toxic than insecticides in case location B (insecticides treated with kerosene solvent). Chlorpyrifos was the best for decreased of termite individuals followed by cypermethrin and fipronil in location A, while the insecticide cypermethrin was in the first rank followed by fipronil and chlorpyrifos in location B. The Chlorpyriphos found amount residues highly stability and more going deeply into depth layers in the treated soil followed by cypermethrin and fipronil, also the leachibility of insecticides treated with water solvent were more going deeply into depth layers than the insecticides treated with kerosene solvent, and vice versa in surface layers, whereas the insecticides treated with kerosene solvent more toxic and counted highly content of treated chemicals.

INTRODUCTION

The subterranean termites *Psammotermes hypostoma* (Desn) attack buildings and all foundations which contained cellulose in the most of soil types in different Egyptian governorates. The suppression of subterranean termites depending on soil treatment by some insecticides which ability to long remaining and persistence in the infested soil, and the insecticides choice has been conduct according to laboratory and field trails. The laboratory screening of the three tested insecticides established by the same author El-Bassiouny (2007). Ismailia Governorate is rich infested regions by sand termite *P. hypostoma,* which more distribution in the desert of Egypt and the more attack for especial and general property. Several of researches were conducted with relation to this field and their get up good results in termite controlling. e.g. Loeck and Nakano (1988), Davis and Kamble (1992), Davis *et al* (1993), Nan-Yao Su *et al* (1993), Abdel-Latif (2003), Waite and Gold (2004) and Cox (2005).

The present work was conducted in Agric., Res., St., at Ezz El-Deen Region, Ismailia Gov; and the work aims to choose a standard termiticides Chlorpyrifos 48%, Fipronil 5% and Cypermethrin 10% to completion bioassay in the field against *P. hypostoma*, El-Bassiouny (2007). In addition to tested of Water and Kerosene as solvents with the tested termiticides. This work will be help to knowledge of termiticides persistence in the soil and ability to termite suppression in the soil nature.

MATERIALS AND METHODS

The experiments were carried out for two successive years from January 2009 to December 2010. The tested area (240m^2), were divided to three locations; 90m^2 for each location A and B while the control location was 60m^2. Location A was determined for tested of insecticides with water solvent. Location B was determined for tested of insecticides with Kerosene solvent and control location was determined for tested of water solvent for location A and Kerosene solvent for location B. Treatments and control were replicated three times. 45 traps, El-Sebay modified traps (El-Sebay 1991) were used for each location and distributed in tested area, aligned in 15 rows and 3 columns with 2 m intervals (each trap subtended an area of 4 m^2), for exploration and determined of colonies places. Traps were soaked in water and buried in the ground at 15cm depth, and renew for every month, El-Bassiouny (2001). Nine places of colonies were determined for each location, each colony place were taken code number for examine the population density before and after treatment throughout the tested two successive years (2009 and 2010), as a follow; 1Ch, 2Ch and 3Ch were tested colony places for Chlorpyrifos, and 1Fi, 2Fi and 3Fi were tested for Fipronil, while the places of 1Cy, 2Cy and 3Cy were tested for Cypermethrin, (Fig. 1).

Location A				**Location B**				**Control**	
*	*	*		*	*	1Cy		1_A	*
1Ch	*	1Cy		*	*	*		*	*
*	*	*		1Ch	*	*		*	1_B
*	1Fi	*		*	*	*		*	*
*	*	*		*	1Fi	*		*	*
*	*	*		*	*	*		*	*
*	2Fi	*		2Ch	*	2Cy		2_A	*
*	*	*		*	*	*		*	*
2Ch	*	2Cy		*	*	*		*	2_B
*	*	*		*	2Fi	*		*	*
*	*	*		*	*	*		3_A	*
*	3Fi	*		3Ch	*	3Cy		*	*
*	*	*		*	*	*		*	3_B
3Ch	*	*		*	*	*		*	*
*	*	3Cy		*	3Fi	*		*	*

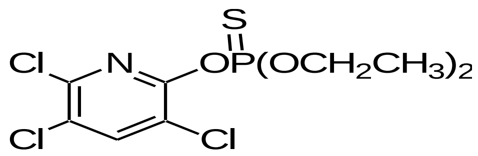
Fig. (1): Illustrative drawing of general distribution of exploration traps in the tested area.

