

IV-RESULTS

IV- RESULTS

Susceptibility of laboratory and field strains of certain cotton pests to several insecticides during two successive years (1995-1996).

A -The white fly *Bemisia tabaci*

1- Laboratory strain:

Our result presented in Table (1) and illustrated in Fig. (1). Showed that the LC_{50} values for most of the tested formulated insecticides ranged between 35.42 – 7063.27 ppm with exception of abamectin and imidacloprid which were the most potent insecticides with LC_{50} of 0.41 and 14.99, respectively. The LC_{50} of natural product abamectin, azadirachtin CaPL1, KZ, CaPL2, misrona and super royal ranged between 0.41 and 7063.27 ppm. Their LC_{50} are 0.41, 264.51, 495.14, 931.78, 1108.09, 5211.03 and 7063.27 ppm respectively. The LC_{50} values of the two applied carbamates are methomy 136.8 ppm. and pirimicab, 277.6 ppm.

The LC_{50} of cypermethrin showed value of 114.33 ppm, while imidazol imidacloprid was 14.99 ppm and the thiourea diafenthiuron was 97.81 ppm. The organophosphates pirimiphos methyl, profenofos, malathion, chlorpyrifos methyl and dimethoate ranged between 35.42 and 1065.22 ppm they measured 35.42, 141.2, 146.24, 561.6 and 1065 ppm, respectively. Etofenprox showed LC_{50} value of 206.77 ppm.

2- Field strain:

2-1. Kalubia strain.

2-1-1- Susceptibility evaluation during 1995.

Results tabulated in Table (2) and illustrated in Fig (2) showed that there is a wide range of susceptibility from 0.22 to 11125 ppm which

Table (1): Susceptibility of whitefly adult *Bemisia tabaci* (laboratory strain) to different insecticides.

Insecticides used	Slope function -	LC50 ppm	90%		LC90 ppm	90% Fiducial limits
			Fiducial limits			
Abamectin *	1.41	0.41	0.28 : 0.54		3.28	2.18 : 6.2
Azadirachtin *	1.03	264.51	180.07 : 462.76		4618.6	1724.3 : 38539
KZ *	1.4	931.78	666.55 : 1279.5		7562.8	4752.3 / 15002
Misrona *	1.46	5211.03	3400.11 : 18421.77		39145	18511:0.264E+06
Super royal*	2.86	7063.27	5237.39 : 8627.17		19797	15062 : 34184
CaPL1 *	.77	495.14	324.98 : 712.96		22710	11014 : 70000
CaPL2*	1.25	1108.09	156.06 : 1557.98		11745	7306.9 : 23009
Etofenprox □□	2.28	206.77	156.06 : 271.91		756.51	478.96 : 2440.55
Profenofos ▽	1.72	141.2	87.4 : 222.86		779.47	393.76 : 7348.6
Dimethoate ▽	1.78	1065.22	521.01 : 1469.24		5580.1	3711.4 : 15659
Malathion ▽	1.15	146.24	87.78 : 207.7		1887.7	1062.8 : 5549.2
Pirimiphos methyl ▽	1.30	35.42	25.16 : 49.1		339.33	190.75 : 925.59
Pirimicarb ▽▽	1.91	277.6	194.75 : 169.01		1297.53	866.29 : 2666.96
Cypermethrin □□	1.63	114.33	78.38 : 172.28		702.33	380.04 : 2503.2
Chlorpyrifos methyl ▽	2.15	561.6	433.96 : 737.5		22170	1458.4 : 4807.0
Diafenthiuron ▽▽▽	2.29	97.81	72.07 : 124.53		353.98	252.93 :
Imidacloprid □□□	1.42	14.99	11.52 : 19.58		111.27	70.38 : 226.09
Methomyl ▽▽	2.64	136.8	88.22 : 175.14		418.46	314.04 : 751.8

* natural product
VVV Insect Growth Regulator
VV carbamates
V organophosphates.

□□ pyrethroid.
□□□ imidazol.

ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent
LC₉₀: Lethal concentration killed ninety percent
RL : Resistance Level : $\frac{LC_{50}}{\text{field strain}}$
LC₅₀ Lab. strain.

Fig(1) LC_{50} values of the used insecticides laboratory strain of *Bemisia tabaci* adults.

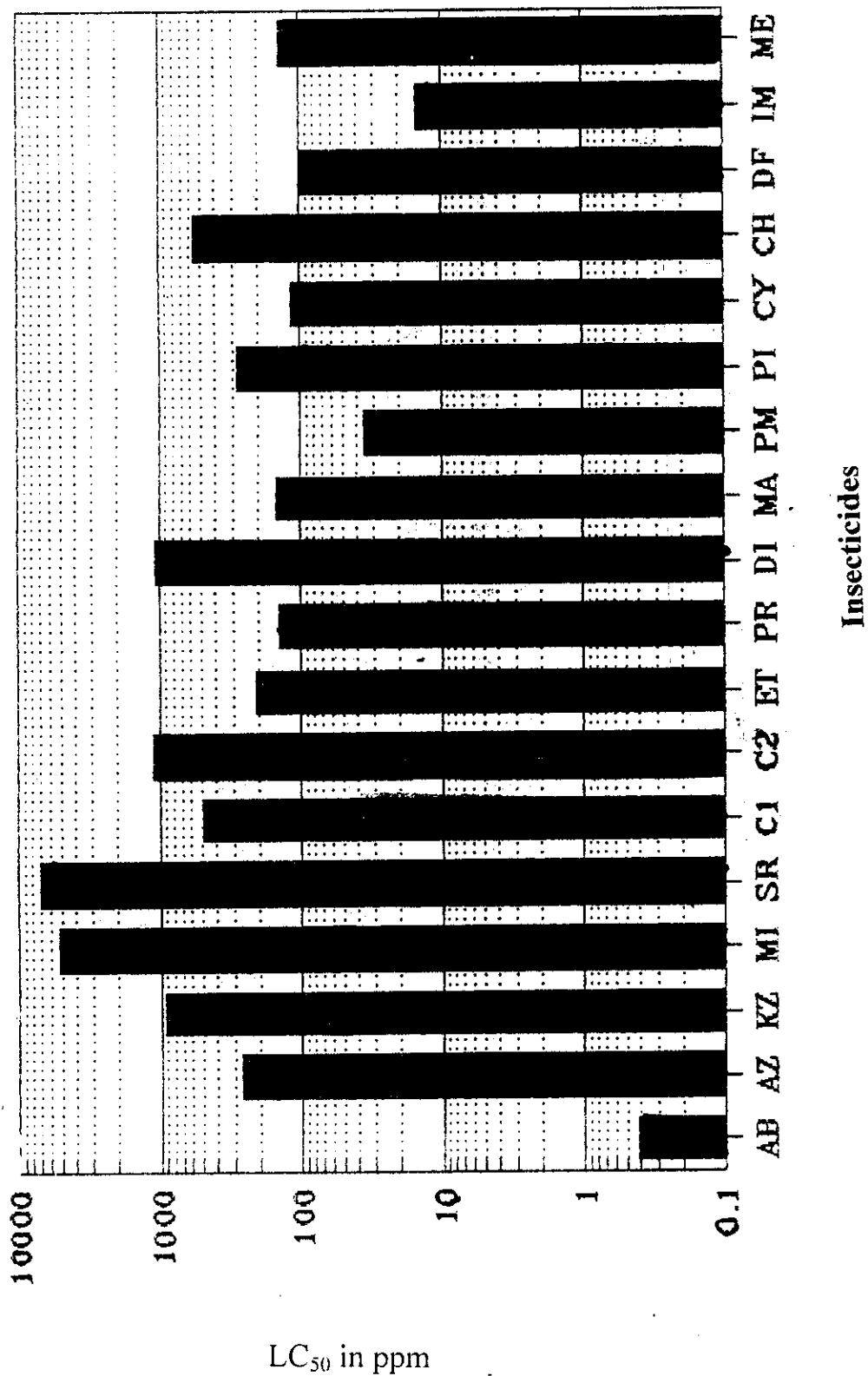


Table (2): Susceptibility of whitefly adult *Bemisia tabaci* of Kalubia Governorate to different insecticides during 1992.

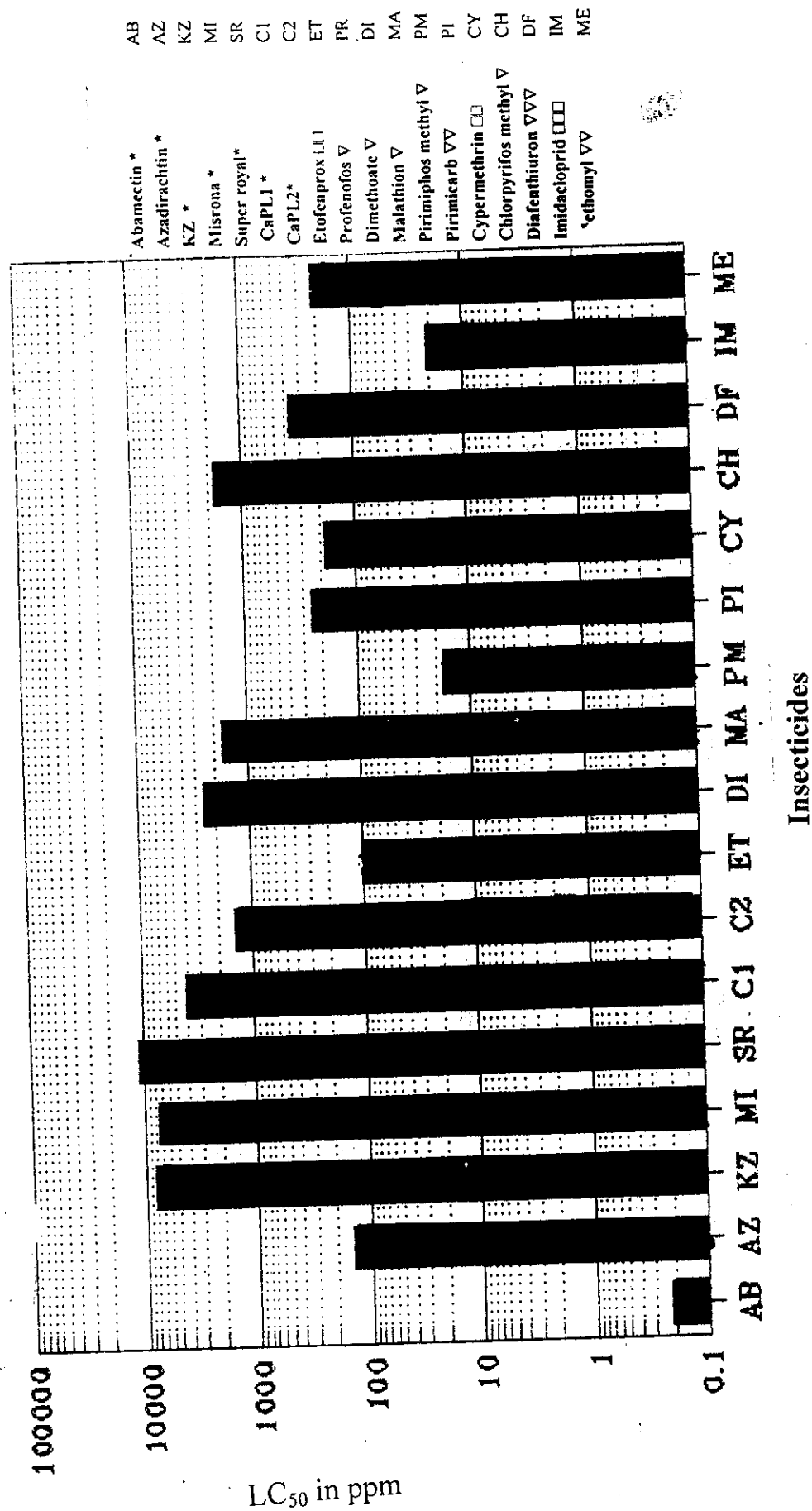
Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	1.5	0.22	0.16 : 0.3		1.58	1.25 : 2.14		0.5
Azadirachtin *	1.8	147.53	4.7 : 197.6		755.68	556.5 : 1231.9		0.6
KZ *	1.2	8219.91	4046 : 14981		93835.11	39497 : 0.81 E+06		8.8
Misrona *	1.8	7645.17	-		38519	-		1.5
Super royal*	0.99	11125	-		21000000	-		1.5
CaPL1 *	1.76	4078.33	2893.4 : 5396.6		21766.14	15829 : 33485		8.2
CaPL2*	1.67	1452.44	1194.6 : 1715.2		8492.35	6737.9 : 11500		1.3
Etofenprox □□	0.8	103.38	55.8 : 208.1		3991.7	1124 : 88162		0.5
Dimethoate ▽	1.84	2566.5	2195.7 : 2980.8		12811.33	9886.4 : 18163		2.4
Malathion ▽	1.95	1699.53	996.9 : 2398.1		7711.17	5136.1 : 16526		11.6
Pirimiphos methyl ▽	1.87	17.5	6.17 : 28.4		84.67	50.95 : 279.7		0.5
Pirimicarb ▽▽	2.38	254.62	116.6 : 355.1		878.9	2828.6 :		0.9
Cypermethrin □□	1.43	185.86	131.7 : 245.3		1464.9	980 : 2712.1		1.6
Chlorpyrifos methyl ▽	2.32	1798.48	918.5 : 2617.1		6423.9	4305.5 : 1444.0		3.2
Diaphenthiuron ▽▽▽	1.08	366.5	279.9 : 463.1		5604.95	3654.3 : 10264		3.8
Imidacloprid □□□	1.45	21.2	15.7 : 27.1		162.86	124.7 : 228		1.4
Methomyl ▽▽	1.15	218.78	-		286	-		1.6

LC₅₀: Lethal concentration killed fifty percent
LC₉₀: Lethal concentration killed ninety percent
RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

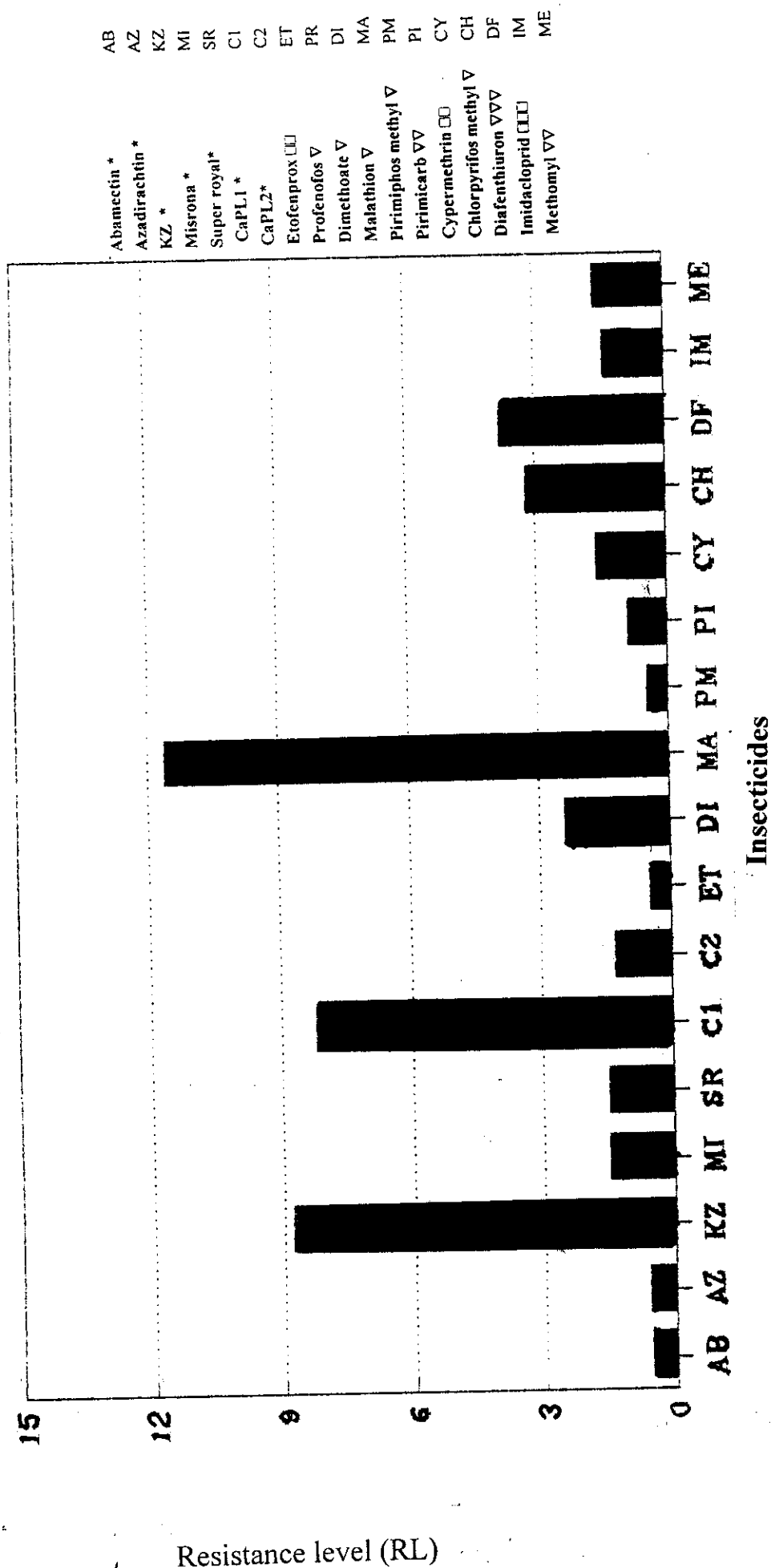
□□ pyrethroid.
□□□ imidazol.
ppm : Part per million

* natural product
▽▽▽ Insect Growth Regulator
▽▽ carbamates
▽ organophosphates.

Fig(2) LC₅₀ values of the used insecticides to Kalubia field strain of *Bemisia tabaci* adults during the year 1995.



Fig(3) Resistance levels of Kalubia strain of *Bemisia tabaci* to the used insecticides (1995) based on LC₅₀s.



is somewhat similar to other Governorates. However, Kalubia strain was more susceptible to natural products. Abamectin and azadirachtin which showed LC_{50} values, of 0.22 ppm and 147.53 ppm, respectively.

The LC_{50} values for other natural products were more than 1000 ppm and less than 12000 ppm. The LC_{50} values of CaPL2, CaPL1 misrona, KZ and super royal are 1452.44 ppm, 4078.33, ppm 7645.17 ppm, 8219.9 ppm and 11125 ppm, respectively. The Kalubia strain showed a somewhat similar degree of susceptibility to both carbamates, methomyl and pirimicarb with LC_{50} values of 218.78 ppm and 254.62 ppm respectively. Cypermethrin showed moderate LC_{50} value of 185.86 ppm.

On the other hand, the organophosphorous showed highest values of LC_{50} (1699.53 – 2566.5) ppm with the exception of pirimiphos methyl which showed 17.5 ppm. The LC_{50} s of malathion, chlorpyrifos methyl and dimethoate were 1699.53 ppm, 1798.48 ppm and 2566.5 ppm respectively. The thiourea, diafenthiuron showed a moderate LC_{50} value of 366.5 ppm. The imidazol i.e, imidacloprid showed lowest LC_{50} value of 103.38 ppm (Table (2) and Fig. (2)). The field strain exhibited similar susceptibility to the CaPL2 (1.3 fold) super royal (1.5 folds), misrona (1.5 fold) and other natural product CaPL1 (8.2 fold) and Kz oil (8.8 fold) abamectin and azadirachtin were more toxic to field strain than the laboratory strain (0.5 fold and 0.6 fold). The imidacloprid showed t 1.4 fold. The carbamate, pirimicarb (0.9 fold) and methomyl (1.6 fold) and the organophosphates, pirimiphos methyl (0.5 fold), dimethoate (2.4 fold) and chlorpyrifos methyl (3.2 fold). Malathion was 11.6 fold and etofenprox was most toxic to Kalubia strain (0.5 fold).

2-1-2- Susceptibility evaluation during 1996

Spectrum of LC_{50} values for various used insecticides were more or less similar to the other tested Governorates strains as shown in Table (3) and illustrated in Fig. (4). Among the tested natural product misrona showed the highest LC_{50} value was of 14985 ppm against 0.38ppm with of abamectin. Azadirachtin showed moderate LC_{50} value of 288.01 ppm. However, other natural product showed higher LC_{50} values as CaPL2, KZ, CaPL1, super royal which were measured 1334.52ppm, 4051.97ppm, 4424.11ppm, 10114ppm, respectively. The pyrethroid cypermethrin showed LC_{50} value of 92.9 ppm but the thiourea, diafenthiuron showed moderate LC_{50} value of 527.84 ppm. Meanwhile the two carbamates methomyl and pirimicarb showed LC_{50} values of 303.5 ppm and 1939.62 ppm, respectively.

Imidacloprid showed LC_{50} value of 53.52 ppm. Among the tested organophosphates profenofos and pirimiphos methyl exhibited moderate LC_{50} values of 123.93ppm and 150.8 ppm, respectively. Chlorpyrifos methyl, malathion, dimethoate showed high LC_{50} values of 4333ppm, 4757.44ppm and 6702.7ppm, respectively however, etofenprox showed lower LC_{50} value of 14.22 ppm. The obtained results clearly indicate that the population acquired resistance, to malathion as shown in Table (3) and Fig. (5). on other hand abamectin showed low resistant level azadirachtin (1 fold) CaPL2 (6.5 fold) super royal (1.4 fold). misrona (2.9 profenofos (0.9 fold), pirimiphos methyl (4.3 fold), dimethoate (6.3 fold) and malathion (32.53 fold). The two carbamates methomyl and pirimicarb showed a resistance level of 2.2 and 7 fold, respectively. For imidacloprid and diafenthiuron the RL. Are 3.6 and 5.4 fold, respectively while for cypermethrin it was only .8 fold.

Table (3): Susceptibility of whitefly adult *Bemisia tabaci* of Kalubia Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	3.09	0.38	0.25 : 0.52		1.003	0.71 : 1.87		1
Azadirachtin *	1.96	288.01	193.67 : 391.18		1292.72	803.08 : 3909.31		1
KZ *	1.7	4051.97	3089.5 : 5126.69		22936.	15282 : 45858		4.3
Misrona *	2.8	14985.0	9115 : 21907		42231.	27526 : 0.11E+06		2.9
Super royal*	1.4	10114	7171.2 : 13167		79528	57.54 : 0.12E+06		1.4
CaPL1 *	1.5	4424.11	-		32984	-		8.9
CaPL2*	1.8	1334.52	1034.62 : 1630.6		7187.3	5317.9 : 11378		6.5
Etofenprox □□	1.5	14.22	4.89 : 21.80		97.73	69.91 : 210.68		0.07
Profenofos ▽	1.28	123.93	81.99 : 166.42		1244.31	807.44 : 2536.62		0.9
Dimethoate ▽	2.3	6702.7	3813.6 : 10056		24776	14581 : 0.14E+06		6.3
Malathion ▽	1.75	4757.44	3761.8 : 5824.19		25608	18889 : 39730		32.53
Pirimiphos methyl ▽	2.7	150.8	-		450.	-		4.3
Pirimicarb ▽▽	1.86	1939.62	1600.22 : 2377.63		9424	6742 : 15163		7
Cypermethrin □□	1.0	92.9	53.45 : 139.72		1778.8	859.68 : 7333.8		0.8
Chlorpyrifos methyl ▽	1.1	4333.0	-		69526	-		7.7
Diafenthuron ▽▽	2.63	527.84	356.58 : 675.8		2255.35	1728.92 : 3494.14		5.4
Imidacloprid □□□	1.5	53.52	43.36 : 64.50		376.7	267.17 : 624.14		3.6
Methomyl ▽▽	1.55	303.5	202.21 : 417.7		2018.84	1237.63 : 5007.25		2.2

LC₅₀: Lethal concentration killed fifty percent
LC₉₀: Lethal concentration killed ninety percent
RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

□□ pyrethroid.