*** = position of exploration traps**
Numbers = chosen infested areas (tested colonies)

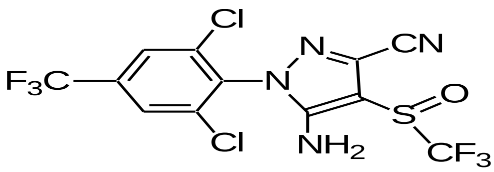
In the year 2009, catching traps were renew and distribute monthly in the infested area for determine the population density of each detected colony. Numbers of individual of each colony place were recorded in tables every month. In the year 2010, each insecticide was treated sub-slabs from concrete (1×1m) make on the center of colony places and holed from center to equal for trap size, traps were put contacted with soil surface. Tested insecticides were repeated three times as a replicates, and the number of individual for colonies were recorded in tables every month throughout the year.

Tested insecticides groups:

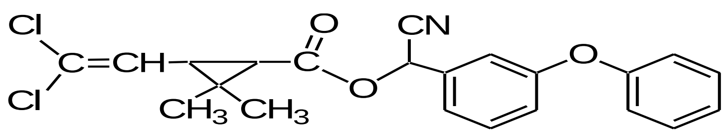
1- **Organophosphates group:** O,O-diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate as Dursban (Chlorpyrifos 48% EC).



2- **Phenylpyrazole group:** (±)-5-amino-1-(2,6-dichloro-ά, ά, ά –trifluoro - p-tolyl) - 4 - trifluoromethylsulfinylpyrazole – 3 - carbonitrile as Termidor (Fipronil 5% EC).



3- **Pyrethroids group:** (RS)- ά -cyano-3-phenoxybenzyl (1RS, 3RS; 1RS, 3SR) – 3 - (2,2 - dichlorovinyl) - 2,2 -dimethylcyclopropanecarboxylate Roth: (RS)- ά -cyano-3-phenoxybenzyl (1RS)-cis-trans-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate as Actamethrin (Cypermethrin 10% EC).



The rates of insecticides:

20ml (2%) from each insecticide were use, and the recommended rate 80ml insecticide /4000ml water or kerosene = 4 liters from insecticide solution were spray on the $1m^2$ tested soil (colony place) sub-slab. In location A, the tested insecticides were dissolve by water solvent, while the kerosene solvent were used in location B, for the same tested insecticide.

Treated soil samples collection:

The treated soil sample sub-slabs were taken at depth of 30, 60, 90cm from soil surface where the most termite activity was considered to be within that area of depth. Samples were analyzed by Pesticides Res., Dept., Fac., of Agric., Cairo University.

Residue determination of insecticides in treated soil:

Gas liquid chromatography GLC were used for chemical determination technique. The original method of **Davis *et al*. (1993)**, was used with some modification, and each insecticide was determined separately in the absence of others insecticides. The methods could be concluded as follows:

Recovery of insecticides residues from the treated soil:

Different solvent systems were used to choice the most suitable and efficient solvent system for extraction of chlorpyrifos, fipronil and cypermethrin from treated soil. These solvent systems were acetone, dichloromethane and ethyl acetate. Their ability to extract the tested insecticides successfully is depending on adding the previous mentioned solvents to samples. Blending, cleaning-up and then determining the recovery percentage of the three tested compounds by GLC. Data of recovery showed that, dichloromethane was used and gave highly rates for tested insecticides extraction.

Dichloromethane extraction method:

A 100gm soil sample was weighed in a 500ml Erlenmeyer flask.10ppm from the tested insecticides (a.i.) was added to the soil and shaken for 10 min.100ml mixture of acetone: water (1:1 v/v) was added to the soil sample. The flask was shaken for 6 hours at room temperature. The extract was filtered through a funnel by using a piece of cotton and the flask was rinsed with 25ml mixture of acetone: water (1:1 v/v). The extract was transferred to a separatory funnel (500ml). 50ml dichloromethane was added to the funnel + 5gm sodium chloride and shaken gently for 5 min. Extract was left to separate and the dichloromethane layer was dried through anhydrous sodium sulphate filter. The remainder was extracted two times 50ml for each with dichloromethane, and the dichloromethane laver was filtered through sodium sulphate anhydrous. The combined extract was evaporated using a rotary evaporator at 40°C and the residues were kept under refrigerator until analysis by GLC. Control sample was made as previously described without adding insecticides.