□□□ imidazol.

ppm : Part per million

* natural product

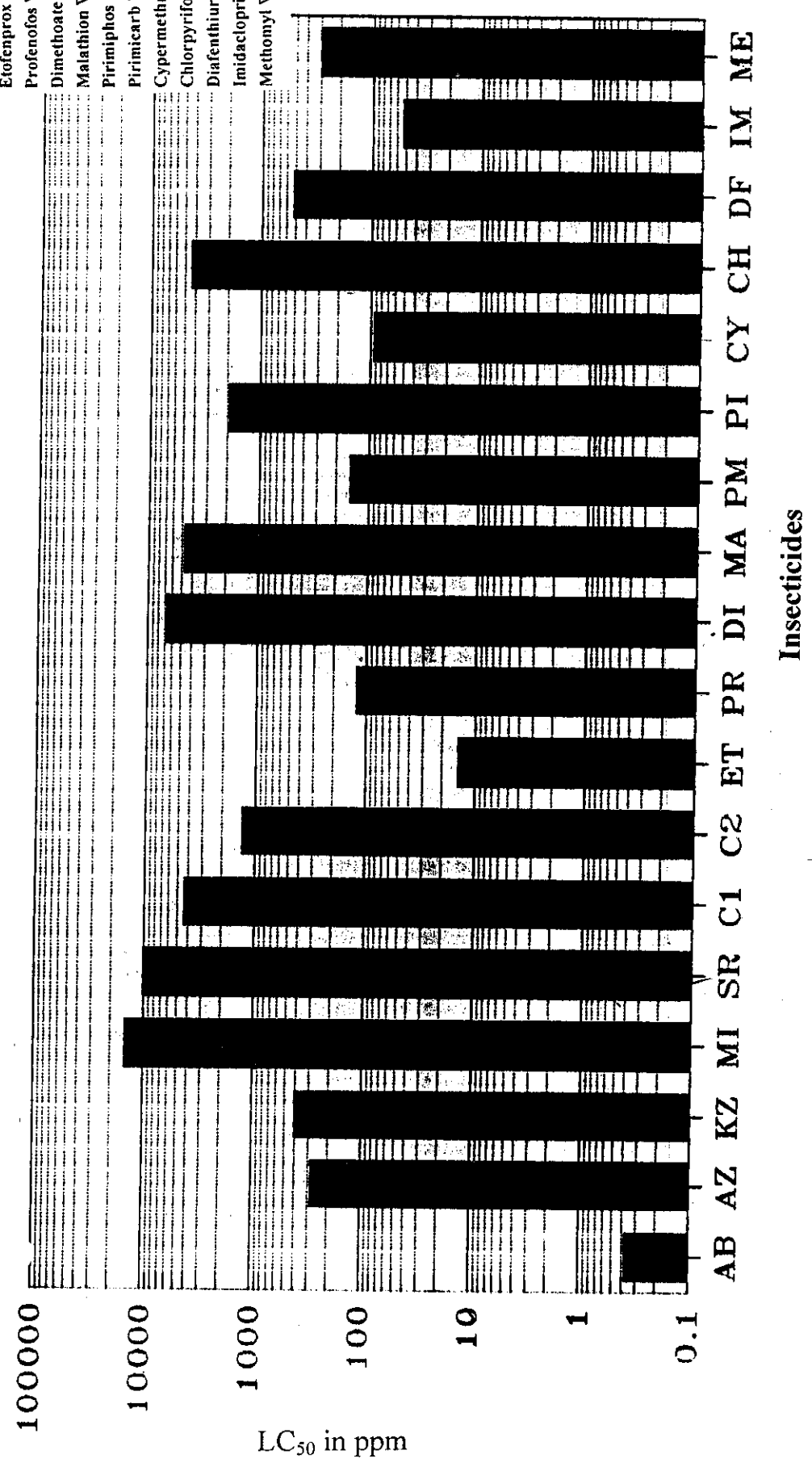
▽▽ Insect Growth Regulator

▽▽ carbamates

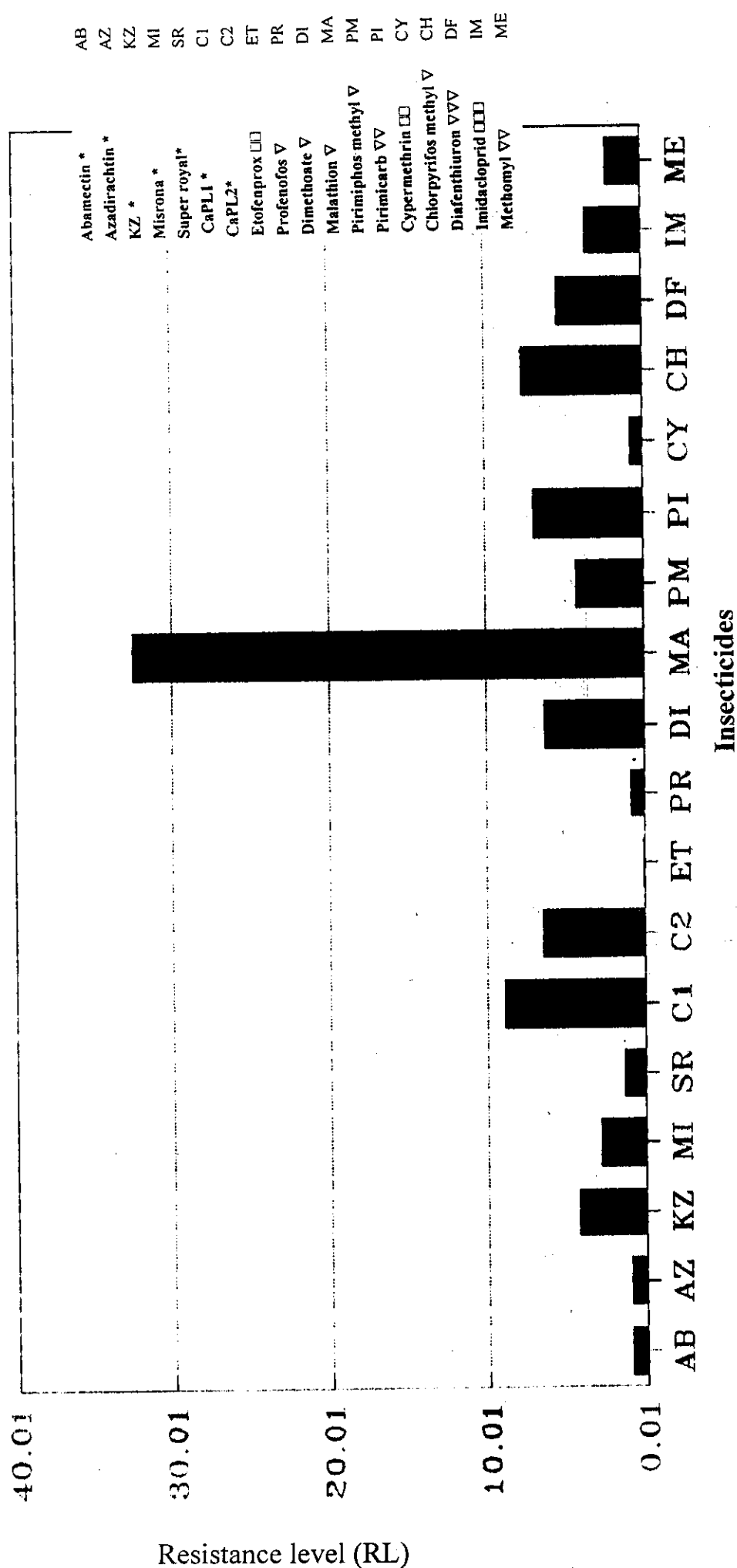
▽ organophosphates.

Abamectin * AB
 Azadirachtin * AZ
 KZ * KZ
 Misrona * MI
 Super royal* SR
 CaPL1 * C1
 CaPL2* C2
 Etofenprox □□ ET
 Profenofos ▽ PR
 Dimethoate ▽ DI
 Malathion ▽ MA
 Pirimiphos methyl ▽ PM
 Pirimicarb ▽▽ PI
 Cypermethrin □□ CY
 Chlorpyrifos methyl ▽ CH
 Diafenthiuron ▽▽ DF
 Imidacloprid □□ IM
 Methomyl ▽▽ ME

Fig(4) LC₅₀ values of the used insecticides to Kalubia field strain of *Bemisia tabaci* adults during the year 1996.



Fig(5) Resistance level of Kalubia strain of *Bemisia tabaci* to the used insecticides (1996) based on LC₅₀.



2-2- Dakahlia Strain:

2-2-1- Susceptibility evaluation during 1995:

Data presented in Table (4) and Fig (6) showed that, the spectrum of LC_{50} values for various insecticides is more or less similar to other Governorates. Among the tested natural products, misrona showed LC_{50} values of 17963 ppm as compared to 0.58 ppm, when insects treated with abamectim. Azadirachtin showed LC_{50} value of 74.96 ppm. CaPL2, CaPL1, KZ, super royal and misrona showed LC_{50} values of 858.59 ppm, 1069.26 ppm, 12414 ppm, 15050 ppm and 17963 ppm, respectively. The carbamates, pirimicarb and methomyl showed LC_{50} values of 34.11 ppm and 65.27 ppm, respectively. Imidacloprid showed LC_{50} value of 3.8 ppm. Cypermethrin showed LC_{50} value 41.33 ppm. the thiourea, diafenthiuron showed high LC_{50} value of 2012.44 ppm. Among the tested organophosphates, pirimiphos methyl and dimethoate showed LC_{50} values of 227.58 ppm, and 569.25 ppm, respectively. In contrast chlorpyrifos methyl and malathion showed high LC_{50} values of 2137.54 ppm and 3168.65 ppm, respectively. The obtained results clearly indicated development of resistance in Dakahlia strain which showed resistance levels (RL) of 13.3, 12.7 and 20.6 fold to KZ oil, malathion and diafenthiuron, respectively. This field strain still susceptible to abamectin (1.4 fold), misrona (3.4 fold) super royal (2.1 fold) CaPL1 (2.2 fold) pirimiphos methyl (6.4 fold) Chlorpyrifos methyl (3.8 fold). On the other hand, some insecticides were effective to Dakahlia strain, where the LC_{50} value was less than the laboratory strain, azadirachtin (0.3 fold) CaPL2 (0.8 fold) dimethoate (0.5 folds), pirimicarb (0.1 fold) cypermethrin (0.4 fold) imidacloprid (0.3 fold) methomyl (0.5 fold) according Fig. (7) and Table (4).

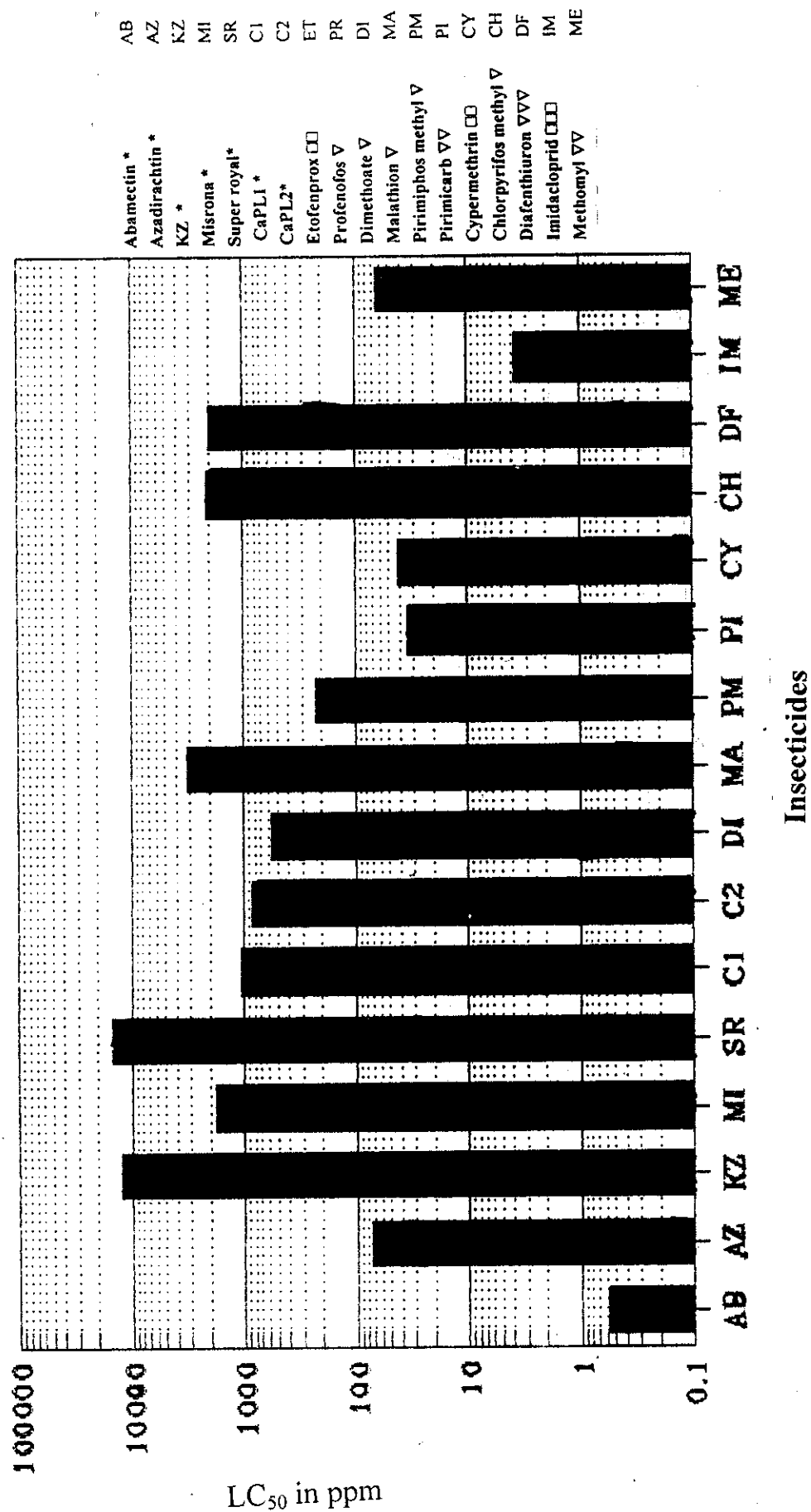
Table (4): Susceptibility of whitefly adult *Bemisia tabaci* of Dakahlia strain to different insecticides during 1993.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	0.19	0.58	60.1 / 90.1		27000000	-		1.4
Azadirachtin *	1.9	7496	-		367.11	293.1 : 493.2		0.3
KZ *	2.8	12414.0	-		35440.	-		13.3
Misrona *	0.68	17963	-		140000000	-		3.4
Super royal*	0.65	15050	-		140000000	-		2.1
CaPL1 *	0.88	1069.26	-		30803	-		2.2
CaPL2*	1.68	858.59	-		4952.52	-		0.8
Dimethoate ∇	1.49	569.25	390.3 : 771.5		4143.3	2885.7 : 68504		0.5
Malathion ∇	1.60	3168.65	1977.35 : 4772.25		19993	11300 : 60762		21.7
Pirimiphos methyl ∇	2.35	227.58	189.95 : 281.9		800.21	551.01 : 1587.3		6.4
Pirimicarb ∇∇	1.78	34.11	9.05 : 62.13		178.9	90.3 : 2266.6		0.1
Cypermethrin □□	0.63	41.33	24.74 : 64.13		4629.69	1881.5 : 19167		0.4
Chlorpyrifos methyl ∇	2.02	2137.54	1799.67 : 2568.9		9192	6543.9 : 15664		3.8
Diafenthuron ∇∇∇	2.27	2012.44	1695.47 : 2337.76		7370.94	6152.8 : 9233.7		20.6
Imidacloprid □□□	2.8	3.8	-		10.93	-		0.3
Methomyl ∇∇	3.8	65.27	57.8 : 72.18		142.74	125.3 : 170.9		0.5

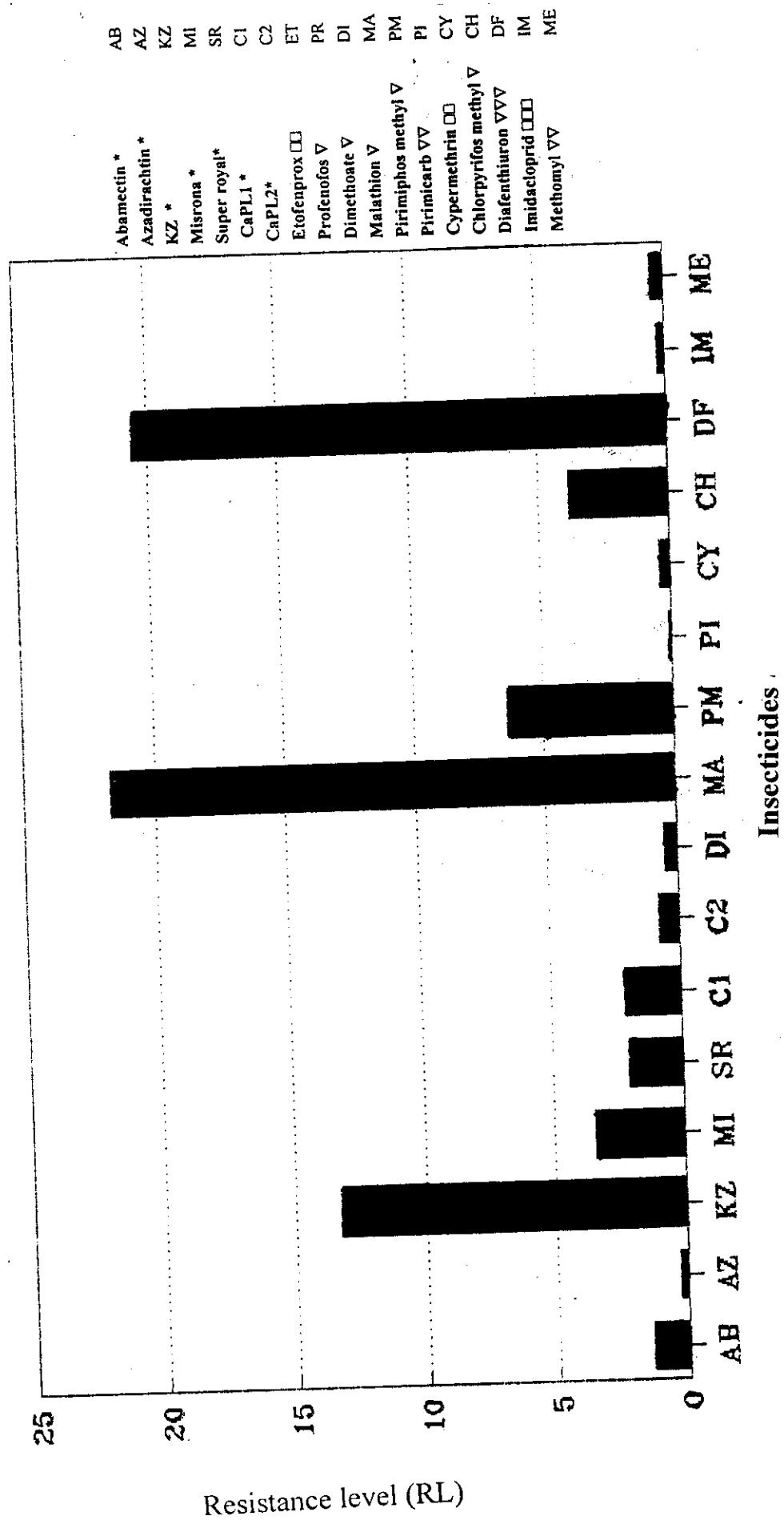
LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level: $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

* natural product
 ∇∇∇ Insect Growth Regulator
 ∇∇ carbamates
 ∇ organophosphates.
 □□ pyrethroid.
 □□□ imidazol.
 ppm : Part per million

Fig(6) LC_{50} values of the used insecticides to *Dakahlia* field strain of *Bemisia tabaci* adults during the year (1995).



Fig(7) Resistance level of *Dakahlia* strain of *Bemisia tabaci* to the used insecticides. (1995).



2-2-2- Susceptibility evaluation during 1996

Results obtain in Table (5) and illustrated in Fig. (8) showed that the LC_{50} values of *Dakahlia* whitefly strain varied drastically from 0.66 to 10370 ppm. Most of these variations were within the group of the natural products. The field strain appeared to be more susceptible to the several compounds as abamectin e.g., which showed lowest LC_{50} value (0.66 ppm) this value for and azadirachtin was LC_{50} values 317.76 ppm. the natural products showed highest LC_{50} values e.g., CaPL2, misrona, KZ, CaPL1, super royal by 1077.19 ppm, 3792.54ppm, 5081.96ppm, 5086.74ppm, 10370 ppm, respectively. The pyrethroids, cypermethrin showed moderate LC_{50} value of 263.04 ppm, the LC_{50} of imidacloprid was 56.22 ppm, and in the case of thiourea, diafenthiuron LC_{50} value, 162.36 ppm; the LC_{50} values two carbamates, methomyl and pirimicarb showed high level of LC_{50} values it was 449.97ppm and 644.45 ppm, respectively. The members of organophosphorous, chlorpyrifos methyl, dimethoate, malathion showed high LC_{50} values of 2273.2ppm, 2908.58 ppm, and 4408.18 ppm, respectively. On the other hand, pirimiphos methyl and profenofos showed moderate LC_{50} values, of 185.69ppm and 347.25 ppm, respectively. The resistant levels were as follows: CaP.L2 (5.2 fold), azadirachtin (1.2 fold), abamectin (1.6 folds), KZ (5.5 fold), but CaPL1 acquired resistance (10.3 fold), super royal (13.5 fold). While misrona was more toxic on this field strain (0.7 fold). The two carbamates showed still susceptible pirimicarb 2.3 fold, methomyl 3.2 fold and the thiourea, diafenthiuron (1.7 fold). The (RL) of pyrethroids cypermethrin was 2.3 fold. Etofenprox was more effective on field strain 0.03 fold than laboratory strain. The organophosphate, profenofos was 2.5 fold, dimethoate 2.7 fold, chlorpyrifos methy 14.04 fold, pirimiphos methy was of tolerance level (5.2 fold) but the strain acquired resistance to malathion (30.14 fold).

Table (5): Susceptibility of whitefly adult *Bemisia tabaci* of Dakahlia Governorate to different insecticides during 1996.

Insecticides used	Slope function .	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	1.4	0.66	-	-	5.07	-	-	1.6
Azadirachtin *	2.16	317.76	-	-	1241.54	-	-	1.2
KZ *	1.6	5081.96	-	-	32001	-	-	5.5
Misrona *	1.76	3792.54	1172.94 : 6493.54	-	20153	11761 : 65505	-	0.7
Super royal*	3.36	10370.	8087 : 120760	-	24926	20711 : 34945	-	13.5
CaPL1 *	5.13	5086.74	3693.15 : 6231.4	-	9039.6	7174.5 : 16857	-	10.3
CaPL2*	5.27	1077.19	-	-	1883.89	-	-	5.2
Etofenprox □□	1.57	6.56	3.44 : 10.47	-	42.68	23.83 : 136.97	-	0.03
Profenofos ∇	3.45	347.25	277.47 : 407.84	-	816.46	673.74 : 1114.31	-	2.5
Dimethoate ∇	1.48	2908.58	2359.16 : 3549.86	-	21175	14827 : 35131	-	2.7
Malathion ∇	1.58	4408.18	3554.40 : 53341.0	-	28449	20341 : 46606	-	30.14
Pirimiphos methyl ∇	1.76	185.69	129.57 : 235.97	-	991.19	690.38 : 1931	-	5.2
Pirimicarb ∇∇	3.9	644.45	360.07 : 831.01	-	1371.2	1032.73 : 3306.88	-	2.3
Cypermethrin □□	1.7	263.04	165.23 : 347.27	-	1477.31	1016.24 : 3055.49	-	2.3
Chlorpyrifos methyl ∇	2.11	2273.2	1693.21 : 3056.12	-	9165.3	6226.3 : 16525	-	4.04
Diafenthuron ∇∇∇	2.61	162.36	120.97 : 201.38	-	502.96	389.25 : 756.35	-	1.7
Imidacloprid □□□	1.37	56.22	38.63 : 75.19	-	483.27	328.11 : 862.09	-	3.8
Methomyl ∇∇	2.47	449.97	389.65 : 512.67	-	1485.55	1239.49 : 1877.4	-	3.2

□□ pyrethroid.

□□□ imidazol.

* natural product

∇∇∇ Insect Growth Regulator

∇∇ carbamates

∇ organophosphates.

ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent

LC₉₀: Lethal concentration killed ninety percent

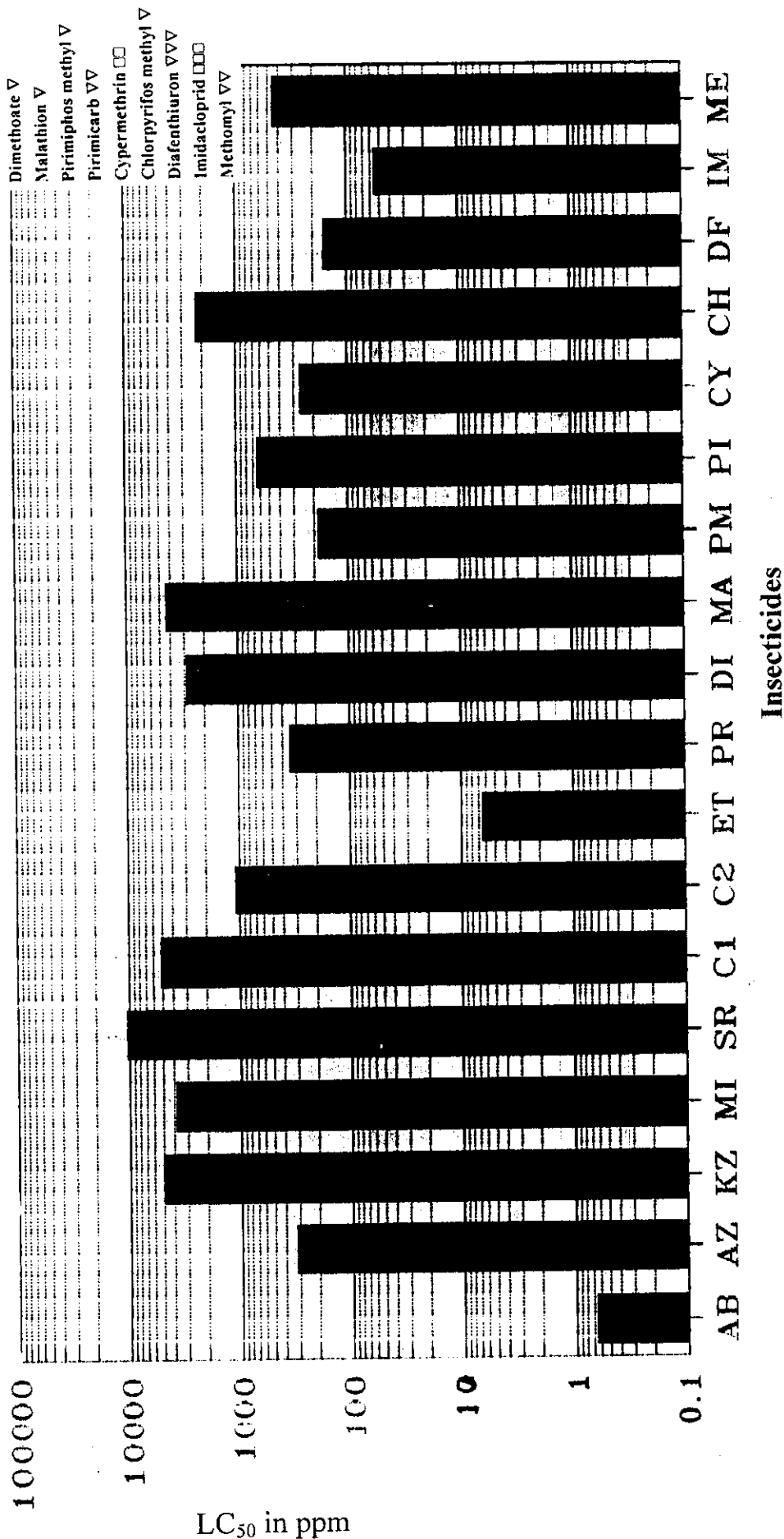
RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

LC₅₀ Lab. strain.

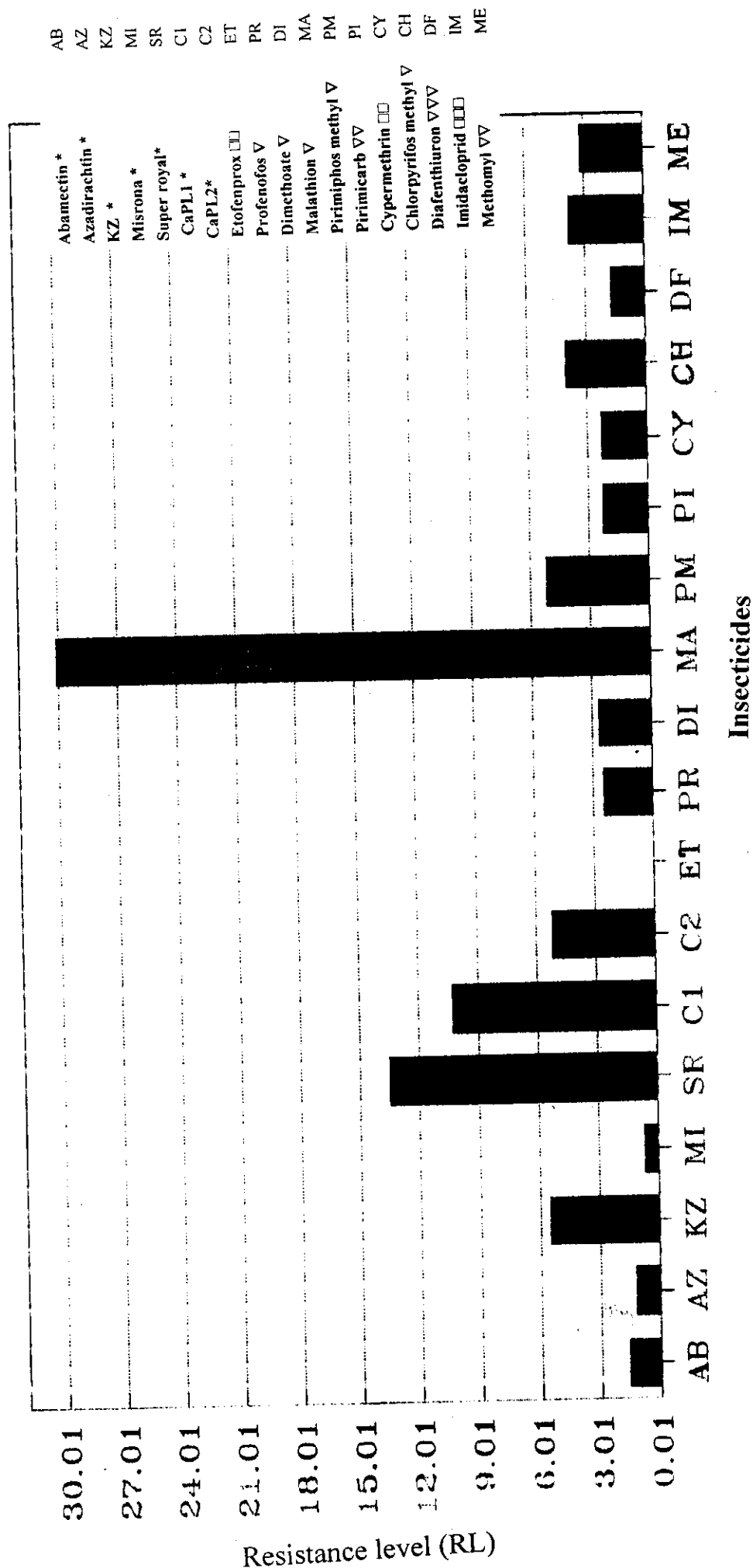
AB
 AZ
 KZ
 MI
 SR
 C1
 C2
 ET
 PR
 DI
 MA
 PM
 PI
 CY
 CH
 DF
 IM
 ME

Abamectin *
 Azadirachtin *
 KZ *
 Misrona *
 Super royal*
 CaPL1 *
 CaPL2*
 Etofenprox □□
 Profenofos ▽
 Dimethoate ▽
 Malathion ▽
 Pirimiphos methyl ▽
 Pirimicarb ▽▽
 Cypermethrin □□
 Chlorpyrifos methyl ▽
 Diafenthiuron ▽▽▽
 Imidacloprid □□□
 Methomyl ▽▽

Fig(8) LC_{50} values of the used insecticides to *Dakahlia* field strain of *Bemisia tabaci* adults during the year 1996.



Fig(9) Resistance level of *Dakahila* strain of *Bemisia tabaci* to the used insecticides (1996) based on LC₅₀.



2-3- Behera strain

2-3-1- Susceptibility evaluation during 1995

Data presented in Table (6) and Fig (11) clearly indicated that this strain showed a wide range of LC_{50} (0.3 – 18748 ppm) and the most of the variation of LC_{50} values in the group of natural products (125 to 18748 ppm) except abamectin which showed the lowest LC_{50} value of 0.3 ppm. CaPL2 oil and CaPL1 oil showed LC_{50} values of 1472.8 and 2895.9 ppm, respectively. Azadirachtin showed moderate value of LC_{50} (125 ppm). On the other hand, the oils, Kz misrona and super royal showed somewhat higher LC_{50} values of 4443.1 ppm, 6617.4 ppm and 18748 ppm, respectively. The two carbamates, pirimicarb and methomyl gave contradicting values of LC_{50} of 7.2 ppm and 251.4 ppm, respectively. The pyrethroid cypermethrin showed moderate LC_{50} value of, 212.7 ppm. The thiourea diafenthiuron showed moderate LC_{50} value of 333.6 ppm, however, imidacloprid showed the lowest LC_{50} value of 49.1 ppm. Most of the variations in LC_{50} value were within the group of the organophosphates showing a range of 1020.01 – 2653.7 ppm except pirimiphos methyl (45.7 ppm). Dimethoate, chlorpyrifos methyl and malathion showed LC_{50} values of 1020.0, 2132.5 and 2653.7 ppm, respectively, from our results obtained in Table (6) and Fig. (12) it is clear that Behera strain showed that Behera field strain didn't manifest any tolerance to the tested materials of dimethoate (1 fold), pirimiphos methyl (1.3 fold) cypermethrin (1.9 fold), CaPL2 (1.3 fold) super royal (2.7 fold), methomyl (1.8 fold). Imidacloprid (3.3 folds), diafenthiuron (3.4 fold), chlorpyrifos methyl (3.8 fold), KZ oil (4.8 folds). While CaPL1 showed tolerance of (5.8 folds). The natural products indicated high susceptibility of field strain to than laboratory strain abamectin (0.7 fold), azadirachtin (0.5 fold) and the carbamate pirimicarb (0.03 fold), but resistance to misrona (12.7 fold) and malathion (18.2 fold).

Table (6): Susceptibility of whitefly adult *Bemisia tabaci* of Behera Governorate to different insecticides during 1995.

Insecticides used	Slope function	LC ₅₀ ppm	90%		LC ₉₀ ppm	90%		RL Based on LC ₅₀
			Fiducial limits			Fiducial limits		
Abamectin *	1.6	0.3	0.15 : 0.43		1.93	1.15 : 5.7		0.7
Azadirachtin *	1.1	125	82.1 : 177.5		1998.5	1127.8 : 4973.9		0.5
KZ *	1.04	4443.1	7685.3 : 6438.8		76321	45553 : 0.17E+06		4.8
Misrona *	1.3	6617.4	12606 : 12557		66357	30.488 : 0.9E+06		12.7
Super royal*	1.6	18748	14606 : 24334		11000000	72797 : 0.29E+06		2.7
CaPL1 *	3.9	2895.9	2691.8 : 3113.8		6122.3	5466 : 7064		5.8
CaPL2*	0.63	1472.8	864.1 : 2399		15000000	67635 : 0.51E+06		1.3
Dimethoate ∇	0.93	1020.01	764.8 : 1333.2		24168	12303 : 74659		1
Malathion ∇	0.66	2653.7	1528.1 : 4989.6		233288.5	62382.6		18.2
Pirimiphos methyl ∇	0.80	45.7	11.5 : 95.7		1925.4	596.9 : 57538		1.3
Pirimicarb ∇∇	1.77	7.2	6.3 : 8.2		38.18	31.5 : 48.1		0.03
Cypermethrin □□	1.9	212.7	185.4 : 242.4		1015.5	759.6 : 1571.1		1.9
Chlorpyrifos methyl ∇	1	2132.5	960.8 : 3722.7		42492	19766 : 0.18E+06		3.8
Diafenthuron ∇∇∇	1.9	333.6	161.5 : 473.9		1481.9	1028.4 : 3232.5		3.4
Imidacloprid □□□	2.1	49.1	39.8 : 58.7		97.7	156.3 : 272.1		3.3
Methomyl ∇∇	1.4	251.4	207.6 : 298.1		2045.4	1518.1 : 3058.2		1.8

* natural product

∇∇∇ Insect Growth Regulator

∇∇ carbamates

∇ organophosphates.

□□ pyrethroid.

□□□ imidazol.

ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent

LC₉₀: Lethal concentration killed ninety percent

RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. Strain}}$

Fig(10) LC_{50} values of the used insecticides to Behera field strain of *Bemisia tabaci* adults during the year (1995).

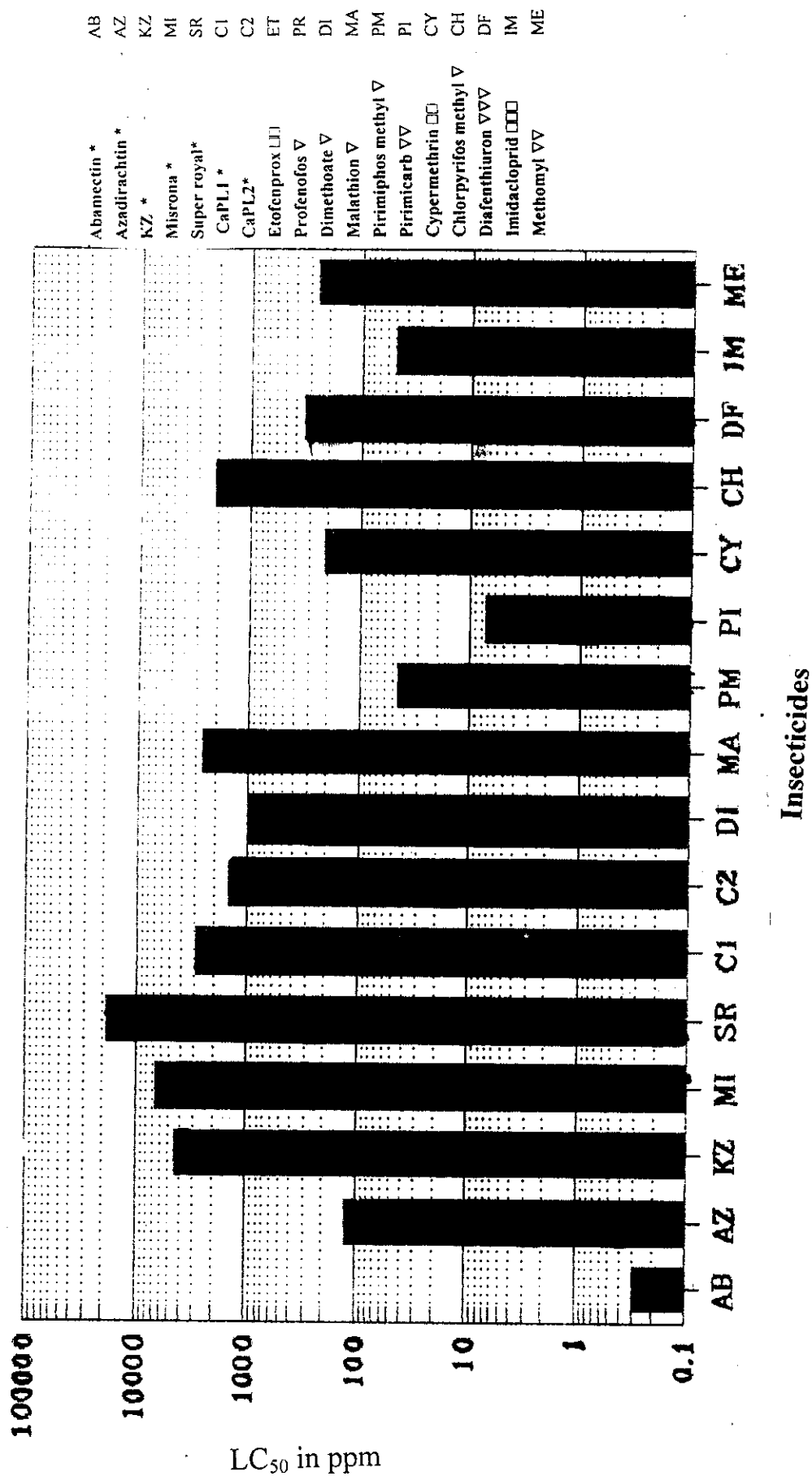
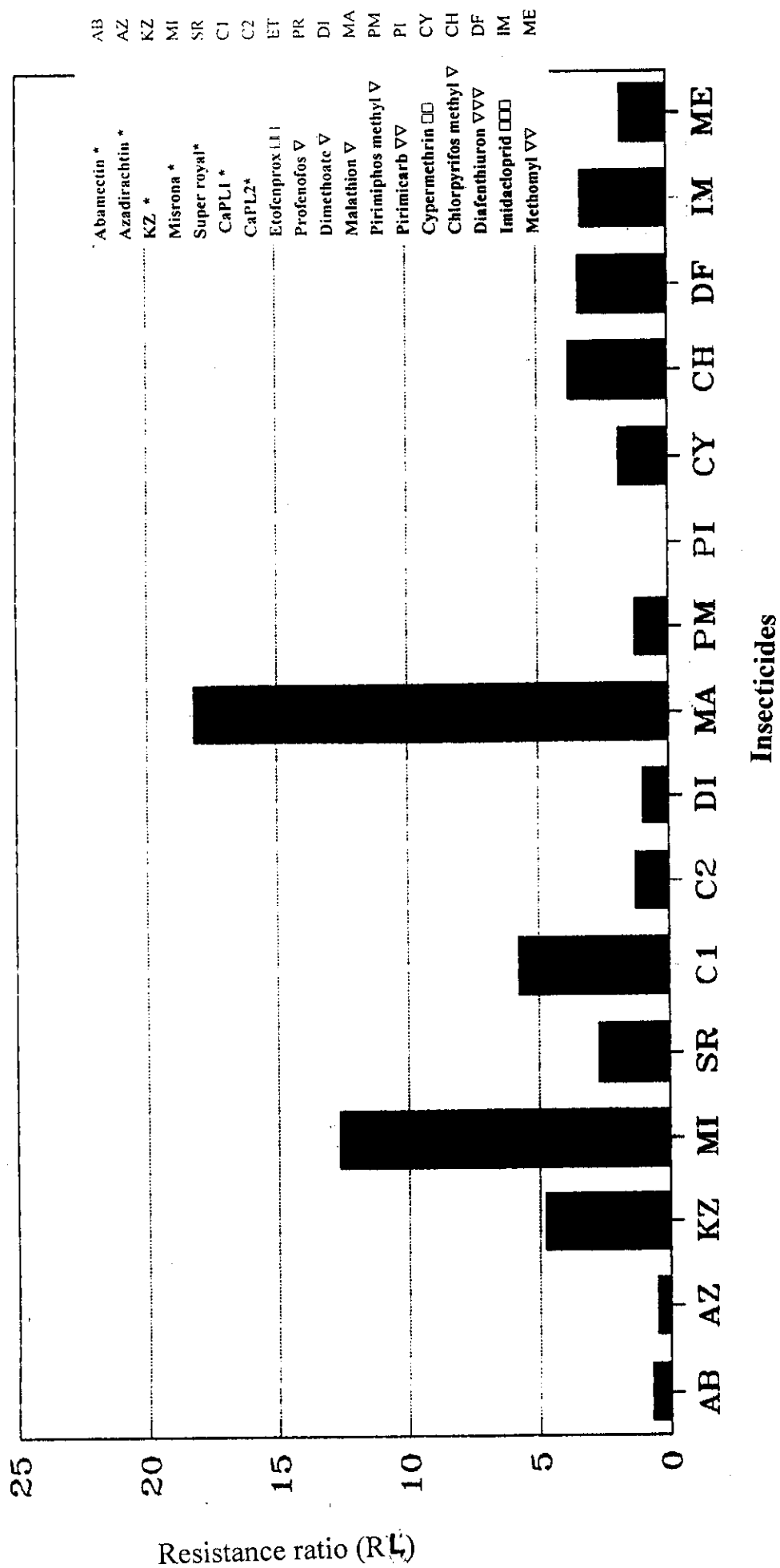


Fig (II) Resistance ratio of the Behera strain of *Bemisia tabaci* to the used insecticides. (1995) based on LC₅₀



2-3-2- Susceptibility evaluation during 1996

The obtained LC_{50} values of the tested products pointed a big range of variations (34.81 – 93576 ppm). except abamectin, (0.56 ppm) Results presented in Table (7) and illustrated in Fig. (12) confirmed previous the some findings in 1995. Among the natural products abamectin and azadirachtin showed the LC_{50} values 0.56 ppm and 149.75 ppm, respectively, while the five other natural products, viz CaPL2, super royal, KZ, misrona and CaPL1 were 1316.03 ppm, 4747.49ppm, 5886.79ppm, 9887.3 ppm, and 93576 ppm, respectively. The tested organophosphorous showed high LC_{50} values of dimethoate, profenofos, chlorpyrifos methyl, and malathion were 1692.96ppm, 1782.71ppm, 2539.25ppm and 7994.52 ppm respectively however, pirimiphos methyl showed moderate LC_{50} values of 231.83 ppm. The pyrethroid cypermethrin showed moderate LC_{50} value of 131.45 ppm. The thiourea diafenthiuron showed also moderate value of 348.89 ppm. Pirimicarb and methomyl showed somewhat higher values of 540.04 ppm and 684.57 ppm, respectively. The imidacloprid showed low LC_{50} value it was 34.81 ppm. The resistance levels revealed that the natural products are of tolerant level to susceptible as CaPL2 (6.3 fold), abamectin (1.4 folds), misrona (9 fold), KZ (6.3 fold). On the other hand, CaPL1 indicating resistant level (188.9 fold). But azadirachtin, super royal and misrona were more effective (0.6 fold, 0.7 fold and 0.9 fold, respectively). This strain showed low susceptible or tolerant to pirimicarb (1.9 fold) and methomyl (5 fold). On the other hand, low resistant level with chlorpyrifos methyl, (4.5 fold) and pirimiphos methyl (6.5 fold) were reported but profenofos showed resistance (12.6 fold) and malathion (54.7 fold) while cypermethrin was susceptible (1.1 fold). Imidacloprid showed of susceptible value (2.3 fold). This strain was susceptible to

Table (7): Susceptibility of whitefly adult *Bemisia tabaci* of Behera Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90%		LC ₉₀ ppm	90%		RL based on LC ₅₀
			Fiducial limits			Fiducial limits		
Abamectin *	2.34	0.56	-		1.97	-		1.4
Azadirachtin *	1.33	149.75	113.55 : 194.34		1384.63	15531 : 26429		0.6
KZ *	2.29	5886.79	4196.66 : 7585.7		21355	15531 : 36429		6.3
Misrona *	2.05	9887.3	8567.4 / 11284		41625.	33090 : 157028		0.9
Super royal*	1.41	4747.49	3860.91 : 5689.5		38527.	28221 : 59150		0.7
CaPL1 *	0.32	93576	3860.91 : 5689.5		38227.	28221 : 59150		188.9
CaPL2*	1.89	1316.03	873.69 : 1816.59		68000000	0.21286E+06.0.51E+07		6.3
Etofenprox □□	1.06	371.93	236.33 : 531.99		6020.1	3630.5 : 12889		1.8
Profenofos ▽	1.15	1782.71	1303.25 : 2350.76		23440.	13696 : 55912		12.6
Dimethoate ▽	1.33	1692.96	1199.08 : 2295.37		15523	94183 : 349441.		1.6
Malathion ▽	2.37	7994.52	-		27749.0	-		54.7
Pirimiphos methyl ▽	1.93	231.83	201.48 : 265.31		1070.9	864.65 : 1402.95		6.5
Pirimicarb ▽▽	0.96	540.04	415.70 : 690.34		11811.0	6920.6 : 25740		1.9
Cypermethrin □□	1.29	131.45	85.03 : 188.37		1274.2	736.45 : 3260.7		1.1
Chlorpyrifos methyl ▽	1.78	2539.25	2104.47 : 301075		13372	10065 : 19945		4.5
Diafenthuiuron ▽▽▽	1.26	348.89	275.06 : 442.63		3612.5	2260.91 : 7283.5		3.6
Imidacloprid □□□	1.38	34.81	22.25 : 51.24		296.44	157.7 : 1032.92		2.3
Methomyl ▽▽	2.58	684.57	593.69 : 788.17		2150	1710.21 : 2977.09		5

* natural product
 ∇∇∇ Insect Growth Regulator
 ∇∇ carbamates
 ∇ organophosphates.

□□ pyrethroid.
 □□□ imidazol.

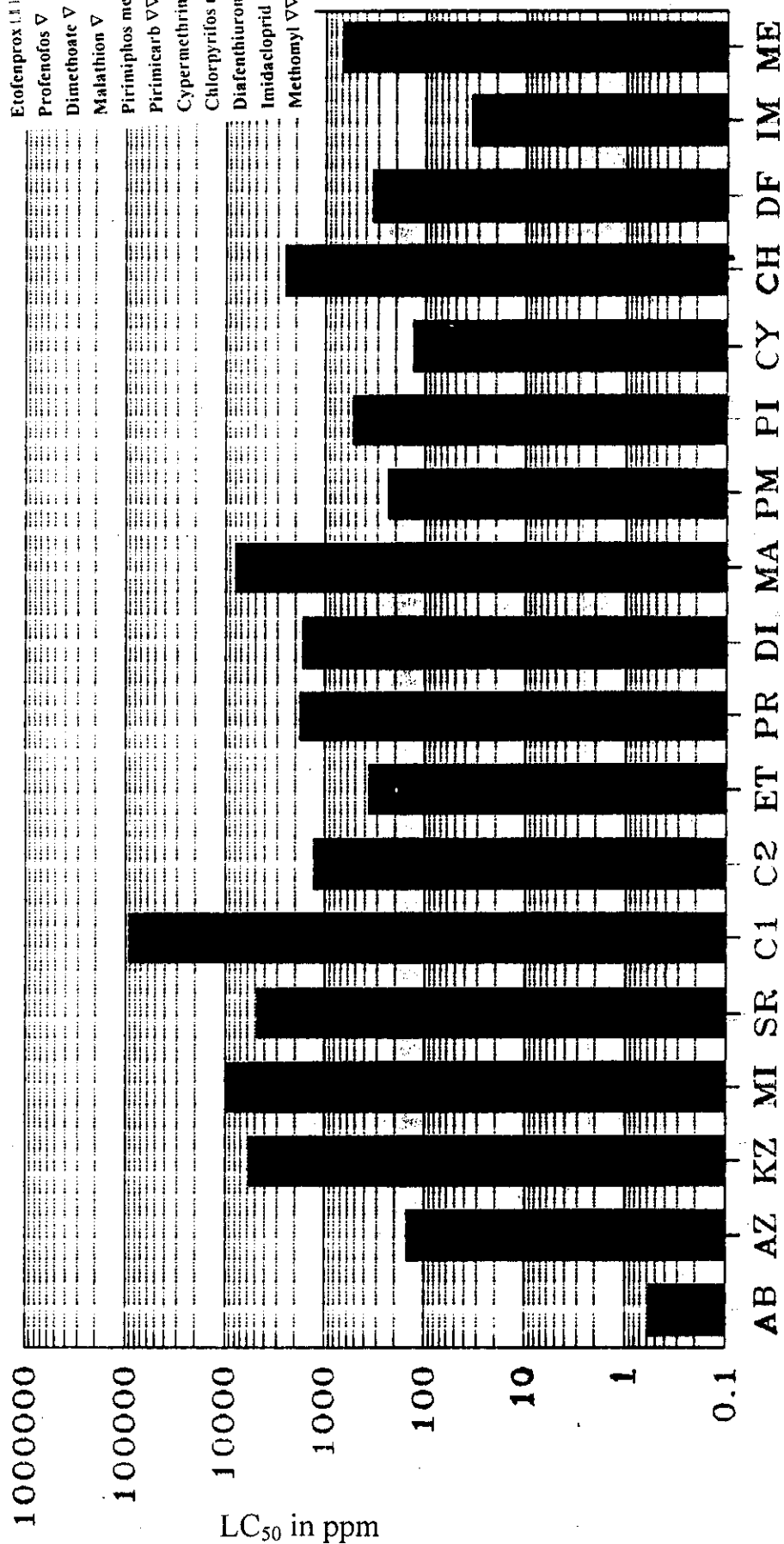
ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL :Resistance level : $\frac{LC_{50}}{field\ strain}$
 LC₅₀ Lab. strain.