Table (1): Analysis condition of tested insecticides

Analysis condition	Insecticides		
	Chlorpyrifos	Fipronil	Cypermethrin
Detector	electron capture	electron capture	electron capture
Column temperature:	180 ^{o}C	200 ^{o}C	250 ^{o}C
Detector temperature:	300 ^{o}C	300 ^{o}C	300 ^{o}C
Injection temperature:	250 ^{o}C	250 ^{o}C	270 ^{o}C
Column type	HP – 1 (25m × 0.23mm × 0.17µm)		

RESULTS AND DISCUSSION

Number of attracted termites in untreated area at 2009:

Data in Table (2) showed that the numbers of attracted termites in the untreated area at 2009, arranged for tested of insecticides at 2010.

In location A, the numbers of termites were 1773, 1637 and 1432 individuals in positions 1Ch, 2Ch and 3Ch respectively. Throughout 12 months during January to December. In positions 1Fi, 2Fi and 3Fi, numbers of attracted termite were, 1053, 1451 and 2330, respectively, while the numbers of termite were, 868, 2141 and 1947, for positions 1Cy, 2Cy and 3Cy, respectively. In location B, the number of attracted termites recorded 2041, 1820 and 2058 in positions 1Ch, 2Ch and 3Ch respectively. Also, in positions 1Fi, 2Fi and 3Fi, the number of attracted termites counted 1269, 1721 and 2000, respectively, while the numbers were 1931, 2167 and 1789, in positions 1Cy, 2Cy and 3Cy, respectively. Control for location A, counted 1291, 1711 and 1820, in position 1A, 2A and 3A respectively, also the attracted termites in location B, counted 1973, 2362 and 2320 in position 1B, 2B and 3B respectively.

Table (2): Number of attracted termites in untreated area during the 1st year 2009

Locations	months												Total
	Jan.	Fibr.	Mar.	April	May	Jun	July	Aug.	Sept.	Oct.	Nov.	Dec.	
	Location A												
1 Ch	15	41	139	148	203	314	294	222	154	103	84	56	1773
2 Ch	24	20	67	160	144	208	400	305	123	69	100	17	1637
3 Ch	66	10	94	109	185	212	188	145	140	117	78	88	1432
1 Fi	0	30	100	118	143	164	194	212	54	33	0	5	1053
2 Fi	25	29	77	106	104	238	305	175	112	119	150	11	1451
3 Fi	136	109	123	209	284	415	477	155	131	127	108	56	2330
1 Cy	2	14	37	110	100	118	154	112	94	102	25	0	868
2 Cy	123	125	187	206	204	338	405	215	162	109	50	17	2141
3 Cy	36	89	143	210	214	310	344	405	111	67	18	0	1947
	Location B												
1 Ch	52	89	100	146	267	284	350	278	265	98	104	44	2041
2 Ch	0	69	109	200	302	321	301	211	155	102	42	8	1820
3 Ch	14	30	76	130	270	405	411	230	253	110	87	42	2058
1 Fi	22	121	94	113	187	200	108	115	171	120	18	0	1269
2 Fi	10	31	117	172	241	209	301	310	164	107	37	22	1721
3 Fi	57	0	37	96	113	209	412	521	311	150	78	16	2000
1 Cy	36	19	102	166	147	379	570	251	140	87	23	11	1931
2 Cy	2	0	87	122	290	312	434	423	290	172	35	0	2167
3 Cy	45	57	110	134	146	261	290	312	195	132	73	34	1789
	Control A												
1A	10	22	150	189	203	100	134	215	200	23	33	12	1291
2 A	0	47	85	144	277	206	417	106	224	93	70	42	1711
3 A	22	34	120	211	215	316	444	150	143	96	56	13	1820
	Control B												
1 B	15	23	170	88	200	234	255	578	254	100	56	0	1973
2 B	0	25	113	146	112	577	813	147	261	108	47	13	2362
3 B	0	20	135	189	300	325	611	304	297	117	22	0	2320

Said (1979), Ali *et al* (1982) and Salman *et al* (1987), they reported that the maximum number of sand termite *P. hypostoma* and harvester termite *A. ochraceus* were occurred during summer season while the lowest number occurred during winter season. El-Sebay (1993), mentioned that, the minimum number of foragers *A. ochraceus* occurred during January, while the maximum one was during February, and the similar results were obtained by Ahmed (1997), who mentioned that, the highest number of harvester termite *A. ochraceus*, was occurred during January and increased gradually until April. El-Bassiouny (2001), estimated the numbers of attracted termites at Ismailia Gov. throughout two successive years 1995 and 1996 and the average numbers were highly abundant during winter, autumn and spring seasons, while, the castes were lower abundant in summer season in both years.