AB
AZ
KZ
MI
SR
C1
C2
ET
PR
DI
MA
PM
PI
CY
CH
DF
IM
ME

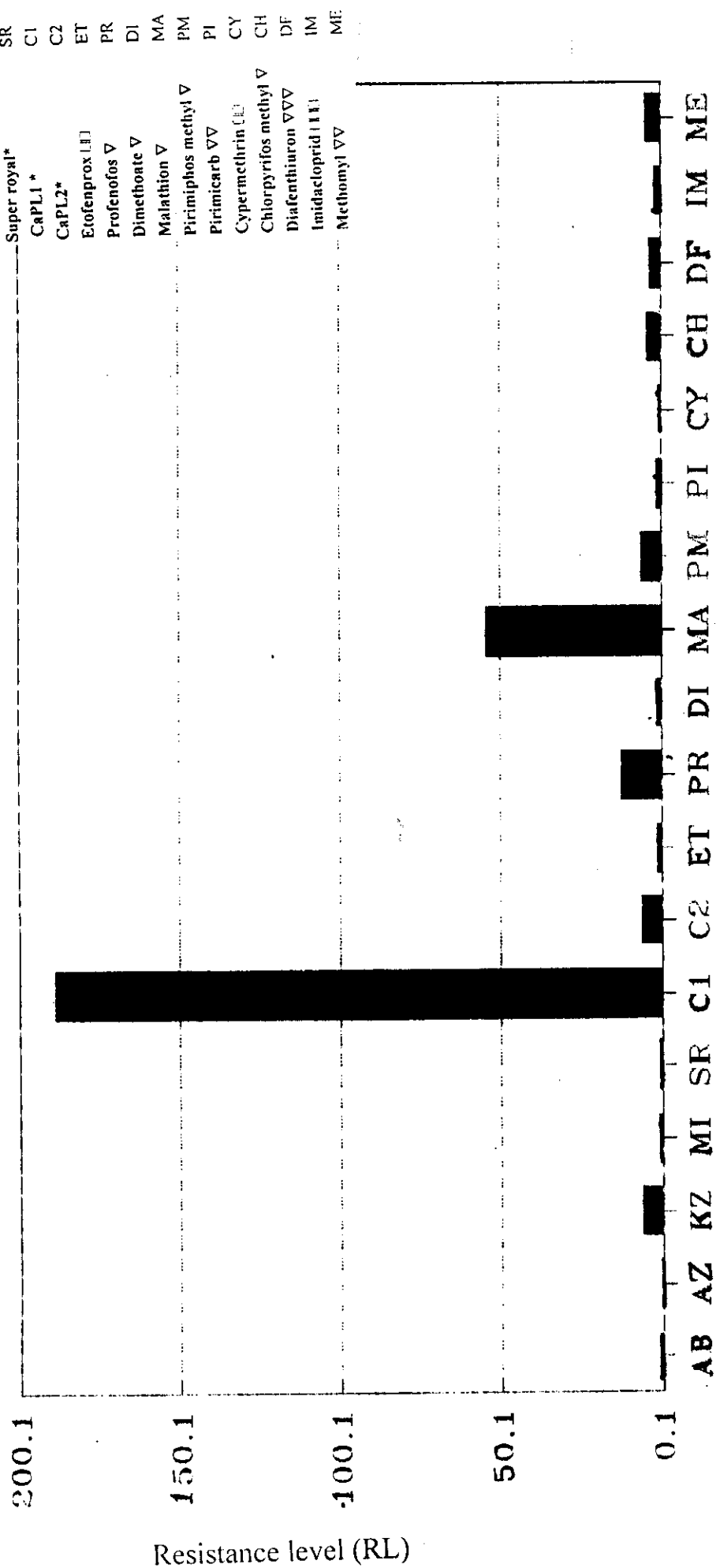
Abamectin *
Azadirachtin *
KZ *
Misrona *
Super royal *
CaPL1 *
CaPL2 *
Etofenprox [L]
Profenofos ∇
Dimethoate ∇
Malathion ∇
Pirimiphos methyl ∇
Pirimicarb ∇∇
Cypermethrin [L]
Chlorpyrifos methyl ∇
Difenthiuron ∇∇∇
Imidacloprid [L]
Methomyl ∇∇

Fig(12) LC₅₀ values of the used insecticides to Behera field strain of *Bemisia tabaci* adults during the year 1996.

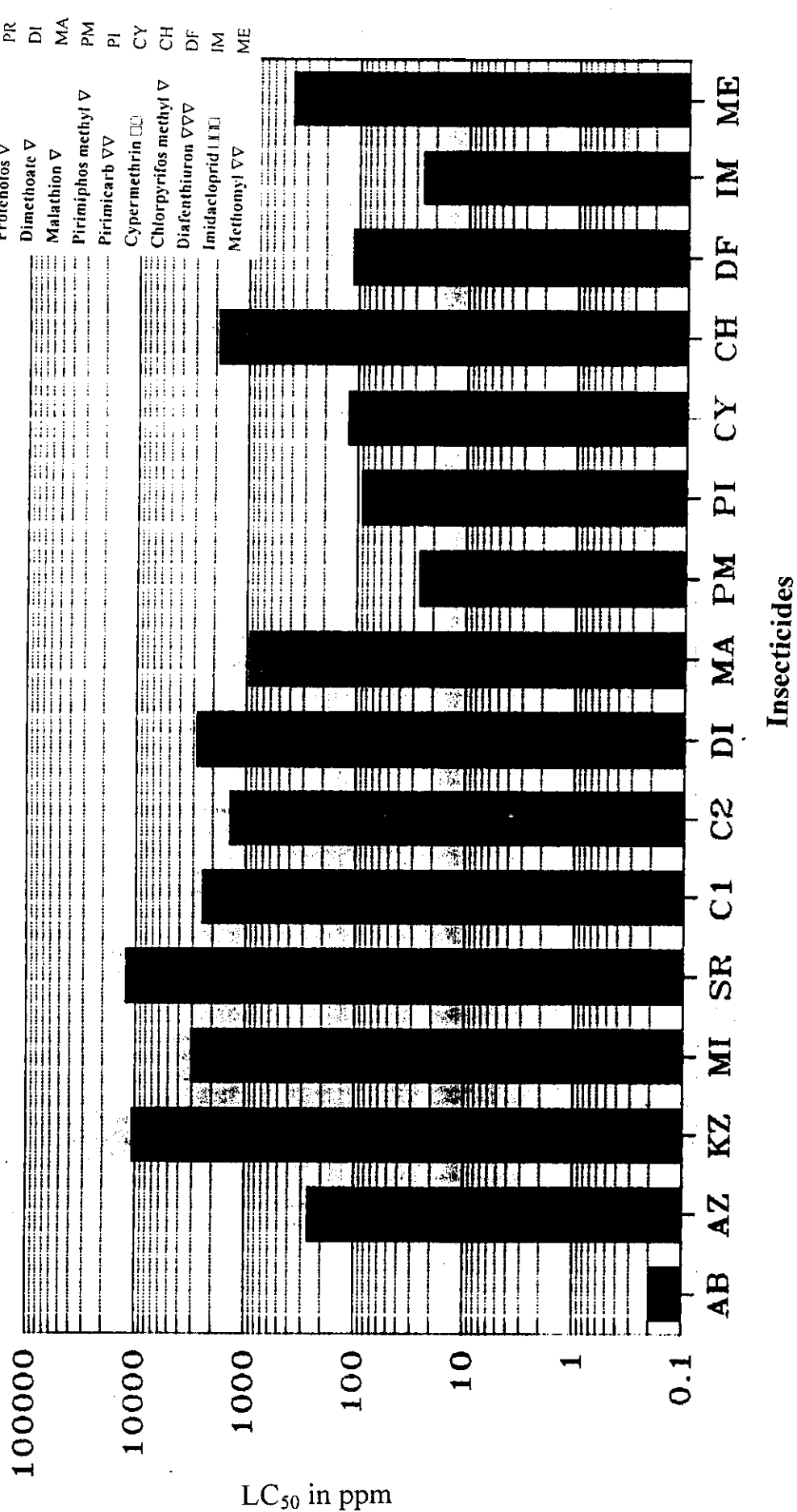


Insecticides

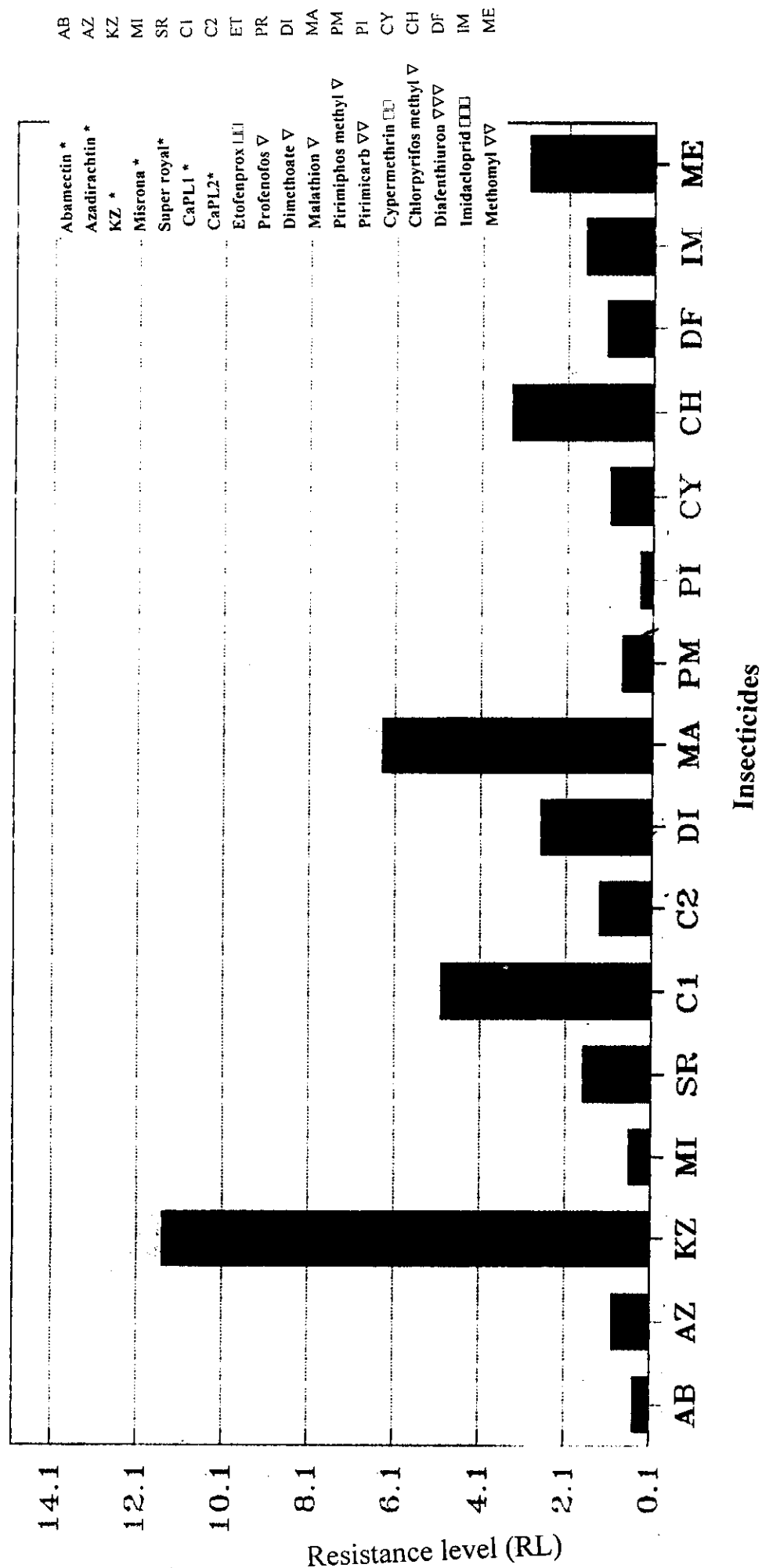
Fig(13) Resistance level of Behera strain of *Bemisia tabaci* to the used insecticides (1996) based on LC₅₀.



Fig(14) LC_{50} values of the used insecticides to Beni suef field strain of *Bemisia tabaci* adults during the year (1995).



Fig(15) Resistance level of Beni suef strain of *Bemisia tabaci* to the used insecticides (1995) based on LC₅₀s.



showed 11.5 fold. In the organophosphorous, the resistance level of Dimethoate chlorpyrifos methyl, malathion were 2.7,3.4,6.4 fold, respectively. While pirimiphos methyl was more effective (0.8 fold). And the resistance level of the two carbamate pirimicarb and methomyl were 0.4 and 3 fold, respectively.

2-4-2- Susceptibility evaluation during 1996

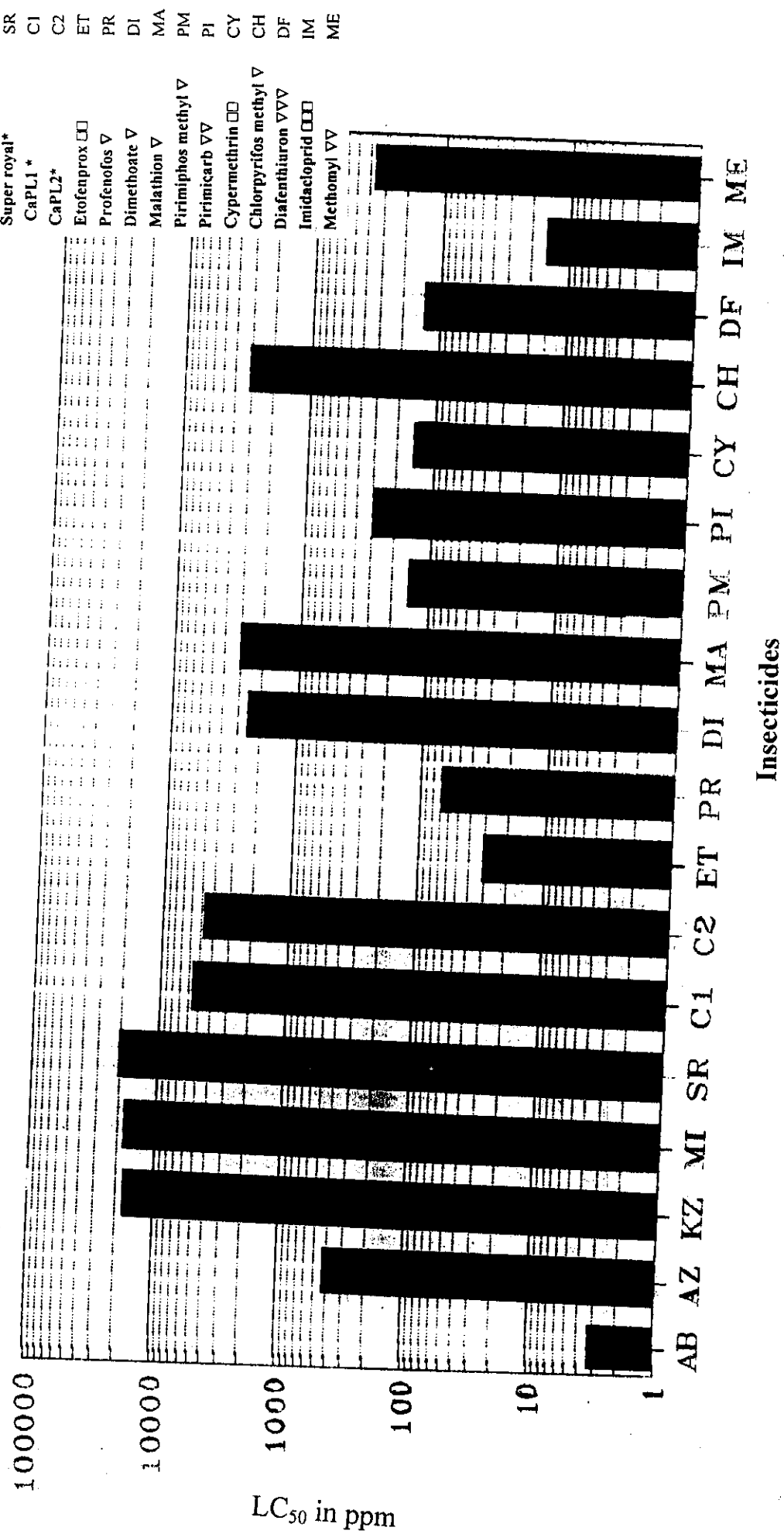
A wide range of variations in LC_{50} has been observed in Beni Suef as the values were ranged between 3.27 to 20703 ppm, as shown in Table (9) and Fig. (16). The LC_{50} values of natural products varied from 3.27 to 20703 ppm. Abamectin showed lower LC_{50} value 3.27 ppm, and moderate LC_{50} value of 427.95 ppm was observed with azadirachtin. Both other natural products oils showed high LC_{50} value to CaPL2, CaPL1, KZ, misrona, super royal to be 4743.35ppm, 5617ppm, 17576ppm, 18044ppm and 20703 ppm, respectively. Cypermethrin showed moderate value of LC_{50} value of 148.45 ppm and the thiourea, diafenthiuron showed moderate LC_{50} value of 135.73 ppm. The Imidazol imidacloprid showed high activity with LC_{50} value of 15.28 ppm. The two carbamates pirimicarb and methomyl showed moderate LC_{50} values of 297.58 and 372.03 ppm, respectively. Also etofenprox showed high activity with LC_{50} value of 31.12 ppm. The LC_{50} values of organophosphorous varied from 68.53 to 317.77 ppm reflecting the selection to some members of this group. Profenofos and pirimiphos methyl showed LC_{50} values of 68.53 and 147.1 ppm, respectively. In comparison the rest of the organophosphorous the recorded high LC_{50} values of 2510.36, 3053.67 and 3127.77 ppm with dimethoate, malathion and chlorpyrifos methyl, respectively. Comparing the Beni Suef field strain with the laboratory strain Table (9) and Fig. (17) revealed the high effect of etofenprox and profenofos (0.2 fold and 0.5 fold, respectively).

Table (9): Susceptibility of whitefly adult *Bemisia tabaci* of Beni Suef Governorate to different insecticides during 1996.

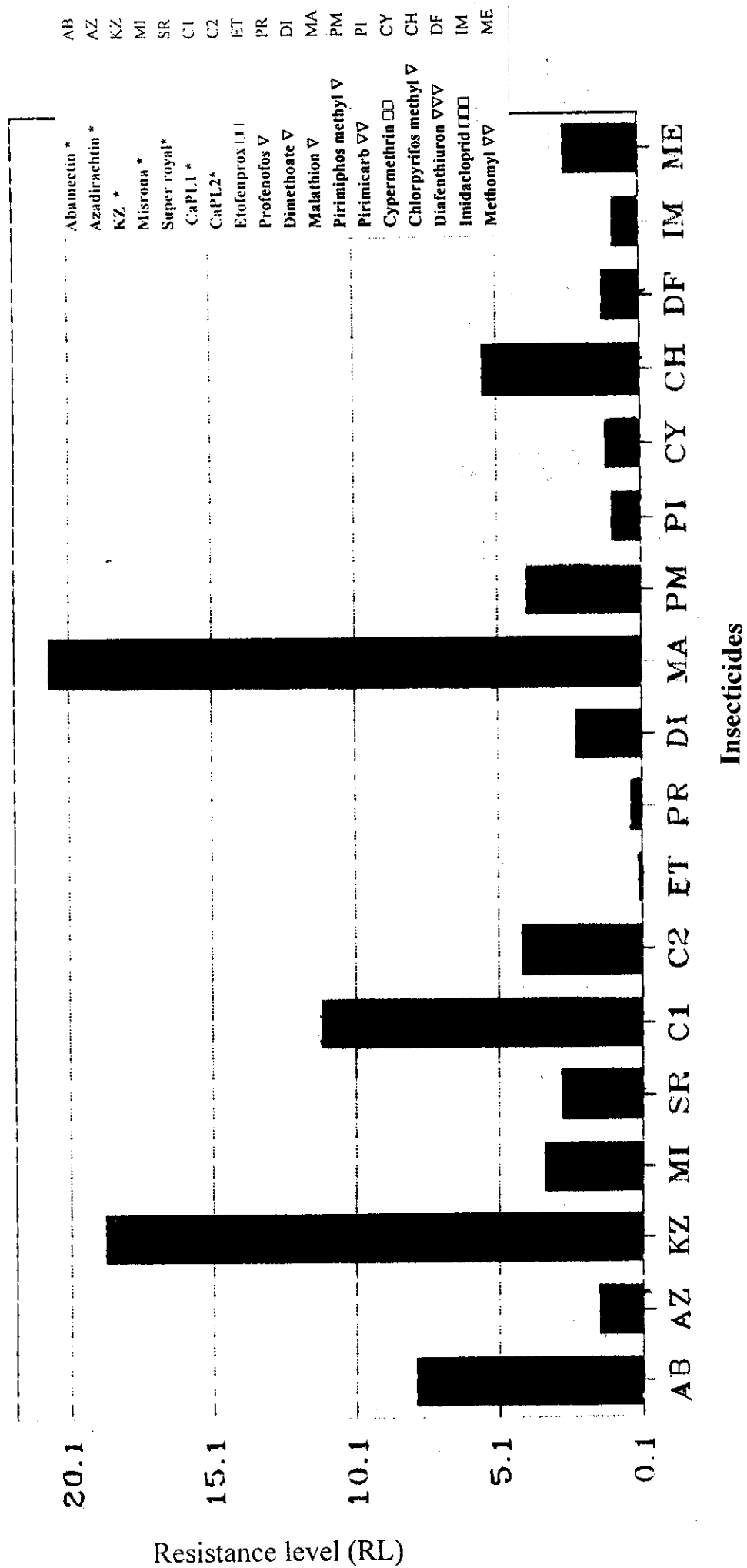
Insecticides used	Slope function	LC ₅₀ ppm	90%		LC ₉₀ ppm	90% Fiducial limits	RL based on LC ₅₀
			Fiducial limits				
Abamectin *	2.61	3.27	-	-	10.13	-	8
Azadirachtin *	3.07	427.95	348.91 : 501.32		1118.80	909.01 : 1551.85	1.6
KZ *	2.62	17576	14354 : 20455		54057	45349 : 69406	18.9
Misrona *	3.92	18044	-		38268	-	3.5
Super royal*	1.87	20703	16812 : 24836		99626	70719 : 0.17E+06	2.9
CaPL1 *	1.65	5617	1616.4 : 9150.9		33396	21341 : 95596	11.3
CaPL2*	2.02	4743.35	2360.13 : 6779.27		20370	14753 : 36266	4.3
Etofenprox □□	1.62	31.12	-		192.72	-	0.2
Profenofos ▽	1.38	68.53	44.23 : 95.69		582.08	377.92 : 1137.55	0.5
Dimethoate ▽	1.54	2510.36	1874.78 : 3194.9		17014	11636 : 30755	2.4
Malathion ▽	1.06	3053.36	-		55764	-	20.8
Pirimiphos methyl ▽	1.97	147.1	116.76 : 176.73		657.76	498.42 : 1007.20	4.1
Pirimicarb ▽▽	2.04	297.58	224.27 : 265.26		1263.53	958.91 : 1960.46	1.1
Cypermethrin □□	1.01	148.45	52.05 : 277.18		2743.2	1139.1 : 27476	1.3
Chlorpyrifos methyl ▽	2.14	3127.77	1578.48 : 4325.05		11996.	8387.6 : 27476	5.6
Diafenthuiuron ▽▽	1.84	135.73	100.50 : 177.49		674.09	458.57 : 1241.08	1.4
Imidacloprid □□□	0.94	15.28	10.3 : 21.33		353.87	193.41 : 1910.3	1
Methomyl ▽▽	2.49	372.03	300.99 : 440.77		1213.49	960.59 : 1732.47	2.7

* natural product
 ▽▽ Insect Growth Regulator
 ▽▽ carbamates
 ▽ organophosphates.
 □□ pyrethroid.
 □□□ imidazol.
 ppm : Part per million
 LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level : LC_{50} field strain
 LC₅₀ Lab. strain.

Fig(16) LC_{50} values of the used insecticides to Beni suef field strain of *Bemisia tabaci* adults during the year 1996.



Fig(17) Resistance level of Beni suef strain of *Bemisia tabaci* to the used insecticides (1996) based on LC₅₀.



The resistance level of two carbamates, pirimicarb and methomyl showed 1.1 fold and 2.7 fold, respectively. The pyrethroid, cypermethrin was reported 1.3 fold. However, the natural products azadirachtin (1.6 fold), misrona, (3.5 fold), super royal (2.9 fold) and CaPL2 (4.3 fold). Among the natural products, resistance was observed to CaPL1 (11.3 fold) KZ (18.9 fold). The strain displayed vigor tolerance to chlorpyrifos methyl (5.6 fold) and resistance to malathion 20.8 fold).

B- The cotton leafworm *Spodoptera littoralis*

1-Laboratory strains

Data presented in Table (10) and Fig. (18) showed that the LC_{50} values for most of the tested formulated products ranged between 15.07 and 615.86 ppm with exception of two Insect Growth Regulator, (IGR) lufenuron, hexaflumuorn, alpha cypermethrin and fenvalerate were the most potent insecticides with LC_{50} of 0.29, 2.09, 2.43 and 4.08 ppm, respectively. The LC_{50} values of chlorpyrifos, aimx (chlorfluazuron + profenofos), profenofos, methomyl, and cyanophos were 15.07, 15.07, 18.79, 30.51, and 615.86 respectively, The LC_{50} values of two natural products abamectin and azadirachtin values were 91.59 and 234.17, respectively.

The mineral oils haven't any effect on laboratory strain. As kz misrona, CaPL1, CaPL2, super royal, and also on field strain after one day or 6 day.

2- Field strains

2-1- Kalubia strain

2-1-1 Susceptibility evaluation during 1995

This strain showed a wide range of LC_{50} (0.29 – 3632.7 ppm) as shown in Table (11) and illustrated in Fig. (19). The majority of the

Table (10): Susceptibility of laboratory strain of *Spodoptera littoralis* to different insecticides.

Insecticides used	S/lope function	LC ₅₀ ppm	90%	
			Fiducial limits	Fiducial limits
Abamectin *	1.28	91.59	61.37 : 135.40	465.24 : 3510.
Azadirachtin *	1.67	234.17	164.13 : 316.36	885.68 : 2806.46
Lufenuron **	1.77	0.29	0.21 : 0.39	1.13 : 2.48
Hexaflumuron **	1.32	2.09	1.43 : 2.91	11.66 : 45.80
Alpha cypermethrin ΔΔ	2.68	2.43	1.96 : 2.89	5.84 : 10.26
Chlorpyrifos Δ	2.65	15.07	11.89 : 18.94	36.67 : 106.56
Fenvalerate ΔΔ	4.58	4.08	3.63 : 4.49	6.95 : 9.8
Cyanophos Δ	1.88	615.86	261.62 : 1056.56	15.85.9 : 9.17210
Profenofos Δ	2.	18.79	-	-
Methomyl □	7.83	30.51	28.23 : 32.58	40.94 : 50.44
Chlorfluazuron + profenofos)Aimx ♦	2.16	15.07	11.91 : 18.94	36.67 : 106.57

(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain.}}$

Fig(18) LC_{50} values of the used insecticides laboratory strain of *Spodoptera littoralis*.

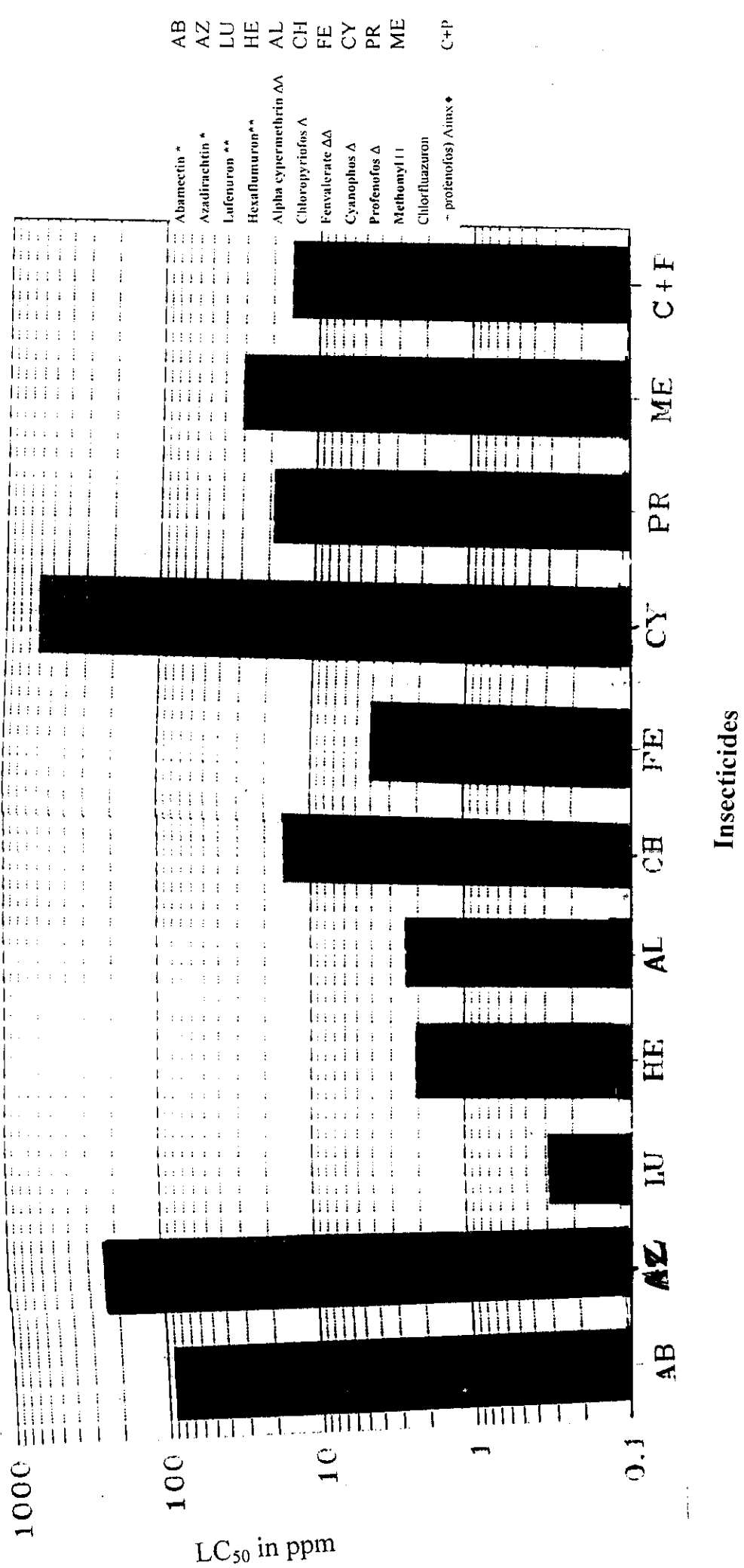


Table (11): Susceptibility of *Spodoptra littoralis* of Kalubia governorate to different insecticide during 1995.

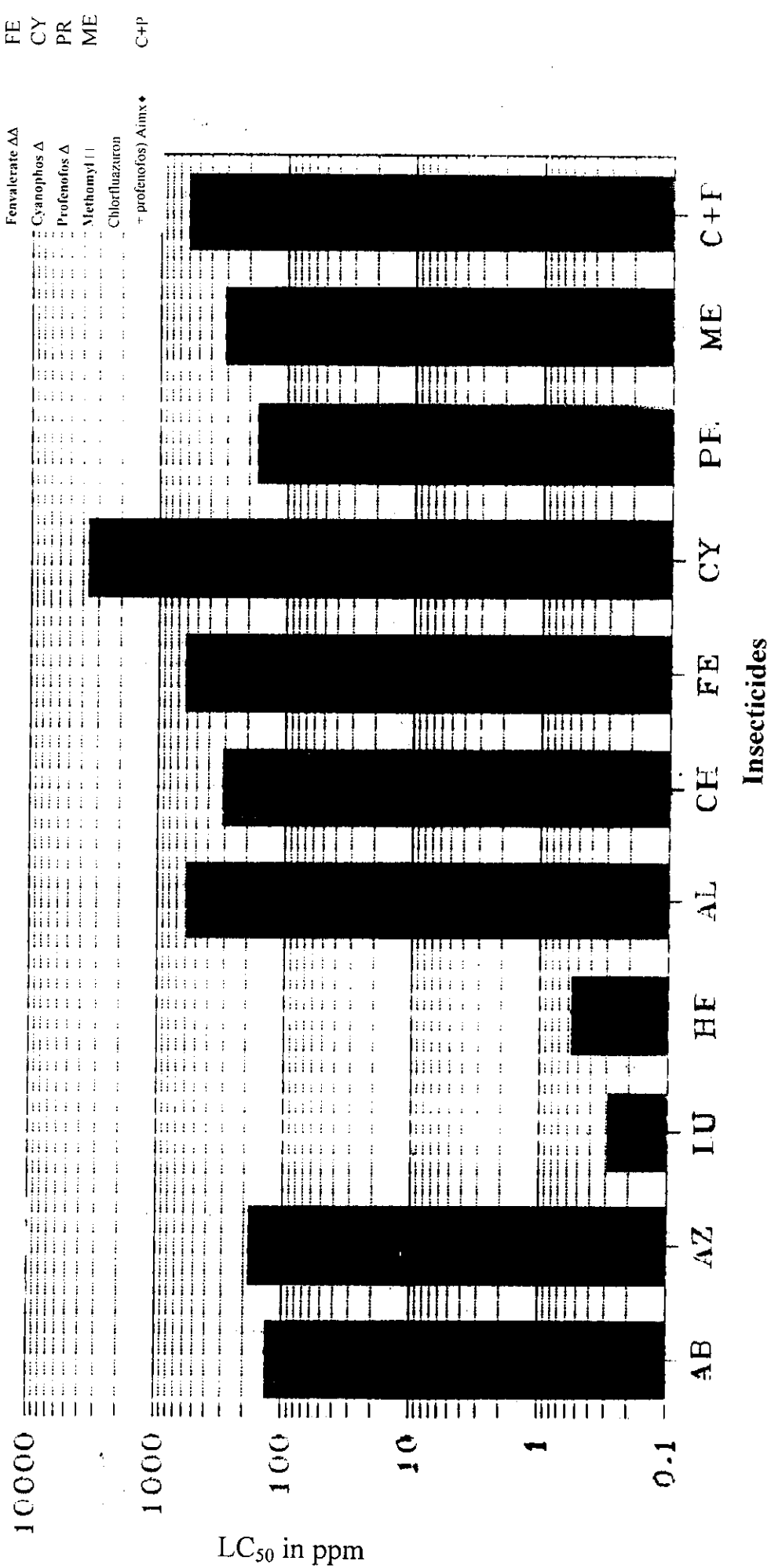
Insecticides used	Slope function	LC ₅₀ ppm	90%		LC ₉₀ ppm	90% Fiducial limits	RL based on LC ₅₀
			Fiducial limits				
Abamectin *	0.80	134.46	46.17 : 307.91		5494.4	1429.6 : 0.31379E+06	1.47
Azadirachtin *	5.3	182.78	159.12 : 204.94		319.01	279.58 : 385.16	0.78
Lufenuron **	16.15	0.29	0.28 : 0.30		0.34	0.32 : 0.41	1
Hexaflumuron **	1.26	0.57	0.34 : 0.81		5.84	3.60 : 13.21	0.27
Alpha cypermethrin ΔΔ	1.94	581.45	249.29 : 904.38		2663.0	1502.6 : 18896	239.28
Chlorpyrifos Δ	1.71	307.67	221.33 : 491.73		1723.2	882.31 : 8302.9	20.4
Fenvalerate ΔΔ	1.92	613.73	399.36 : 861.90		2864.7	1775.6 : 7786.0	150.42
Cyanophos Δ	4.41	3632.74	-		7095.33	-	5.9
Profenofos Δ	1.3	172.57	17.27 : 251.4		1684.9	908.2 : 5030.2	9.18
Methomyl □	3.99	312.65	212.58 : 461.9		655.05	448.49 : 2515.81	10.24
Chlorfluazuron + profenofos)Aimx ♦	2.21	598.56	448.59 : 795.53		2274.3	1483.2 : 5362.1	39.71

(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

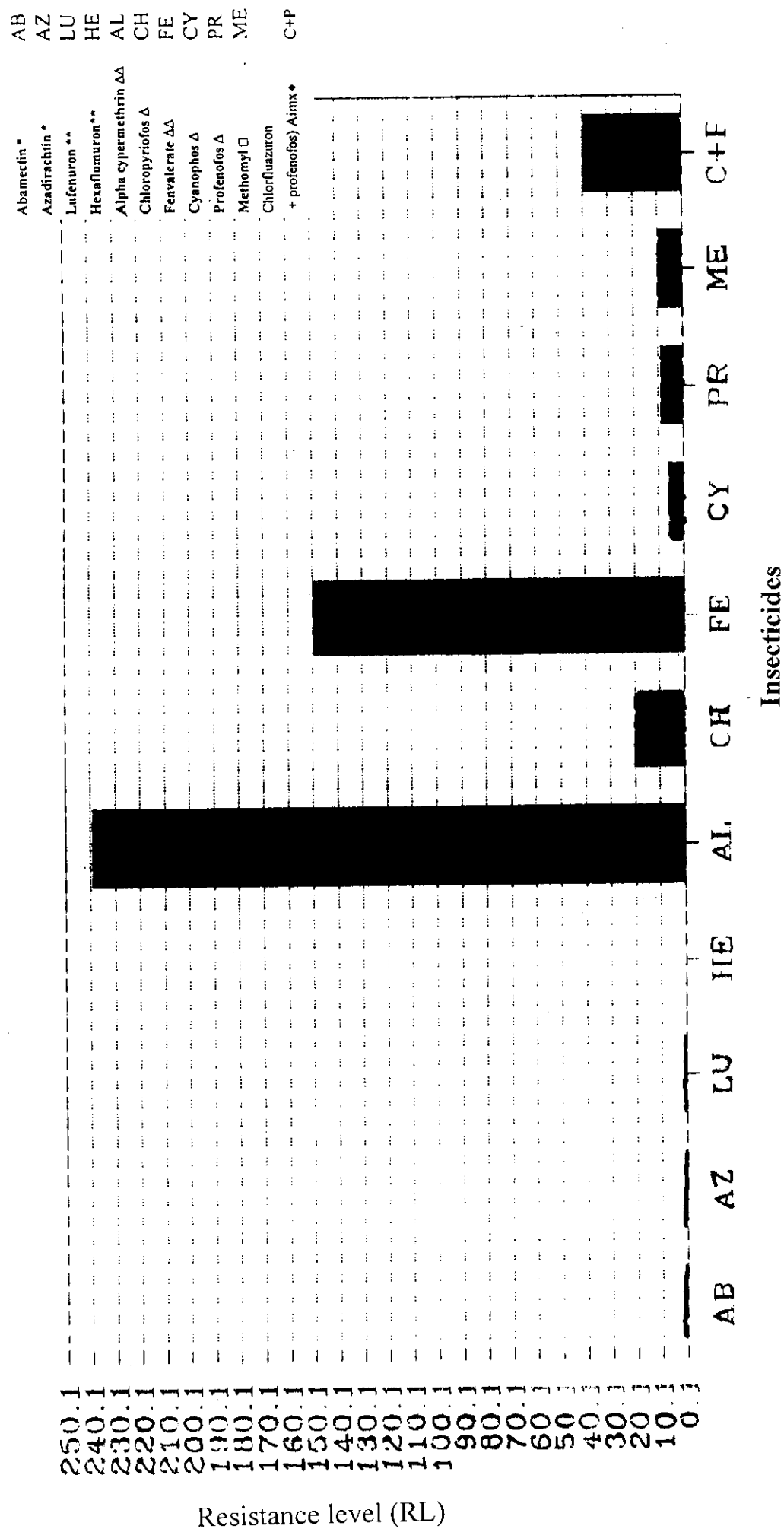
(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level : LC₅₀ field strain
 LC₅₀ Lab. strain.

Fig (19) LC50 values of the used insecticides to the larvae
Kalubia field strain *Spodoptera littoralis* 1995.



Fig(20) Resistance level of kalubia strain of *Spodoptera littoralis* (1995) based on LC₅₀.



variations of LC_{50} values was in the group of natural products (134.46 – 182.78 ppm) within the group of organophosphorous of (172.54 – 3632.74 ppm).

Both Alpha cypermethrin and fenvalerate showed somewhat similar LC_{50} values of 581.45 and 613.73 ppm, respectively. The two IGR lufenuron and hexaflumuron showed low LC_{50} values of 0.29 ppm, and 0.57 ppm respectively, referring the high sensitivity of Kalubia strain, to these IGRs. LC_{50} value of aimx (chlorfluazuron + profenofos) showed 598.56 ppm. Resistance are calculated in Table (11) and Fig. (20) which showed that Kalubia field strain manifested susceptible to abamectin (1.47 fold) lufenuron (1 fold) and azadarachtin (0.78 fold), while cyanophos (5.9 fold) and profenofos (9.18 fold), were vigor tolerance, and resistance to methomyl (10.24 fold), chlorpyrifos (20.4 fold), and amix (chlorfluazuron + profenofos) (39.71 fold). Resistance was also observed to alpha cypermethrin (239.28 fold) and fenvalerate (150.24 fold).

2-1-2- Susceptibility evaluation during 1996

The obtained LC_{50} values revealed a relatively of low sensitivity of this strain to the most of the tested products. The LC_{50} values showed a wide range of variations (69.7 to 3989.2 ppm), except lufenuron (0.5 ppm) as presented in Table (12) and illustrated in Fig. (12). Among the toxicity of the natural products in the field strain abamectin and azadirachtin gave moderately effect with LC_{50} s of 69.7 and 75.8 ppm, respectively. The IGRs showed value of LC_{50} lufenuron (0.5 ppm). Meanwhile, the LC_{50} of the organophosphorous chlorpyrifos, were profenofos and cyanophos were 122.4ppm, 218.9ppm and 3989.2 ppm, respectively. The two pyrethroids alpha cypermethrin and fenvalerate

Table (12): Susceptibility of *Spodoptera littoralis* of Kalubia Governorate to different insecticides during 1996.

Insecticides used	Slope function.	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀	
Abamectin *	1.9	69.7	50.1 : 91.5		329.6	230.1 : 578.9		0.76	
Azadirachtin *	1.2	75.8	47.8 : 109.2		816.8	514.5 : 1610.6		0.32	
Lufenuron **	2.1	0.5	0.31 : 0.6		2.01	1.4 : 3.1		1.72	
Alpha cypermethrin ΔΔ	1.8	562.5	204.2 : 1010.5		3001.7	1498.1 : 34186		231.48	
Chlorpyrifos Δ	2.6	122.4	54.4 : 187.7		373.4	234.8 : 1425.9		8.12	
Fenvalerate ΔΔ	2.3	1208.1	719.7 : 1569.4		4278.5	3245. : 7636.6		296.10	
Cyanophos Δ	3.9	3989.2	3405.4 : 4517.9		8508.	7105.8 : 11585		6.48	
Profenofos Δ	2.6	218.9	-		673.3	-		11.65	
Methomyl [1]	3.1	564.4	456.7 : 696.1		1474.2	1086.7 : 2654.7		18.49	
Chlorfluazuron + profenofos)Aimx ♦	2.5	653.5	491.4 : 825.34		2099.2	1568.9 : 3312.9		43.36	

(*) : natural product

(Δ) : organophosphates

(♦) : mixed

ppm : part per million.

(**) : Insect Growth Regulator

(ΔΔ) : pyrethroids

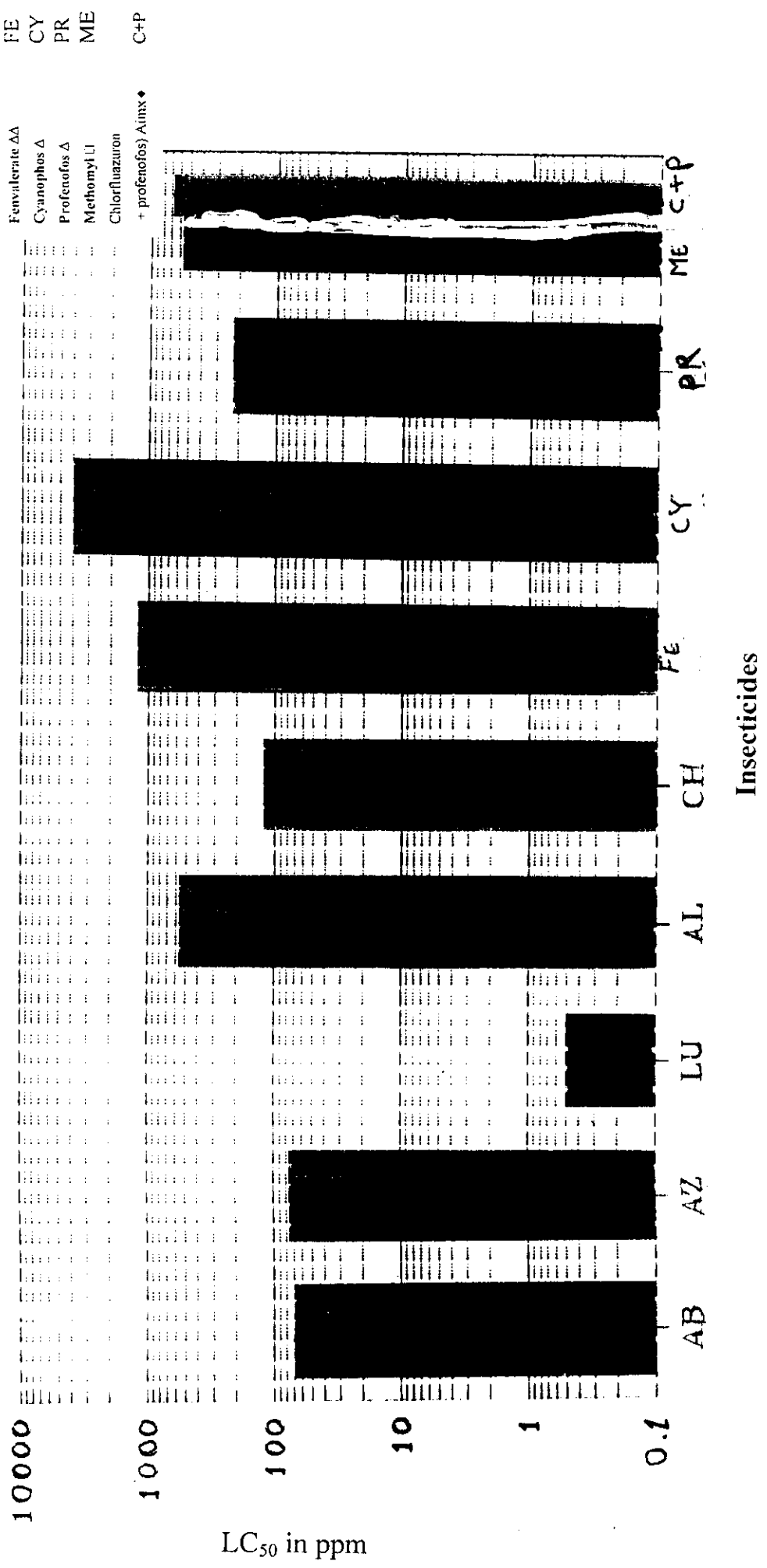
(□) carbamates

LC₅₀: Lethal concentration killed fifty percent

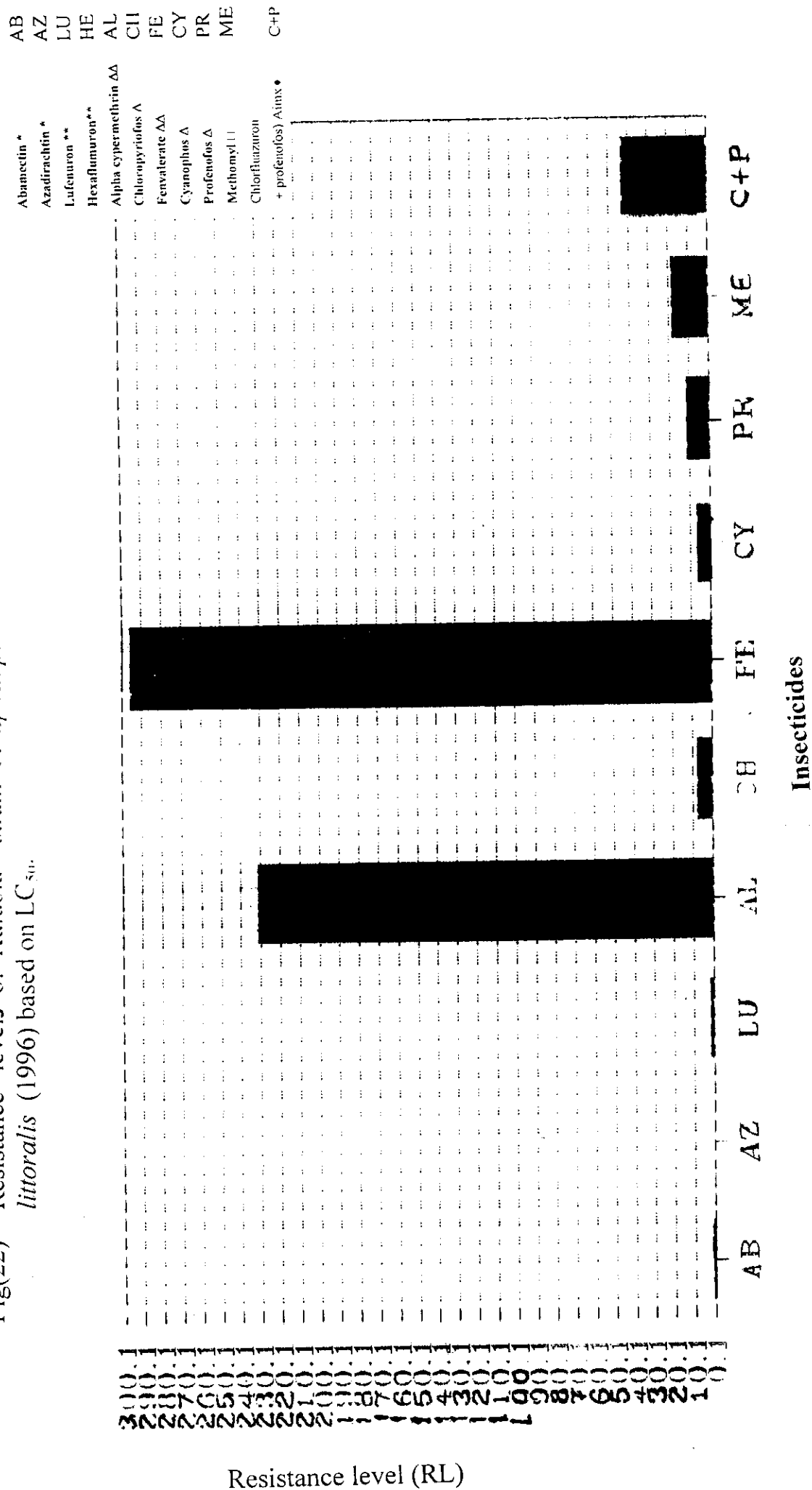
LC₉₀: Lethal concentration killed ninety percent

RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain.}}$

Fig(21) LC₅₀ values of the used insecticides to Kalubia field strain of *Spodoptera littoralis* larvae during 1996



Fig(22) Resistance levels of *Kalubia littoralis* (1996) based on LC₅₀ strain of *Spodoptera*



showed LC_{50} s 562.5ppm and 1208.1 ppm, respectively. The carbamate, methomyl showed moderate level of LC_{50} value (564.4 ppm) and aimx (chlorfluazuron + profenofos) showed LC_{50} s value of 653.5 ppm. Comparison between field and laboratory strain revealed high toxicity, as abamectin (0.76 fold) and azadirachtin (0.32 fold) and for lufenuron showed 1.72 fold. The two pyrethroids showed resistance as alpha cypermethrin (231.48 fold) and fenvalerate (297.1 fold). Meanwhile, cyanophos, chlorpyrifos and profenofos showed LC_{50} s of 6.48, 8.12 and 11.65 fold. While carbamate was resistant as methomyl (18.49 fold) and aimx (43.36 fold) as shown in Table 12 and illustrated in Fig. 22).