Number of attracted termites in treated area at 2010:

Data in Table (3) showed that the number of attracted termites in treated area at 2010. In location A, were 435, 417 and 321 in positions 1Ch, 2Ch and 3Ch respectively, throughout the year. In positions 1Fi, 2Fi and 3Fi, numbers of attracted termite counted 310, 402 and 864, respectively, during 12 months of the year 2010, while the numbers of termites counted 191, 726 and 505, for positions 1Cy, 2Cy and 3Cy, respectively. In the same table, data for location B, calculated the number of attracted termites were 502, 363 and 584 in positions 1Ch, 2Ch and 3Ch respectively, throughout the year.

Table (3): Number of attracted termites in treated area during the 2nd year 2010

Locations	months												Total
	Jan.	Fib.	Mar.	April	May	Jun	July	Aug.	Sept.	Oct.	Nov.	Dec.	
	Location A												
1 Ch	0	4	12	34	14	21	41	67	102	55	64	21	435
2 Ch	1	3	6	11	17	44	53	94	89	67	30	2	417
3 Ch	0	0	11	10	21	19	18	38	84	60	48	12	321
1 Fi	0	12	17	27	21	20	34	42	98	23	11	5	310
2 Fi	0	15	26	12	28	23	45	59	120	45	27	2	402
3 Fi	20	38	31	54	107	111	115	103	107	80	74	24	864
1 Cy	0	0	3	11	10	12	15	52	55	18	15	0	191
2 Cy	8	22	43	102	164	116	45	76	72	50	13	15	726
3 Cy	0	10	10	16	15	100	154	105	60	23	7	5	505
	Location B												
1 Ch	0	0	22	30	19	31	100	170	70	37	23	0	502
2 Ch	5	7	13	15	20	75	100	65	35	28	0	0	363
3 Ch	0	10	20	34	77	101	107	100	88	42	0	5	584
1 Fi	0	0	15	29	26	25	29	37	81	31	16	0	289
2 Fi	0	17	28	14	30	25	47	61	122	47	29	4	424
3 Fi	10	20	25	27	20	30	103	175	107	50	63	20	650
1 Cy	0	0	15	25	20	24	39	55	100	34	0	0	312
2 Cy	15	30	29	49	105	109	113	122	120	85	52	5	834
3 Cy	0	0	0	34	40	61	40	52	13	4	0	0	244
	Control A												
1A	15	44	133	205	176	104	217	238	154	73	20	17	1396
2 A	12	56	79	214	244	356	301	257	202	104	56	31	1912
3 A	31	67	113	110	271	245	507	255	100	122	48	16	1885
	Control B												
1 B	5	13	131	97	103	116	308	421	295	106	88	10	1693
2 B	12	11	52	123	217	451	611	115	154	132	27	42	1947
3 B	26	17	65	109	298	424	505	213	323	54	50	2	2086

In positions 1Fi, 2Fi and 3Fi, the numbers of attracted termite calculated 289, 424 and 650, respectively, while the numbers were 312, 834 and 244, in positions 1Cy, 2Cy and 3Cy, respectively. Control for location A, counted 1396, 1912 and 1885, in position 1A, 2A and 3A respectively, also the attracted termites in location B, counted 1693, 1947 and 2086 in position 1B, 2B and 3B respectively.

In total, data in table (4), indicated that, by using the water solvent, Chlorpyriphos was the best insecticide for decreasing the termite individuals in the field before and after treatment in two successive years (2009 and 2010), followed by cypermethrin and fipronil whereas, the reduction % recorded 75.7, 71.0 and 67.3 for three insecticides respectively. While the insecticides cypermethrin was in the first rank for decreased of termite individuals before and after treatment in two years (2009 and 2010), followed by fipronil and chlorpyrifos, whereas the reduction % recorded 76.3, 72.6 and 64.3 when using kerosene solvent for three insecticides respectively. In all treatments the insecticides with kerosene solvent were more toxic, except in case of Chlorpyriphos whereas the reduction of individuals% equal in two cases recorded 75.7 with water solvent and 75.5 with kerosene solvent. In control treated with water solvent the attracted termites were stable approximately throughout the two tested successive years, whereas data mean recorded 1607.3 and 1731.3 individuals of termites in the first and second years respectively, with variable 7.4%, but when the control treated by kerosene solvent in the attracted termites were decreased in the second year (2010), recorded 1908.3 termite individuals than the first year (2009), treated with water solvent, recorded 2218.3 of termite individuals, with variable 15.0%. So, the solvent kerosene was effective with insecticides in 7.6% mortality approximately.