2-1- Dakahlia strain

2-2-1 Susceptibility evaluation during 1995

The obtained LC_{50} values were characterized by relatively higher values and wide range of susceptibility of 0.15 to 2327.07 ppm (Table 13 and Fig. 23). Three members of organophosphorous showed LC_{50} values ranged between 156.06 to 2216.69 ppm. These were chlorpyrifos, profenofos and cyanophos and the LC_{50} values were 156.06, 226.93 and 2216.93 ppm, respectively of . 468.81 and 2327.07 ppm for alpha cypermethrin and fenvalerate, respectively. The two members of natural products showed somewhat lower figures of 62.73 and 131.30 ppm for azadirachtin and abamectin, respectively.

The carbamate (methomyl) was less effective than natural products when the LC_{50} value was 983.19 ppm. The two members of the IGRs lufenuron and hexaflumuron showed somewhat of lower values (0.15 and 0.91 ppm, respectively). Only aimx (chlorfluzuron + profenofos), showed the high LC_{50} value of 753.73 ppm The resistance level of Dakahlia field strain with laboratory strain (Fig. 24 and Table 13 refer

Table (13): Susceptibility of *Spodoptera littoralis* of Dakahlia governorate to different insecticides during 1995.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	1.8	131.3	86.62	178.13	679.21	464.18	1273.0	1.43
Azadirachtin *	1.11	62.73	35.8	94.1	888.24	514.62	2185.65	0.27
Lufenuron **	1.02	0.15	0.05	0.33	2.77	0.89	147.7	0.51
Hexaflumuron **	0.91	0.91	0.26	1.62	23.56	10.44	191.41	0.44
Alpha cypermethrin ΔΔ	1.67	468.81	209.14	750.56	2753.1	1552.5	10738	192.93
Chlorpyrifos Δ	2.53	156.06	117.15	214.69	501.31	319.70	1565.77	10.36
Fenvalerate ΔΔ	3.08	2327.07	1573.36	3123.82	6065.6	4289.9	12628	570.36
Cyanophos Δ	3.14	2216.69	1769.81	2684.64	5674.5	4477.5	8137.1	3.6
Profenofos Δ	2.99	226.93	178.47	289.98	609.69	432.54	1249.6	12.08
Methomyl □	2.98	983.19	773.23	1234.97	2650.91	1933.85	4813.85	32.22
Chlorfluazuron + profenofos) Aimx ♦	4.53	753.73	567.01	898.57	1445.92	1161.13	2468.12	50.02

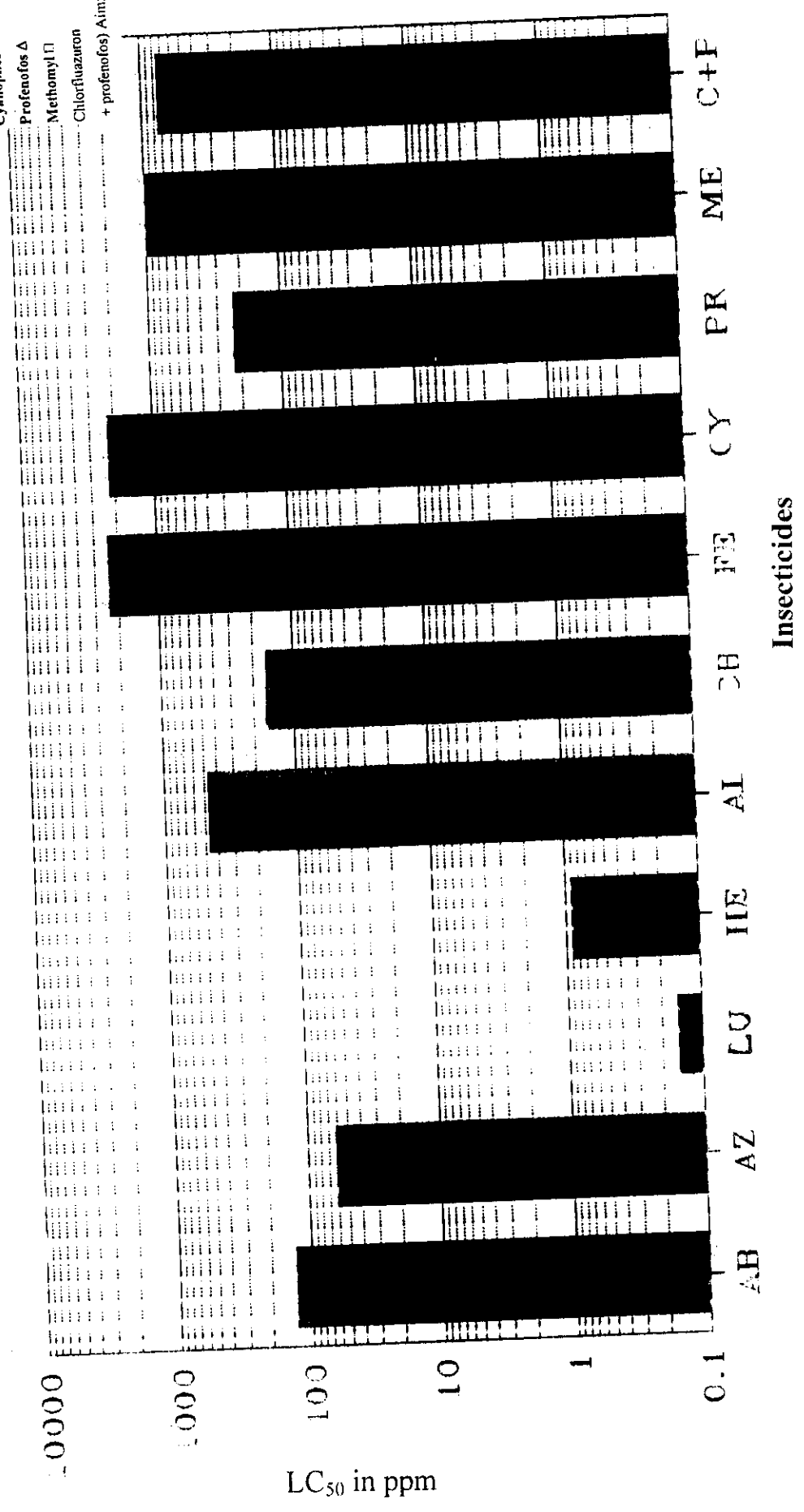
(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level : LC_{50} field strain
 LC_{50} Lab. strain.

AB
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 Abamectin *
 Azadirachtin *
 Lufenuron **
 Hexaflumuron**
 Alpha cypermethrin ΔΔ
 Chlorpyrifos Δ
 Fenvalerate ΔΔ
 Cyanophos Δ
 Profenofos Δ
 Methomyl □
 Chlorfluazuron
 + profenofos) Aimx ♦

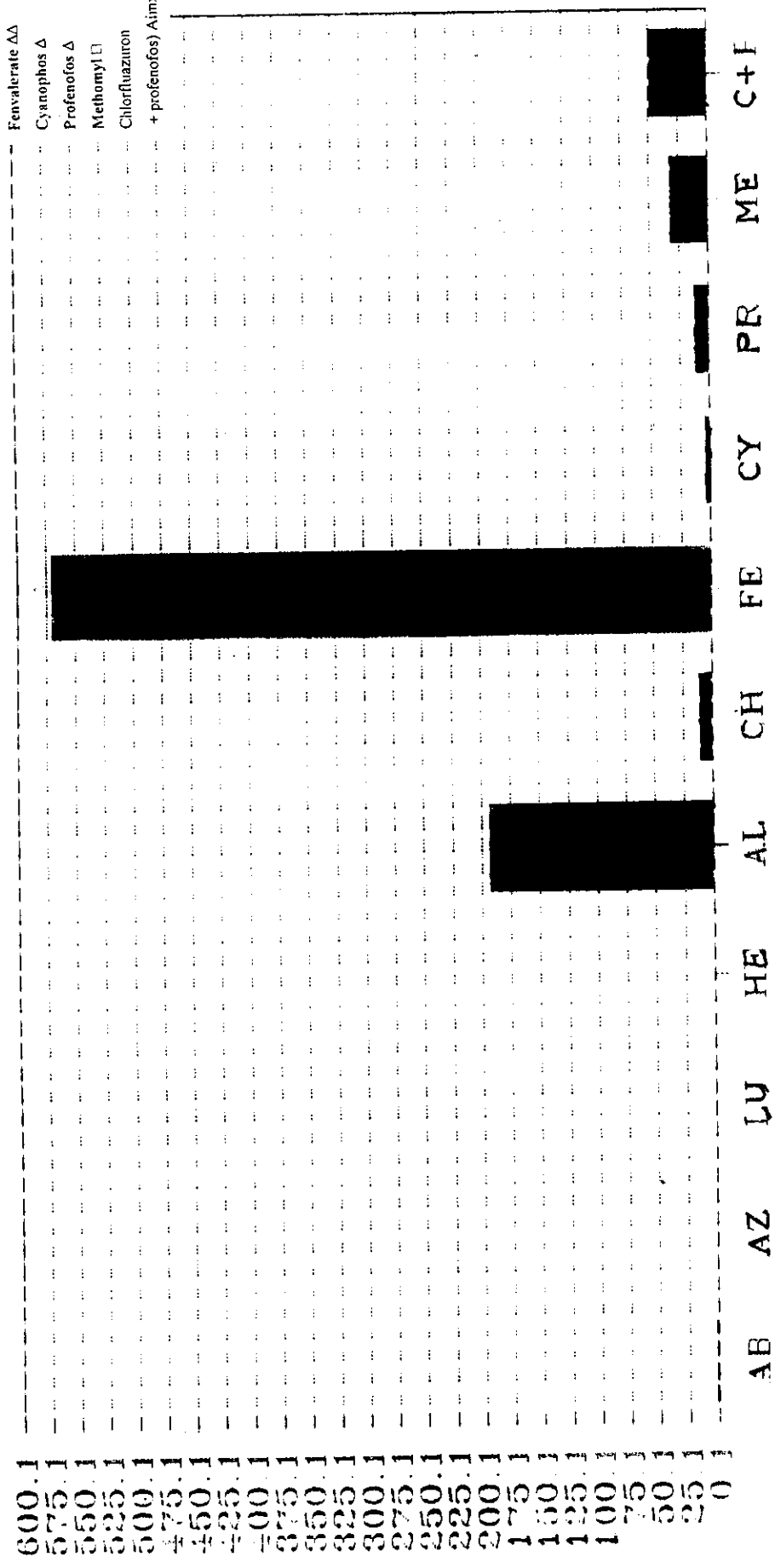
Fig(23) LC₅₀ values of the used insecticides to *Dakahlia* field strain of *Spodoptera littoralis* larvae during 1995.



AB
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C+P

Abamectin *
Azadirachtin *
Lufenuron **
Hexaflumuron**
Alpha cypermethrin ΔΔ
Chlorpyrifos Δ
Fenvalerate ΔΔ
Cyanophos Δ
Profenofos Δ
Methomyl □
Chlorfluazuron
+ profenofos/ Aimx ♦

Fig(24) Resistance levels of the *Dakahlia* strain of *Spodoptera littoralis* (1995) based on LC₅₀.



Insecticides

Resistance level (RL)

the high sensitivity of this strain to the natural products abamectin and azadirachtin 1.43 and 0.27 fold. The IGRs hexaflumuron and lufenuron indicated very high toxicity on field strain (0.44 and 0.51 fold respectively).

Among the organophosphorous this strain showed tolerance to cyanophos (4.36 fold) and resistance to chlorpyrifos and profenofos (10.36 and 12.08 fold, respectively). Referring the levels of resistance (RL) to the pyrethroids alpha cypermethrin and fenvalerate were (192.93 and 570.36 fold, respectively). The strain also displayed resistance to carbamate methomyl (32.23 fold) and to aimx (chlorfluazuron + profenofos) (50.02 fold).

2-2-2- Susceptibility evaluation during 1996

Spectrum of LC_{50} values for various insecticides is more or less similar the tested to other Governorates (Fig. 25 and Table 14). Among the tested natural products, abamectin and azadirachtin showed the moderate values of LC_{50} values of 92.27 and 97.59 ppm, respectively. The IGRs lufenuron and hexaflumuron showed LC_{50} values of 0.45 and 0.072 ppm, respectively. Among the organophosphorous the LC_{50} s of profenfos, chlorpyrifos and cyanophos are 100.57ppm, 291.25ppm and 1901.11 ppm, respectively, however the two pyrethroids alpha cypermethrin and fenvalerate showed highest LC_{50} values of 717.35ppm and 1119.78 ppm, respectively. The carbamate showed moderate showed highest LC_{50} values of values for methemyl (250.96 ppm) and aimx (483.54 ppm). Comparing the LC_{50} values of field strain with crosspounding values of the laboratory strain (Fig. 36 and Table 14) revealed the field strain was tolerant to the natural products, abamectin (1.0 fold) and azadirachtin is very toxic on field strain to be 0.42 fold the

Table (14) : Susceptibility of *Spodoptera littoralis* of Dakahlia Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	0.9	92.27	43.06	165.05	2353.3	925.83	17054	1
Azadirachtin *	1.6	97.59	63.21	136.62	654.63	436.48	1203.95	0.42
Lufenuron **	1.4	0.45	0.27	0.66	3.51	2.13	8.54	1.55
Hexaflumuron **	1.3	0.072	0.02	0.15	0.71	0.3	16.78	0.03
Alpha cypermethrin ΔΔ	1.8	717.35	310.73	1046.22	3835.6	2263.3	19889	295.2
Chlorpyrifos Δ	1.9	291.25	186.12	405.06	1412.98	907.8	3302.93	19.32
Fenvalerate ΔΔ	2.0	1119.76	788.61	1480.13	4832.8	3456	8004	274.4
Cyanophos Δ	2.4	1901.11	1380.3	2450.28	6585.8	4850.3	10598	3
Profenofos Δ	2.1	100.52	71.84	131.71	401.96	294.2	630.99	5.35
Methomyl □	2.4	250.96	186.44	321.59	853.73	624.69	1397.02	8.22
Chlorfluazuron + profenofos)Aimx ♦	2.5	483.54	398.8	626.34	1599.55	1157.25	2860.33	32.08

(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

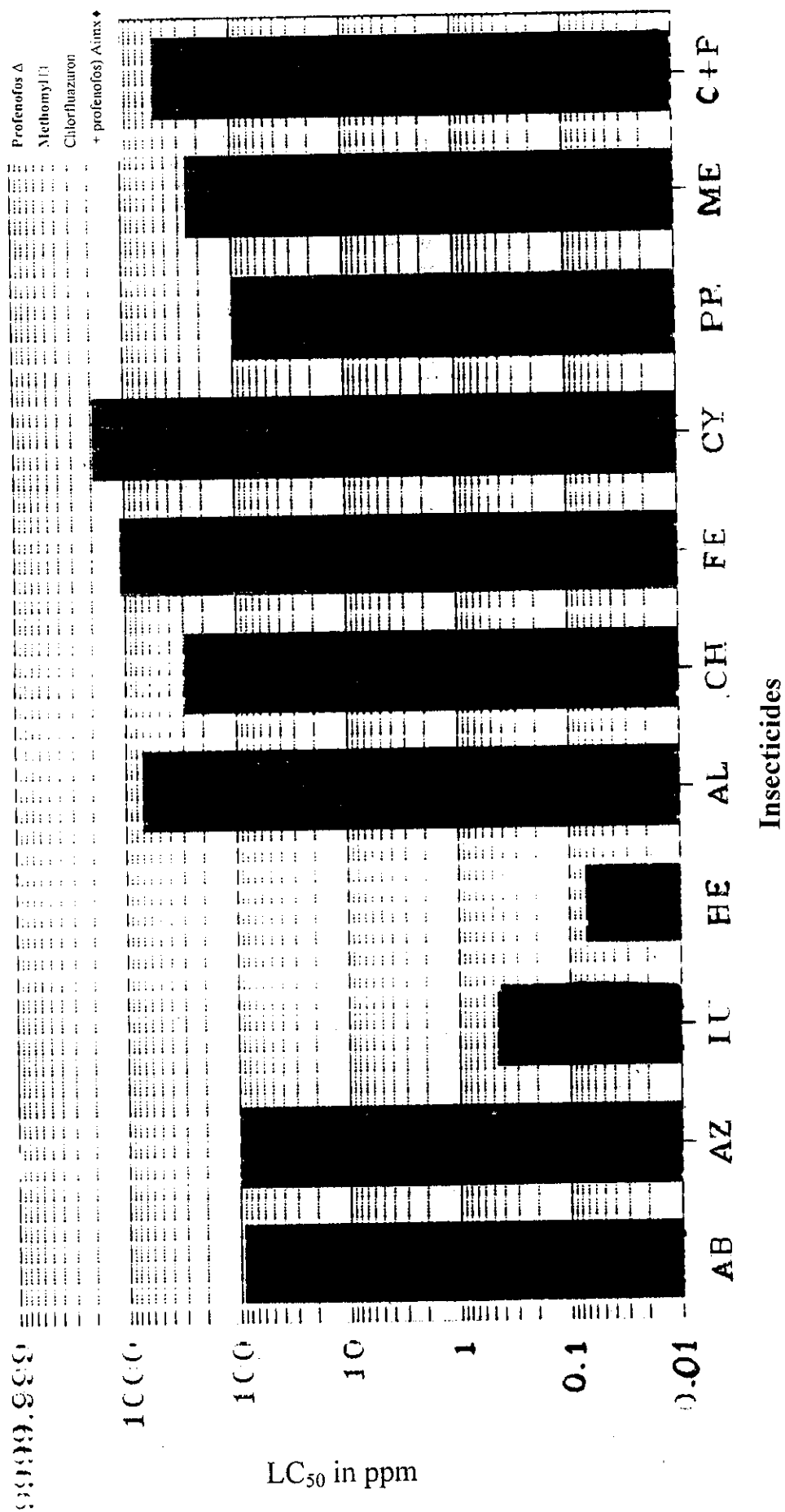
(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain.}}$

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PR
ME
C+P

Abamectin *
Azadirachtin *
Lufenuron **
Hexaflumuron **
Alpha cypermethrin ΔΔ
Chlorpyrifos Δ
Fenvalerate ΔΔ
Cyanophos Δ
Profenofos Δ
Methomyl []
Chlorfluazuron
+ profenofos/ Amax *

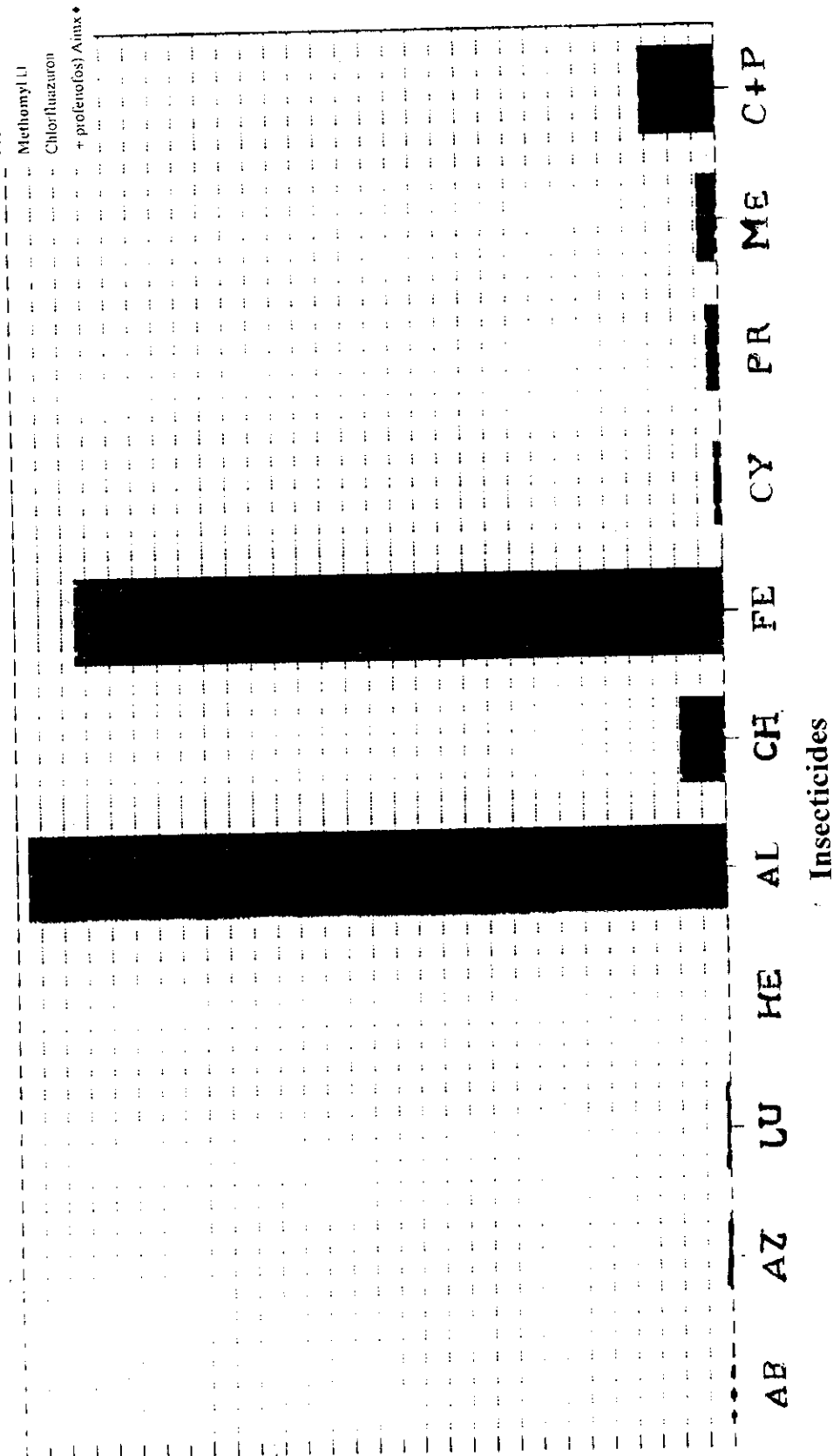
Fig(25) LC₅₀ values of the used insecticides to *Dakahlia* field strain of *Spodoptera littoralis* larvae during 1996.



AB
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FE
CY
PR
ME
C+P

Abamectin *
Azadirachtin *
Lufenuron **
Hexaflumuron**
Alpha cypermethrin ΔΔ
Chlorpyrifos Δ
Fenvalerate ΔΔ
Cyanophos Δ
Profenofos Δ
Methomyl LU
Chlorfluazuron
+ profenofos) Amax *

Fig(26) Resistance levels of *Dakahlia littoralis* (1996) based on LC₅₀.



Resistance level (RL)

IGRs Lufenuron (1.55 fold) and hexaflumuron (0.03 fold). While it was tolerant to profenofos (5.35 fold) and cyanophos (3 fold) and to showed resistance chlorpyrifos (19.32 fold). Carbamate indicated vigor tolerance to methomyl (8.22 fold) resistant to aimx (32.08 fold). The two pyrethroids indicated resistance to fenvalerate (274.4 fold) and alpha cypermethrin (295.2 fold).

2-3- Behera strain

2-3-1- Susceptibility evaluation during 1995

A wide range of variations in the LC_{50} values was observed (79.4 – 2684.73 ppm), Table (15) and illustrated in Fig. (27). Two members of the natural products, abamectin and azadirachtin showed moderate values of LC_{50} . 79.4 and 485.32 ppm, respectively, while the carbamate methomyl showed higher value of LC_{50} (886.81 ppm). The two pyrethroids alpha cypermethrin and fenvalerate showed higher values of LC_{50} s (574.61 – 1640.44 ppm, respectively), while of organophosphates profenofos, chlorpyrifos and cyanophos were 554.97ppm, 750.67ppm and 2684.73 ppm, respectively. The aimx (chlorfluazuron + profenofos) showed also high LC_{50} value of 482.84 ppm. Comparison between field strain and laboratory strain revealed that there is toxic action abamectin 0.91 fold and azadirachtin 2.07 fold, cyanophos (4.36 fold), profenofos 29.53 fold, methomyl 29.06 fold, aimx (chlorfluazuron + profenofos) 32.03 fold and chlorpyrifos 49.81 fold. While the two pyrethroids indicated high level of resistance, to alpha cypermethrin (236.46 fold) and fenvalerate (402.06 fold). The results showed that this strain is still susceptible to natural products (0.91 fold and 2.07 fold) to the pyrethroids resistance alpha cypermethrin and fenvalerate (236.46 and 402.06 fold respectively), as shown in the Table (15) and Fig. (28).

Table (15): Susceptibility of *Spodoptera littoralis* of Behera Governorate to different insecticides during 1995.

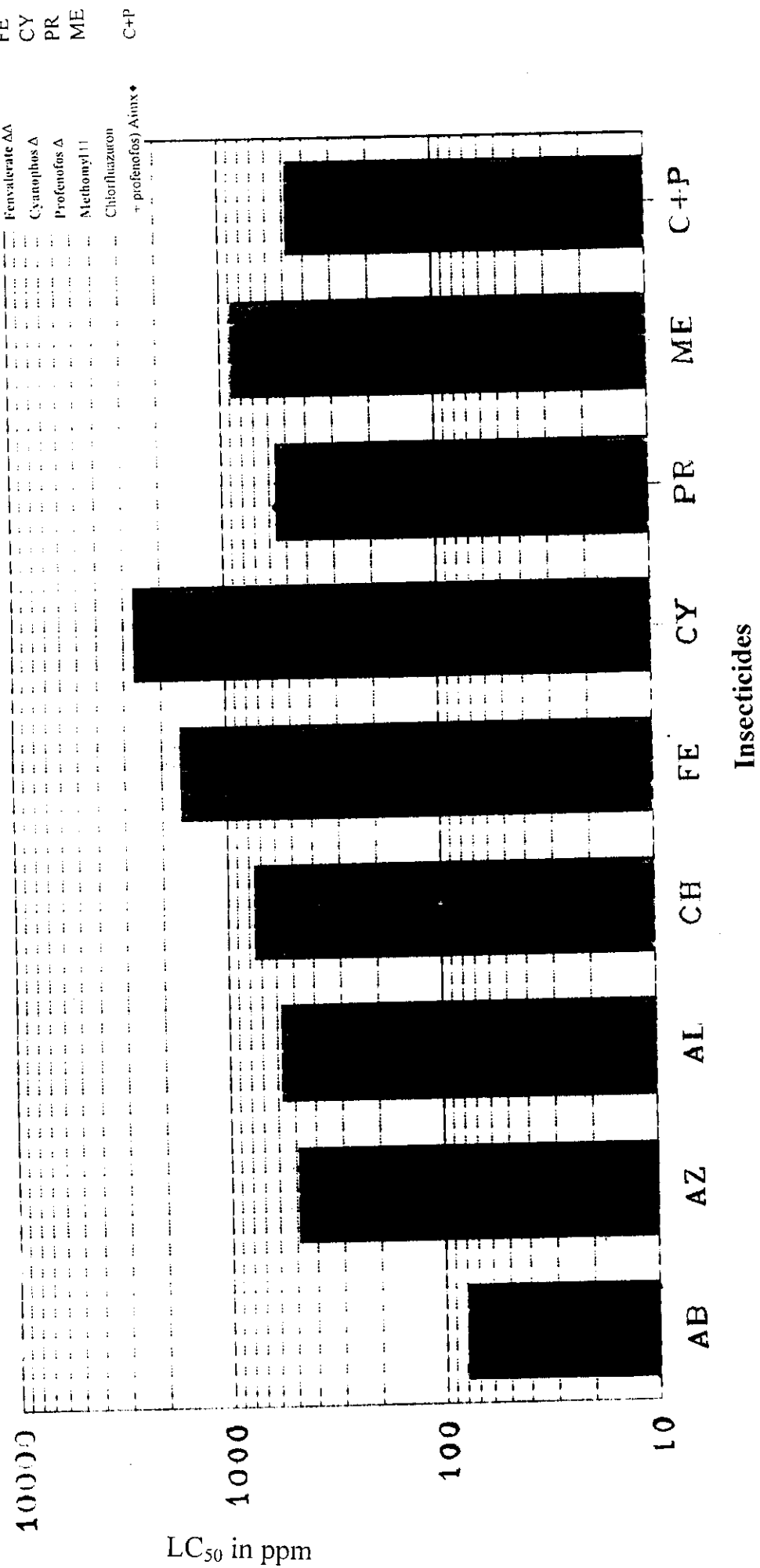
Insecticides used	Slope function	LC ₅₀ ppm	90%		LC ₉₀ ppm	Fiducial limits	RL based on LC ₅₀
			Fiducial limits				
Abamectin *	1.75	79.4	-	-	430.88	-	0.91
Azadirachtin *	1.19	485.32	316.17 : 1212.97	-	5819.1	1906.1 : 0.12688 E-06	2.07
Alpha cypermethrin ΔΔ	1.46	574.61	397.4 : 775.72	-	4332.8	2757.7 : 9111.7	236.46
Chlorpyrifos Δ	3.02	750.67	-	-	1993.59	-	49.81
Fenvalerate ΔΔ	2.33	1640.44	909.93 : 2469.82	-	5816.1	3531.3 : 23803	402.06
Cyanophos Δ	2.82	2684.73	1194.73 : 4071.45	-	7644.1	4897.6 : 28092	4.36
Profenofos Δ	2.26	554.97	-	-	2052.25	-	29.53
Methomyl □	3.90	886.81	756.70 : 1022.52	-	1890.43	1580.7 : 2444.48	29.06
Chlorfluazuron + profenofos)Aimx ♦	2.42	482.84	288.73 : 836.55	-	1632.3	911.92 : 10671	32.03

(*) : natural product
(Δ) : organophosphates
(♦) : mixed
ppm : part per million.

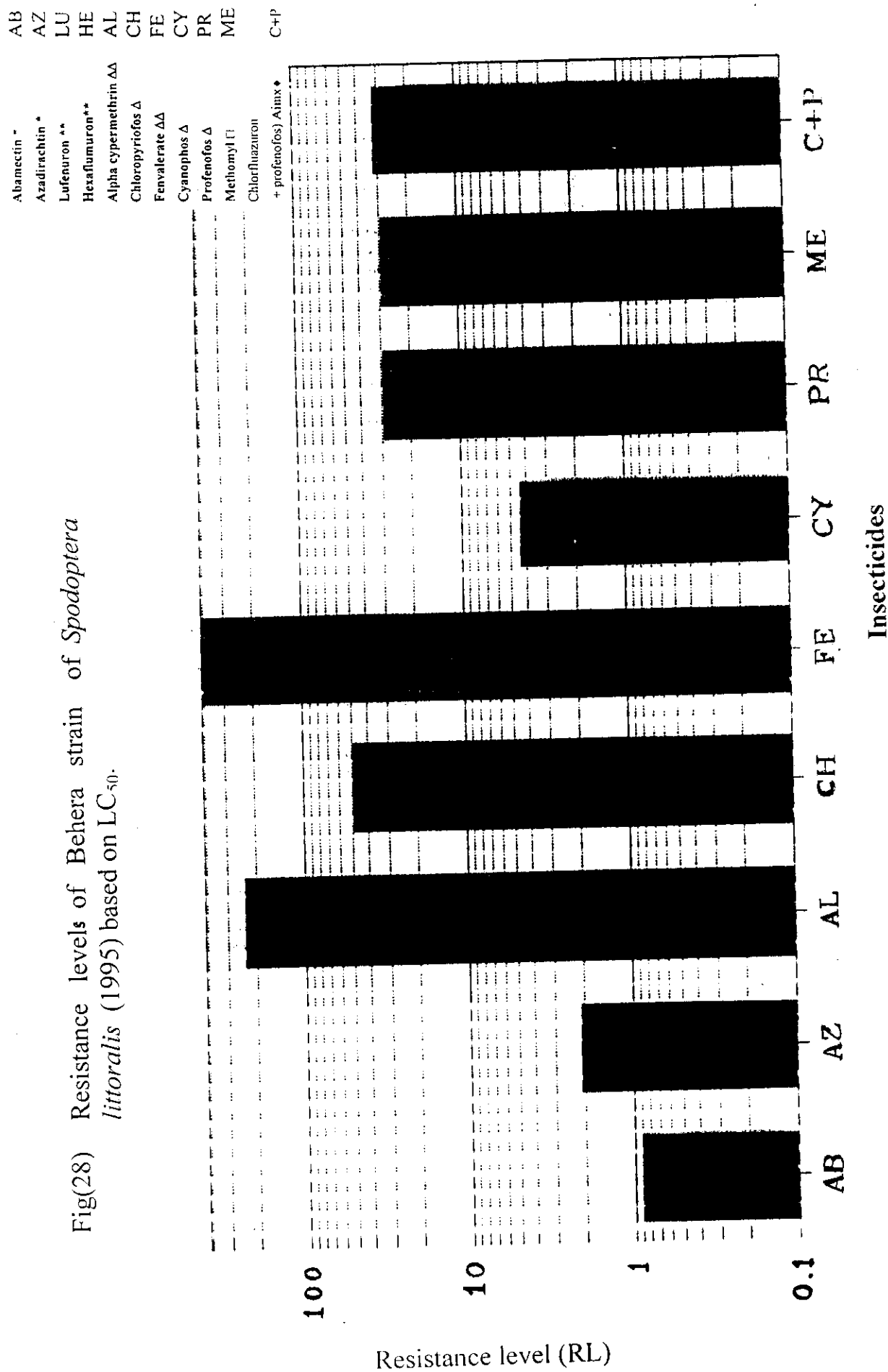
(**) : Insect Growth Regulator
(ΔΔ) : pyrethroids
(□) carbamates

LC₅₀: Lethal concentration killed fifty percent
LC₉₀: Lethal concentration killed ninety percent
RL : Resistance level: $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

Fig(27) LC_{50} values of the used insecticides to Behera field,
strain of *Spodoptera littoralis* larvae during 1995.



Fig(28) Resistance levels of Behera strain of *Spodoptera littoralis* (1995) based on LC₅₀.



2-3-2- Susceptibility evaluation during 1996

This strain has a wide range of susceptibility, (0.6 to 1096.2 ppm), the Behera strain was moderately resistant to natural products abamectin and azadirachtin (189.6 and 90.8 ppm respectively), The IGRs Lufenuron and hexaflumuron showed the lowest LC_{50} values (0.6 and 4.4 ppm, respectively), as shown in Table (16) and Fig. (29). The Behera strain showed similar susceptibility to the organophosphorous chlorpyrifos, profenofos and cyanophos and the LC_{50} values were 188.92ppm, 236.14ppm, 1081.9 ppm, respectively. While two members of pyrethroids alpha cypermethrin and fenvalerate showed LC_{50} values of 364.8 and 1096.2 ppm, respectively. It was found that carbamate, methomyl was 510.8 ppm. The Behera field strain appeared to be high resistant to aimx, (546.3 ppm).

The resistance level (RL) reflects a highly resistance level of this strain to organophosphorous, chlorpyrifos (12.54 fold), profenofos (12.56 fold) and was susceptible to cyanophos (2.92 fold).

The natural products gave highly effect as abamectin (2.07 fold) and azadirachtin (0.39 fold). The strain was is susceptible to lufenuron was (2.07 fold) and Hexaflumuron was (2.11 fold). Behera strain showed resistance to alpha cypermethrin (150.12 fold) and fenvalerate (268.62 fold). It observed resistant to methomyl (16.74) and aimx (36.25 fold) as indicated in Table 16 and Fig.30.

2-4- Beni Suef

2-4-1 Susceptibility evaluation during 1995

This strain showed a wide range of LC_{50} values (82.67 – 2644.57 ppm), as shown in Table (8) and Fig. (31). Most of the LC_{50} variations

Table (16): Susceptibility of *Spodoptera littoralis* of Behera governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	1.0	189.6	100.3	346.7	3672.3	1414.6	28359	2.07
Azadirachtin *	1.6	90.8	57.3	127.3	553.7	378.5	978.5	0.39
Lufenuron **	2.3	0.6	0.4	0.8	2.1	1.6	3.4	2.07
Hexaflumuron **	2.3	4.4	3.0	6.4	26.4	15.3	73.67	2.11
Alpha cypermethrin ΔΔ	2.0	364.8	248.5	489.7	1636.8	1152.9	2816.5	150.12
Chlorpyrifos Δ	1.6	188.92	127.2	280.1	1225.9	678.1	3928.5	12.54
Fenvalerate ΔΔ	2.3	1096.2	768.8	1447.8	4022.5	2769.2	8104.3	268.62
Cyanophos Δ	1.4	1081.9	1144.3	2792	1497	7533.5	62591	2.92
Profenofos Δ	1.6	236.14	155.36	340.92	1464.3	850.09	4189.9	12.56
Methomyl □	2.5	510.8	320.5	721.9	1676.03	1118.3	3759.7	16.74
Chlorfluazuron + profenofos) Aimx ♦	3.8	546.3	374.9	673.6	1178.9	945.1	1811.6	36.25

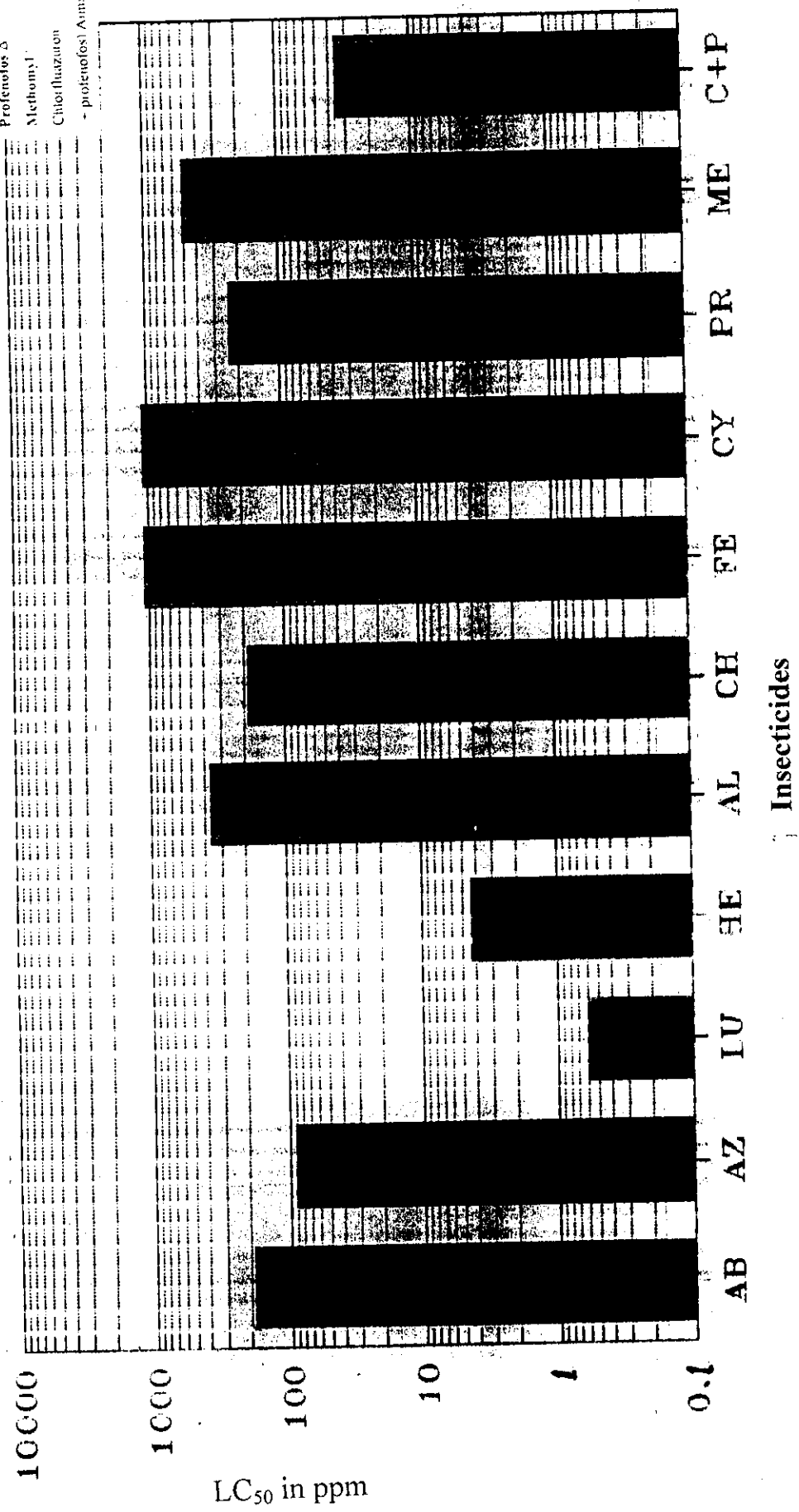
(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level: LC₅₀ field strain
 LC₅₀ Lab. strain.

AB
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 C+P
 Al. insectin
 Azadirachtin
 Lufenuron
 Hexaflumuron
 Alpha cypermethrin
 Chlorpyrifos
 Fenvalerate
 Cyanophos
 Profenofos
 Methomyl
 Chlot (luzatun)
 - profenofos) Amx

Fig(29) LC₅₀ values of the used insecticides to Behera field strain of *Spodoptera littoralis* larvae during 1996.



Fig(30) Resistance levels of Behera strain of *Spodoptera littoralis* (1996) based on LC₅₀.

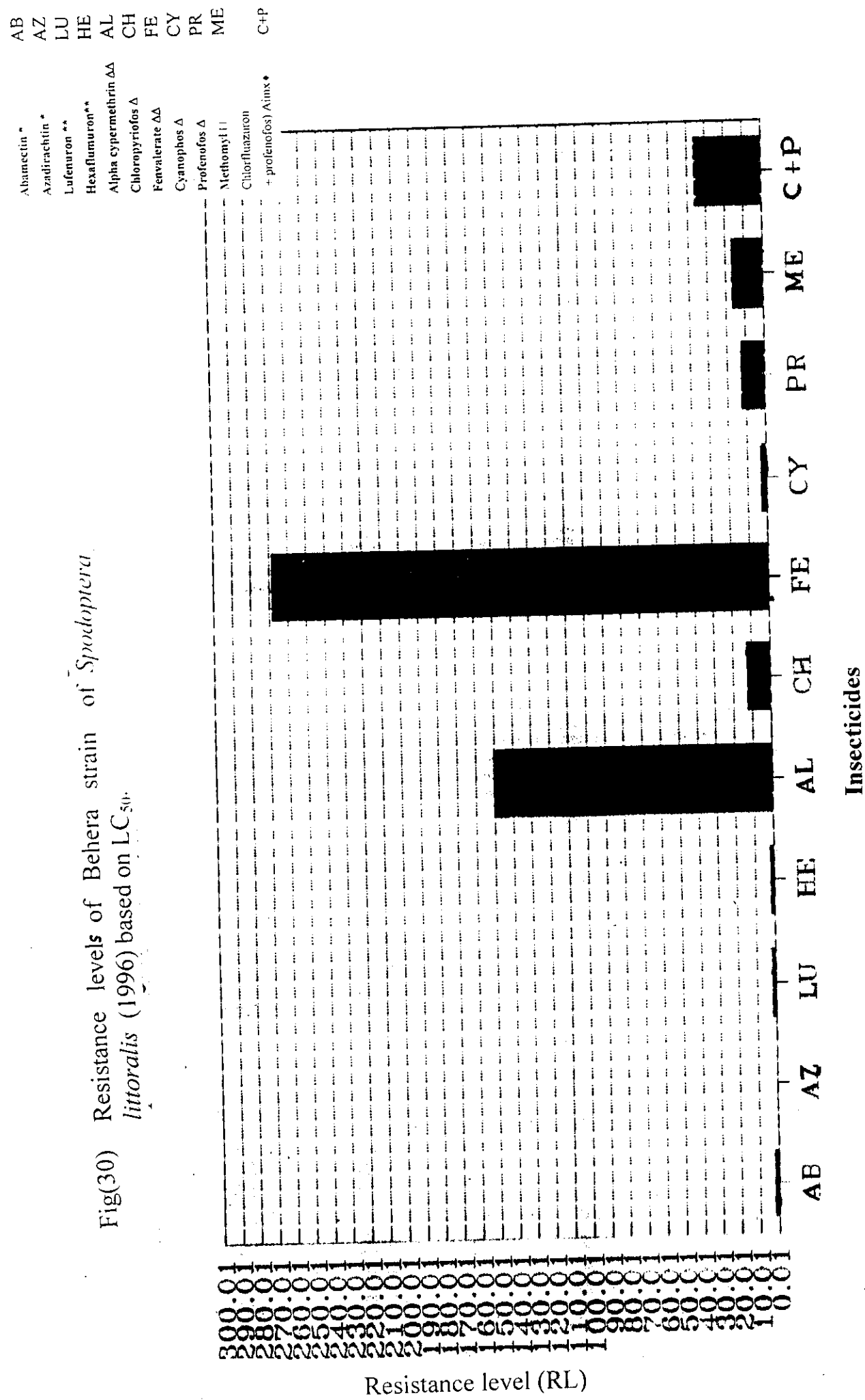


Table (17): Susceptibility of *Spodoptera littoralis* of Beni Suef Governorate to different insecticides during 1995.

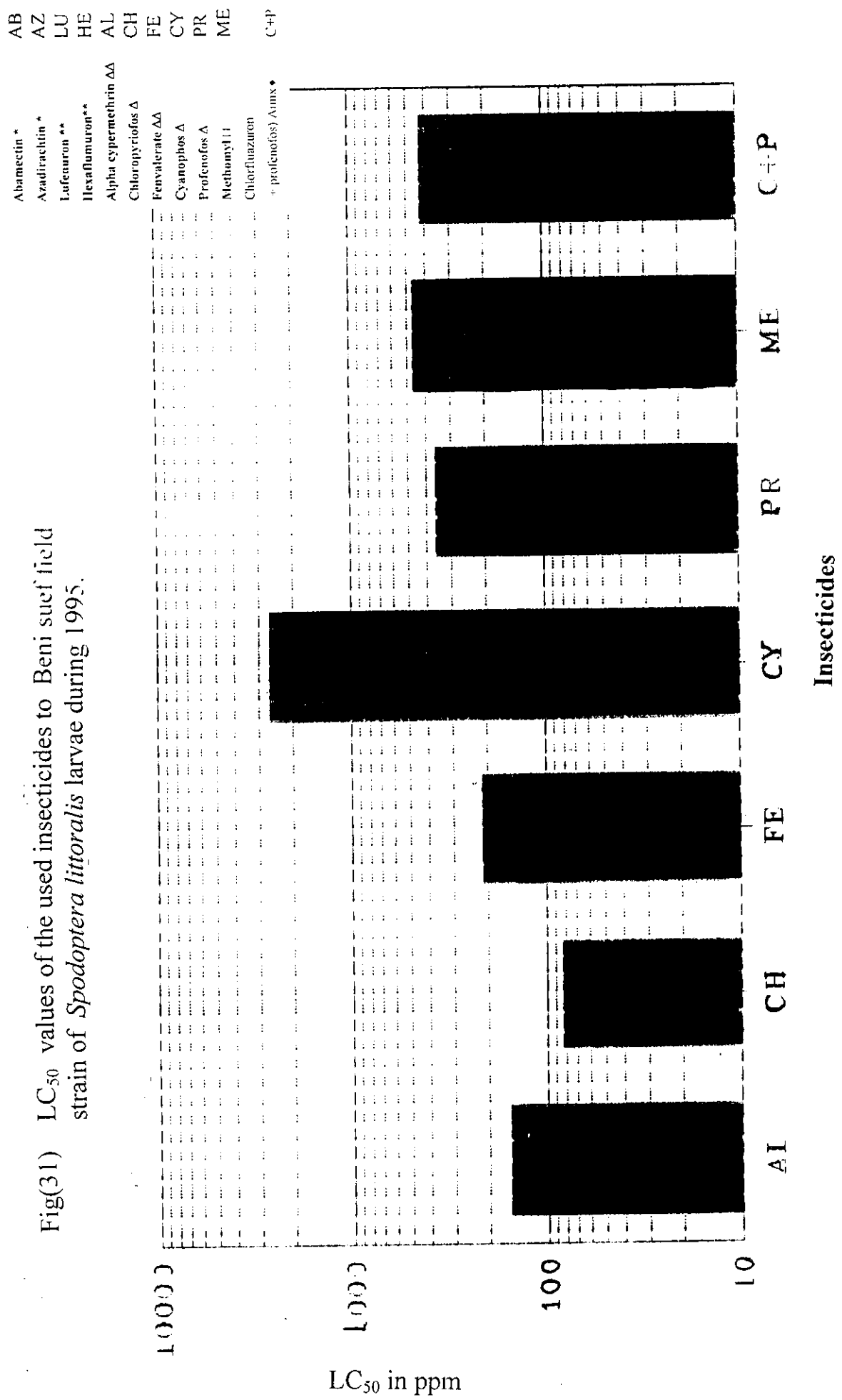
Insecticides used	Slope $\pm$ S.E.	LC ₅₀ ppm	90%		LC ₉₀ ppm	90%		RL based on LC ₅₀
			Fiducial limits			Fiducial limits		
Alpha cypermethrin $\Delta\Delta$	1.39	153.97	99.23 : 232.73		1288.9	673.48 : 4708.5		36.36
Chlorpyrifos Δ	3.66	82.67	57.31 : 102.17		185.21	147.18 : 189.56		5.49
Fenvalerate $\Delta\Delta$	1.93	212.27	147.5 : 286.69		982.46	655.75 : 1954.82		52.03
Cyanophos Δ	2.67	2644.57	1808.77 : 3402.33		7994.3	5912.6 : 14055.19		4.29
Profenofos Δ	2.13	359.57	267.44 : 466.12		1431.56	1014.97 : 2446.19		19.14
Methomyl $\square$	1.61	467.38	308.83 : 661.15		2925.3	1768.6 : 7322		15.31
-Chlorfluazuron + profenofos)Aimx $\blacklozenge$	2.44	425.38	279.29 : 1015.55		1423.44	1015.55 : 277.34		28.23

(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent.
 LC₉₀: Lethal concentration killed ninety percent.
 RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

Fig(31) LC₅₀ values of the used insecticides to Beni suef field strain of *Spodoptera littoralis* larvae during 1995.



were within the group of the organophosphorous to be 82.67 – 2644.57 ppm. They were recorded 82.67 ppm to chlorpyrifos 359.57 ppm to profenofos and 2644.57 ppm to cyanophos. The two alpha cypermethrin and fenvalerate pyrethroids showed moderate values of LC_{50} (153.97 ppm and 212.27 ppm, respectively). Beni Suef strain showed a somewhat similar degree of susceptibility to carbamates since methomyl which showed 467.38 ppm. On the other hand, aimx (chlorfluazuron + profenofos) showed LC_{50} value of 425.38 ppm. The resistance levels for Beni Suef strain as compared with LC_{50} values of laboratory strain exhibited susceptible and resistance to cyanophos and fenvalerate (4.29 fold and 52.03 fold, respectively). This strain was proved resistant to methomyl (15.31 fold), profenofos (19.14 fold), aimx (28.23 fold) and alpha cypermethrin (63.56 fold) (Fig. 23 and Table 8).