Table (4): The mean numbers of attracted termites before and after treatment during the 1st and 2nd years (2009 and 2010).

insecticide	insecticides with water solvent				insecticides with kerosene solvent			
	1st year	2nd year	Reduction	%	1st year	2nd year	Reduction	%
chlorpyrifos	1773	435	1338	75.4	2041	502	1539	75.4
	1637	417	1220	74.5	1820	363	1457	80.5
	1432	321	1111	77.5	2058	584	1474	71.6
Mean	1614	391	1223	75.7	1973	483	1490	75.5
fipronil	1053	310	743	70.5	1269	289	980	77.2
	1451	402	1049	72.2	1721	424	1297	75.3
	2330	864	1466	62.9	2000	650	1350	67.5
Mean	1611.3	525.3	1086	67.3	1663.3	454.3	1209	72.6
cypermethrin	868	191	677	77.9	1931	312	1619	83.8
	2141	726	1415	66.0	2167	834	1333	61.5
	1947	505	1442	74.0	1789	244	1545	86.3
Mean	1652	474	1178	71.0	1962.3	463.3	1499	76.3
Control	1st year	2nd year	Variable	%	1st year	2nd year	Variable	%
	1291	1396	105	7.8	1973	1693	280	15.4
	1711	1912	201	11.0	2362	1947	415	19.2
	1820	1885	65	3.5	2320	2086	234	10.6
Mean	1607.3	1731.3	123.6	7.4	2218.3	1908.3	309.6	15.0

Solvent recovery rates from treated soil:

Data in Table (5), clarified the extraction of tested insecticides from treated soil sample with water and kerosene solvent was extracted by three different solvents namely: acetone, dichloromethane and ethyl acetate. In case of soil treated with water solvent, data tested that, the most suitable of which was dichloromethane with 94.0, 91.1 and 90.2% percent recovery, for chlorpyrifos, fipronil and cypermethrin, respectively.

Table (5): Recovery results of three solvents for the tested insecticides in treated soil samples with water and kerosene solvents

Tested insecticides	Solvent	Recovered 5ppm		Amount recovered %		Average %
		R 1	R2	R 1	R2	
Chlorpyrifos	Acetone	4.21	4.33	84.2	86.6	85.4
	Dichloromethane	4.66	4.74	93.2	94.8	94.0
	Ethyl acetate	4.52	4.31	90.4	86.2	88.3
Fipronil	Acetone	4.15	4.22	83.0	84.0	82.0
	Dichloromethane	4.65	4.46	93.0	89.2	91.1
	Ethyl acetate	4.33	4.57	86.6	91.4	89.0
Cypermethrin	Acetone	4.33	4.21	86.6	84.2	85.4
	Dichloromethane	4.57	4.45	91.4	89.0	90.2
	Ethyl acetate	4.22	4.21	84.4	84.2	84.3

R1 = Recovered sample treated with water solvent
R2 = Recovered sample treated with kerosene solvent

Insecticides recovery rates from treated soil:

As shown in table (6). Data revealed that, the rate of recoveries from soil treated with three insecticides with water and kerosene solvent, the rates was follow; in the case of insecticides with water solvent, the replicates of Chlorpyriphos recorded 93.0 and 95.0% with average 94.0%, fipronil estimated 82.0 and 83.5% with average 82.7%, and cypermethrin estimated 86.5 and 91.5% with average 89.0%.

Table (6): The amount recovered for tested insecticides, in soil samples treated with water and kerosene solvents.

Insecticides	Amount recovered		Recovered %		Average %
	R 1	**R** 2	R 1	**R** 2	
Chlorpyrifos	465.0	475.0	93.0	95.0	94.0
Fipronil	410.0	417.5	82.0	83.5	82.7
Cypermethrin	432.5	457.5	86.5	91.5	89.0

R1 = Recovered sample treated with water solvent
R2 = Recovered sample treated with kerosene solvent

Determination of insecticides residues in soil samples of long tube:

Depending on GLC (Gas Liquid Chromatography), the results of soil samples analysis representing residues of the three tested insecticides moved downward into the depth of treated soil. According to data of recoveries in (Table 5), the values of the insecticides residues were corrected according to means of recoveries. In table (7) Data showed, in location A (insecticides treated with water solvent) the results of determination contained tested chemicals/ppm in the sample taken after 3 months, and the corrected data of treated soil was contained high amount of chemicals, 1081.5, 818.9 and 1459.1 ppm for the three insecticides chlorpyrifos, fipronil and cypermethrin, respectively at 30 Depth/cm decreased gradually at 60 Depth/cm to reach minimum level at 90 Depth/cm. Chemicals/ppm in the sample taken after 6 months, counted contained amount of chemicals, 721.5, 68.05 and 539.2 ppm for the three insecticides, respectively at 30 Depth/cm decreased gradually at 60 Depth/cm to reach minimum level at 90 Depth/cm. Chemicals/ppm in the sample taken after 12 months, recorded the lower rates of contained amount chemicals, 22.2, 10.6 and 140.2 ppm for the three insecticides, respectively at 30 Depth/cm decreased gradually at 60 Depth/cm to reach minimum level at 90 Depth/cm. In same trend, data in location B (insecticides treated with kerosene solvent) the results of determination contained tested chemicals/ppm were to emulate, but recorded the highly chemicals amount of tested insecticides more than chemicals amount in location A at depth of 30cm., and vice versa at depths of 60 and 90cm/depths. In total, the amount insecticide/ppm the chlorpyrifos found highly stability and more going deeply into depth layers in the treated soil followed by cypermethrin and fipronil, also the leachibility of insecticides treated with water solvent in the sand soil were more going deeply into depth layers than the insecticides treated with kerosene solvent, and vice versa, in surface layers of treated soil, whereas the insecticides treated with kerosene solvent more toxic and counted highly content of treated chemicals.

Table (7): The insecticide residues in ppm of chemical determination for treated soils.

Location	Time/ month	insecticides	Amount correct values in ppm at soil depths		
			30 Depth/cm	60 Depth/cm	90 Depth/cm
A	3	Chlorpyrifos	1081.5	480.0	123.7
		Fipronil	818.9	76.7	26.6
		Cypermethrin	1459.1	714.05	112.0
	6	Chlorpyrifos	721.5	47.1	21.3
		Fipronil	68.05	19.0	1.09
		Cypermethrin	539.2	113.2	12.0
	12	Chlorpyrifos	22.2	11.7	0.6
		Fipronil	10.6	0.3	0.01
		Cypermethrin	140.2	16.01	0.8
B	3	Chlorpyrifos	1214.0	70.5	12.0
		Fipronil	1022.1	26.7	0.6
		Cypermethrin	1612.0	34.0	2.0
	6	Chlorpyrifos	801.4	17.01	0.3
		Fipronil	113.02	8.02	0.0
		Cypermethrin	640.3	13.5	1.0
	12	Chlorpyrifos	120.7	1.06	0.0
		Fipronil	111.3	0.04	0.0
		Cypermethrin	204.6	0.09	0.0

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إختبـارات حقليـة لـثلاث مبيـدات ضـد النمـل الأبـيض تحـت أرضـى "سـاموترمس هيبوستوما"

أيمن رمضان البسيونى
مركز البحوث الزراعية - معهد بحوث وقاية النباتات - الدقى - جيزة - مصر

أوضحت النتائج ان اعداد الحشرات الممسوكة فى السنة الأولى 2009 للتربة الغير معاملة بالمبيدات كانت عالية مقارنة بالحشرات الممسوكة فى السنة الثانية 2010 بعد المعاملة بالمبيدات الثلاثة المختبرة . أيضا أوضحت النتائج فى السنة الثانية أن المبيدات المختبرة والمذابة فى الماء كانت أقل سمية وأعلى فى تعداد الحشرات عنه فى حالة المبيدات المذابة فى الكيروسين . كان مبيد الكلوربيريفوس أكثر سمية فى حالة الإذابة فى الماء تلاه مبيد السيبرمثرين ثم الفبرونيل ، أما فى حالة الإذابة فى الكيروسين كان مبيد السيبرمثرين أكثر سمية تلاه مبيد الفبرونيل ثم الكلوربيريفوس . أظهرت النتائج أن كميات المبيدات المتبقية فى التربة كانت مرتفعة وأكثر ثباتا لمبيد الكلوربيريفوس والسيبرمثرين ثم الفبرونيل على التوالى ، وكانت المبيدات المذابة فى الماء الأكثر تعمقا فى التربة من الأخرى ، أيضا كانت المبيدات المذابة فى الكيروسين الأكثر سمية فى الطبقة السطحية للتربة .

بتحكيم البحث

أ.د / على على عبد الهادى	**كلية الزراعة – جامعة المنصورة**
أ.د / سعيد محمد حجاج	**معهد وقاية النباتات**