2-4-2- Susceptibility evaluation during 1996

This strain showed a wide range of susceptibility, (33.8 – 2239.8 ppm) nearly similar to Fayom, strain. Beni Suef strain was moderately resistant to the organophosphorous, chlorpyrifos, profenofos and cyanophos which showed the highest LC_{50} values of 33.8, 191.5 and (2239.8 ppm), respectively. (Fig. 33 and Table 18). The Beni Suef strain showed resistant to the carbamate, methomyl which showed LC_{50} of 437.2 ppm. The two members of the pyrethroids showed the high level of LC_{50} values as alpha cypermethrin and fenvalerate (160.2 and 222.8 ppm, respectively) and as aimx (237.6 ppm). The field strain was susceptible to chlorpyrifos and cyanophos (2.24 fold and 3.63 fold), and resistant to profenofos (10.19 folds), methomyl (14.32 fold) and aimx (15.77 fold). Alpha cypermethrin recorded 65.92 fold, and fenvalerate 54.6 fold (Table 18 and Fig. 34).

Table (18): Susceptibility of *Spodoptera littoralis* of Beni Suef Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Alpha cypermethrin ΔΔ	1.6	160.2	122.0	: 217	1073.2	632.5	: 27004	65.92
Chlorpyrifos Δ	1.5	33.8	25.7	: 46.7	233.7	134	: 624.7	2.24
Fenvalerate ΔΔ	1.8	222.8	175.3	: 286.3	1124.1	746.2	: 2171.6	54.6
Cyanophos Δ	1.7	2239.8	1743.4	: 2911.4	11298	7938.1	: 25217	3.63
Profenofos Δ	1.8	191.5	144.5	: 246.3	1005.1	663.6	: 1969.5	10.19
Methomyl □	1.7	437.2	338.0	: 5640	2413.9	1582.1	: 4810.8	14.33
Chlorfluazuron + profenofos)Aimx ♦	1.6	237.6	174.3	: 312	1602.3	1013.1	: 3507.8	15.77

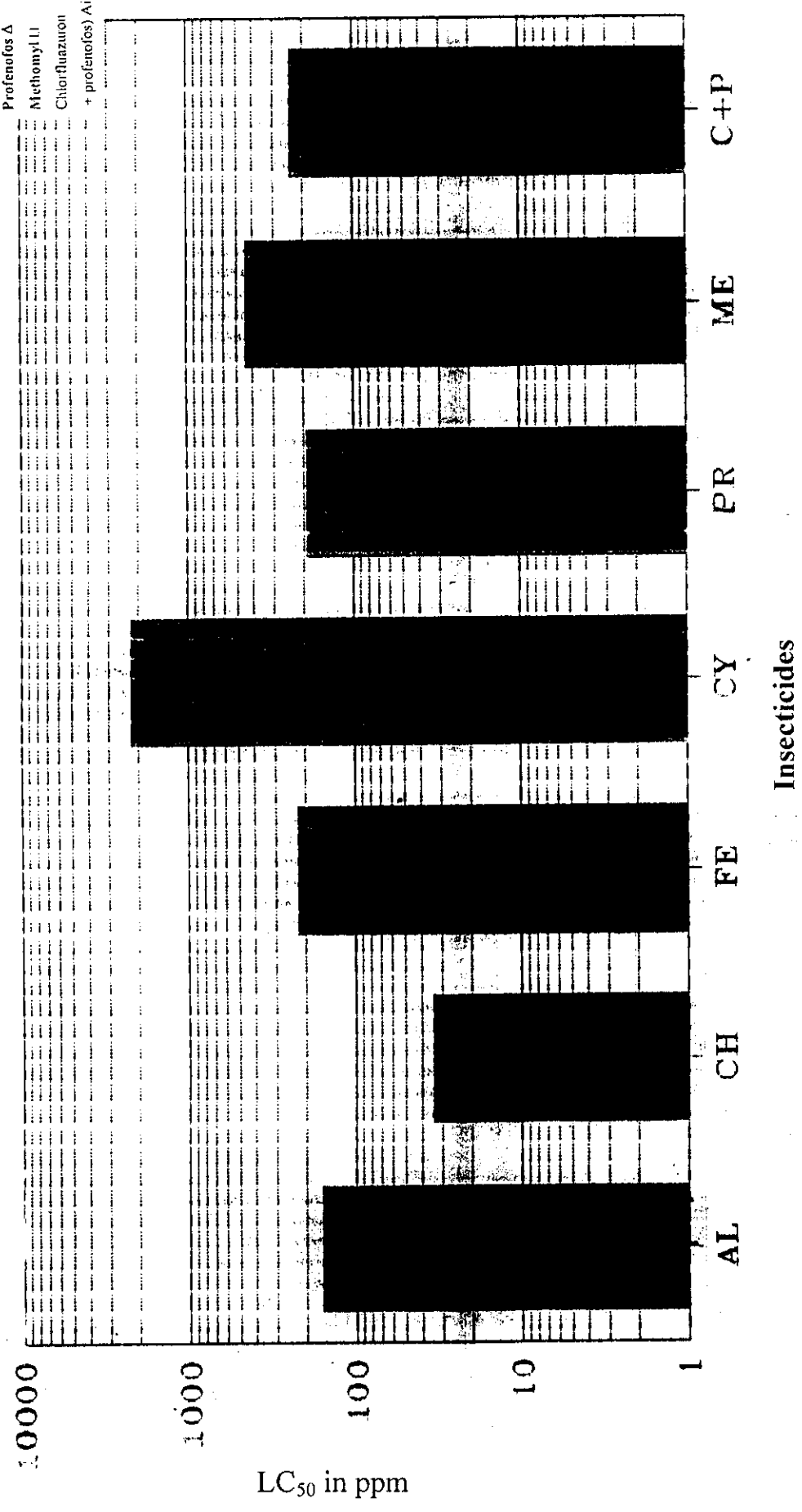
(*) : natural product
(Δ) : organophosphates
(♦) : mixed
ppm : part per million.

(**) : Insect Growth Regulator
(ΔΔ) : pyrethroids
(□) carbamates

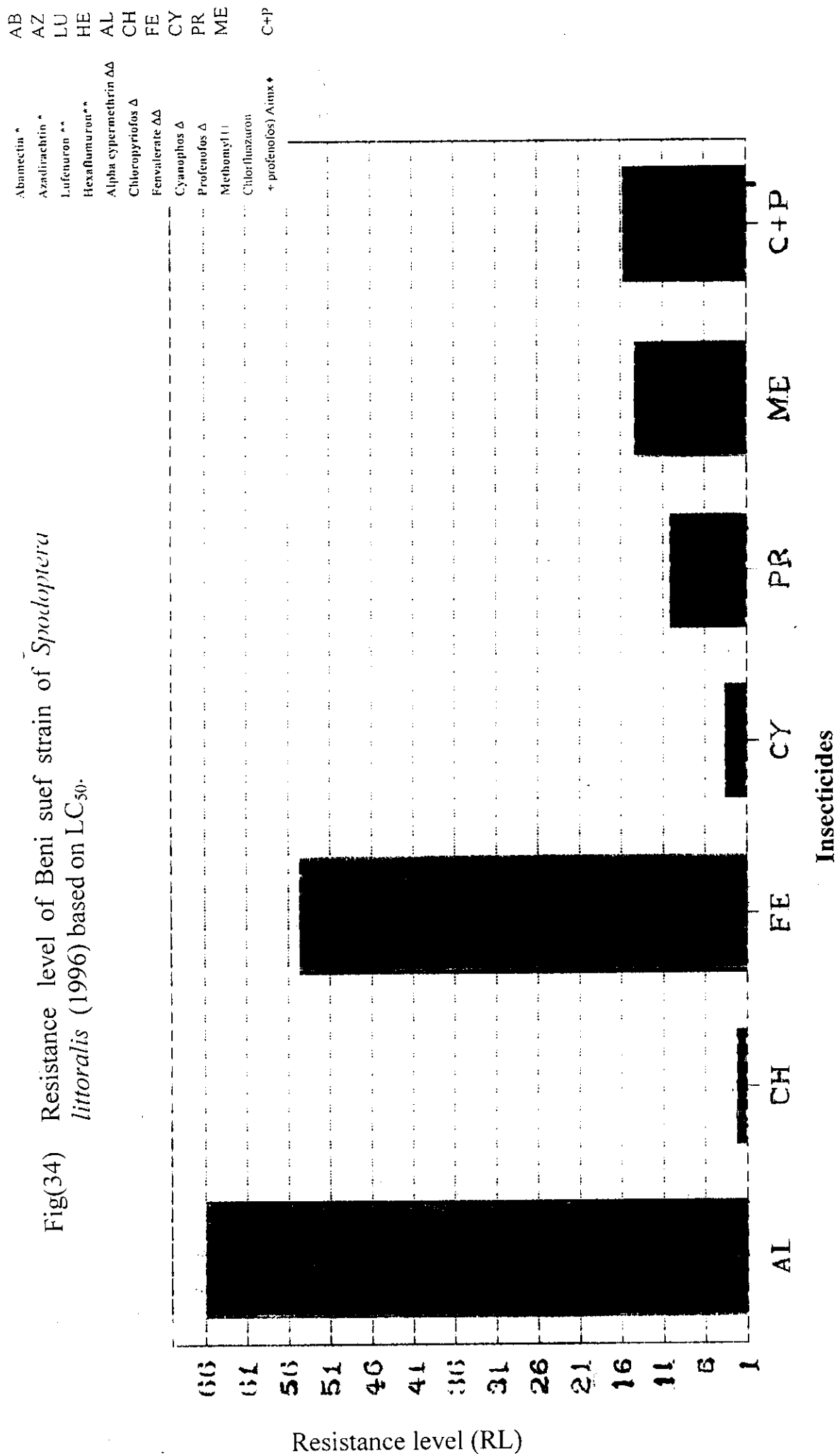
LC₅₀: Lethal concentration killed fifty percent
LC₉₀: Lethal concentration killed ninety percent
RL : Resistance level : $\frac{LC_{50}}{LC_{50} \text{ Lab. strain}}$

AB Abamectin *
 AZ Azadirachtin *
 LU Lufenuron **
 HE Hexaflumuron**
 AL Alpha cypermethrin ΔΔ
 CH Chlorpyrifos Δ
 FE Fenvalerate ΔΔ
 CY Cyanophos Δ
 PR Profenofos Δ
 ME Methomyl U
 Chlorflazuron
 C+P + profenofos) Auxx *

Fig(33) LC₅₀ values of the used insecticides to Beni suef field strain of *Spodoptera littoralis* larvae during 1996.



Fig(34) Resistance level of Beni suef strain of *Spodoptera littoralis* (1996) based on LC₅₀.



2-5- Fayom

2-5-1- Susceptibility evaluation during 1995

The obtained LC_{50} values revealed that this strain was relatively of low sensitivity to most of the tested products. LC_{50} values ranged from 0.33 – 2154.89 ppm (Fig. (35) and Table 19). The LC_{50} values of the two natural products abamectin and azadirachtin were 36.43 and 609.62 ppm, respectively. Among the organophosphorous, the LC_{50} s values of chlorpyrifos, profenofos and cyanophos were 59.04ppm, 74.33ppm and 2154.89 ppm, respectively. Meanwhile, the LC_{50} s of alpha cypermethrin was 431.35 ppm. The LC_{50} of carbamate, methomyl was 206.44 ppm. Aimx (chlorfluazuron + profenofos) showed high value of LC_{50} (658.15 ppm) in contrast lufenuron and hexaflumuron showed somewhat lower values of LC_{50} (0.33 and 2.38ppm, respectively). Comparison between field and laboratory strain revealed that this strain is still susceptible to azadirachtin (2.6 fold), lufenuron (1.14 fold), hexaflumunorn (1.14 fold), chlorpyrifos (3.92 fold), cyanophos (3.49 fold), profenofos (3.96 fold), methomyl (6.77 fold) and abamectin (0.4 folds). In contrast resistanc was detected to alpha cypermethrin (177.5 fold) and aimx (chlorfluazuron + profenofos) (43.67 fold), respectively, according to the results presented in Table (19) and illustrated in Fig. (36).

2-5-2- Susceptibility evaluation during 1996

The obtained LC_{50} values were characterized by relatively higher values of wide range of susceptibility, (0.6 to 3360.6 ppm) in Table (20) and Fig.(37). This strain showed resistance abamectin and azadirachtin, LC_{50} are (273.2 – 309 ppm, respectively). This strain indicated very low susceptibility lufenuron and Hexaflumuron (0.6 – 3 ppm) respectively. The two members of the pyrethroids showed higher figures (537.1 – 3360.6 ppm),as alpha cypermethrin and fenvalerate, respectively. The

Table (19): Susceptibility of *Spodoptera littoralis* of Fayoum Governorate to different insecticides during 1995.

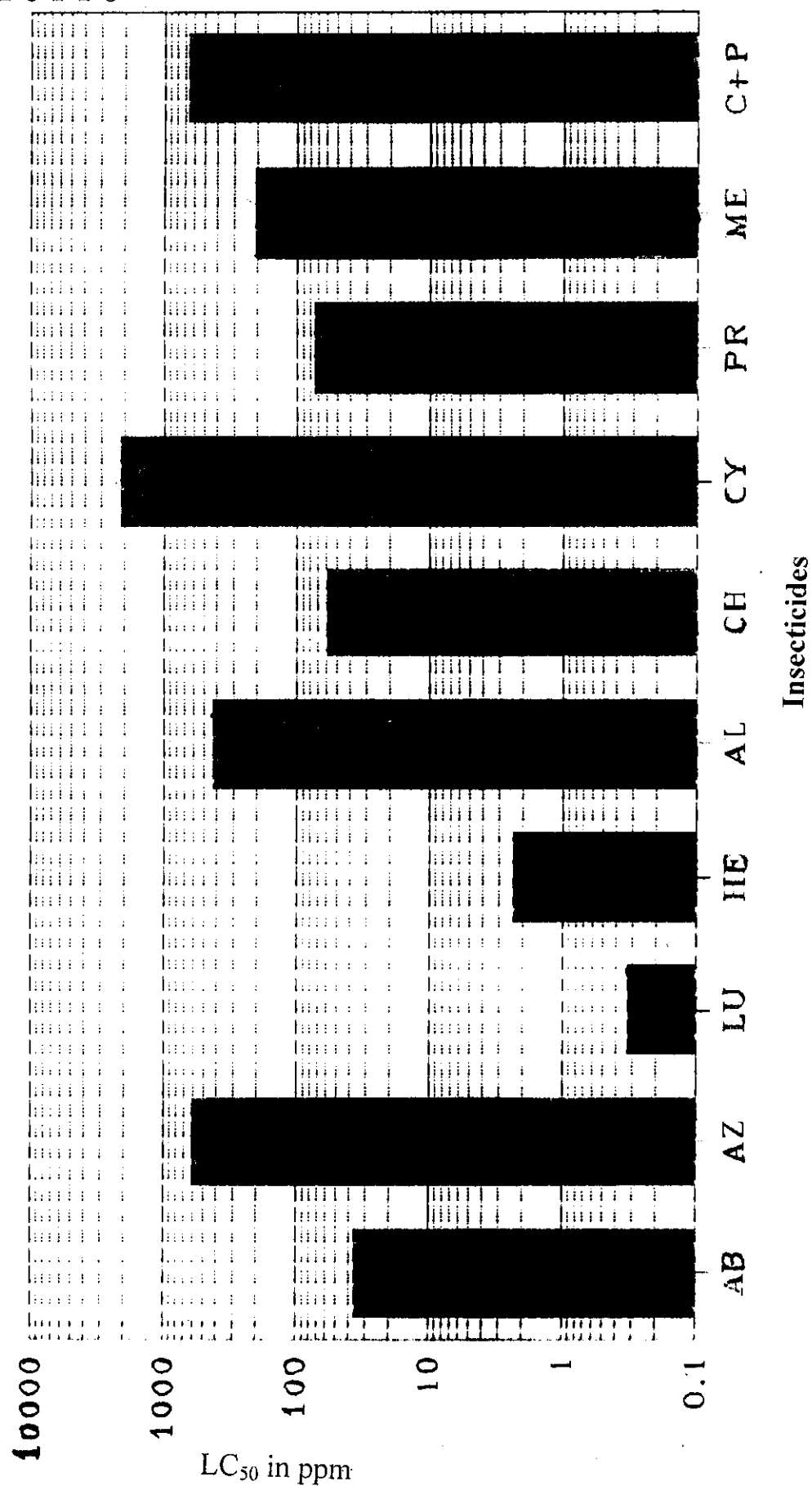
Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	2.35	36.43	25.49	54.39	128.06	78.61	503.65	0.4
Azadirachtin *	0.75	609.62	297.12	2145.86	31580	5811.2	:	2.60
Lufenuron **	2.23	0.33	0.23	0.42	1.22	0.41578E+07	:	1.14
Hexaflumuron**	1.41	2.38	1.67	3.30	19.31	0.90	1.95	1.14
Alpha cypermethrin ΔΔ	2.82	431.35	250	46	621.22	11.74	42.72	177.5
Chlorpyrifos Δ	2.35	59.04	39.4	77.59	207.77	808.57	3706.33	3.92
Cyanophos Δ	3.03	2154.89	1844.30	2593.76	5701.4	151.42	359.06	3.92
Profenofos Δ	2.56	74.33	54.17	94.03	226.16	4212.2	10039	3.96
Methomyl □	1.48	206.44	105.41	291.39	1022.81	162.05	544.91	6.77
Chlorfluazuron + profenofos)Aimx ♦	2.49	658.15	435.10	853.81	2149.0	733.11	1931.29	43.67

(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level: $LC_{50} \text{ field strain}$
 LC₅₀ Lab. strain.

Fig(35) LC₅₀ values of the used insecticides to Fayom field strain of *Spodoptera littoralis* larvae during 1995.



Fig(36) Resistance level of Fayom strain of *Spodoptera littoralis* (1995) based on LC₅₀.

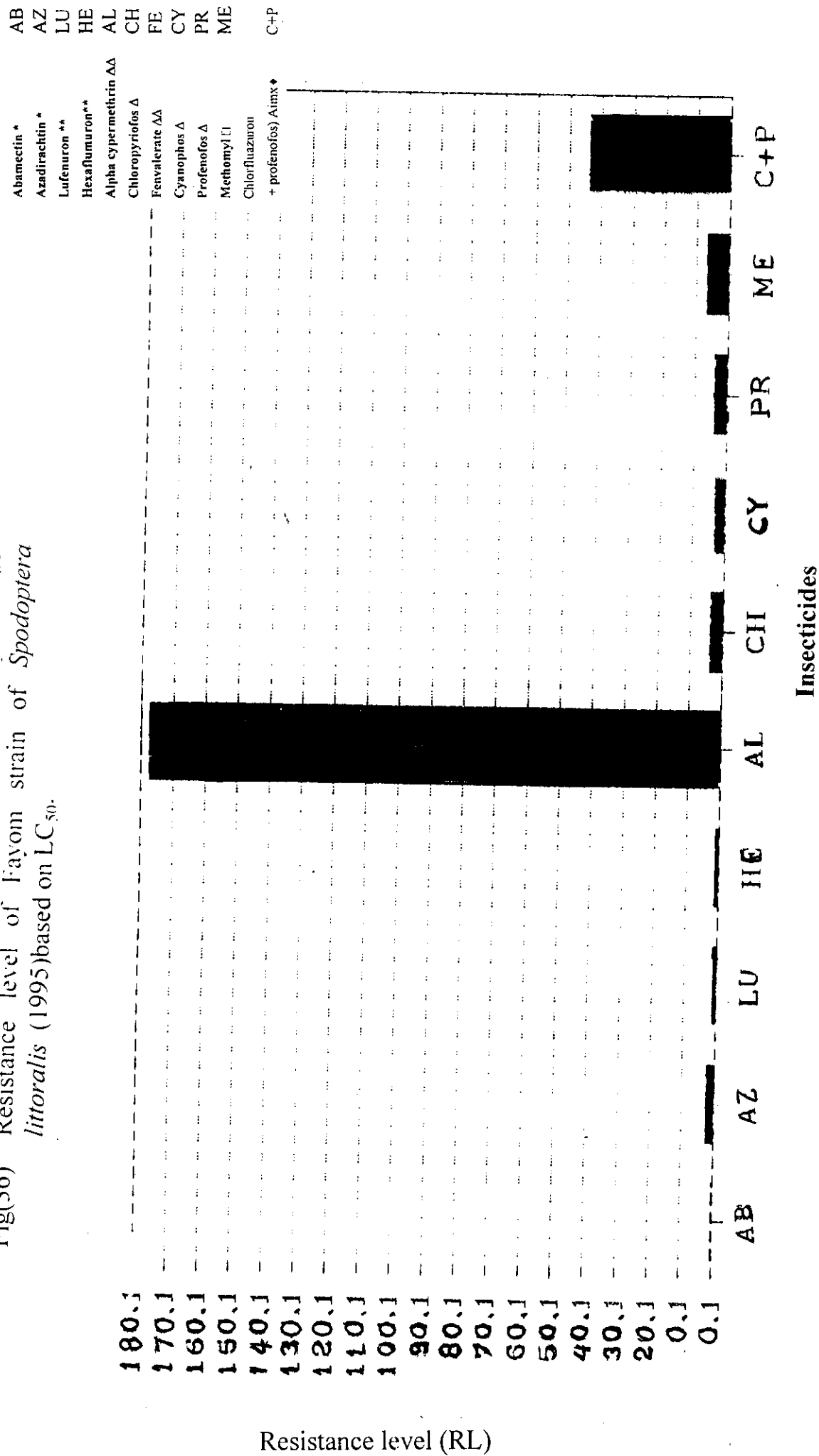


Table (20): Susceptibility of *Spodoptera littoralis* of Fayom Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90%		LC ₉₀ ppm	90%		RL based on LC ₅₀
			Fiducial limits			Fiducial limits		
Abamectin *	1.5	273.2	167.4 : 419.2		1865.8	983.8 : 7931.6		2.98
Azadirachtin *	0.9	309	140.1 : 793.7		7303.6	1959.5 : 0.44E+06		1.32
Lufenuron **	2.1	0.6	0.4 : 0.8		2.3	1.7 : 4		2.07
Hexaflumuron **	2.7	3	2.2 : 3.8		8.9	6.8 : 13.8		1.43
Alpha cypermethrin ΔΔ	1.5	537.1	378.5 : 752.8		4012.9	2356.5 : 9948.1		221.03
Chlorpyrifos Δ	3.7	283.1	-		622.40	-		18.79
Fenvalerate ΔΔ	4.1	3360.6	2889.0 : 3836.4		6921.3	5659.6 : 10037		823.67
Cyanophos Δ	3.7	10714.0	8666.9 : 12383		23553	19139 : 35708		17.4
Profenofos Δ	2.4	579.5	376.3 : 944.5		2031.7	1150.8 : 13222		30.84
Methomyl □	3.0	1442.4	-		3897.4	-		47.28
Chlorfluazuron + profenofos)Aimx ♦	3.0	4481.2	31792 : 6244.6		12103	7931.4 : 47714		297.36

(*) : natural product
 (Δ) : organophosphates
 (♦) : mixed
 ppm : part per million.

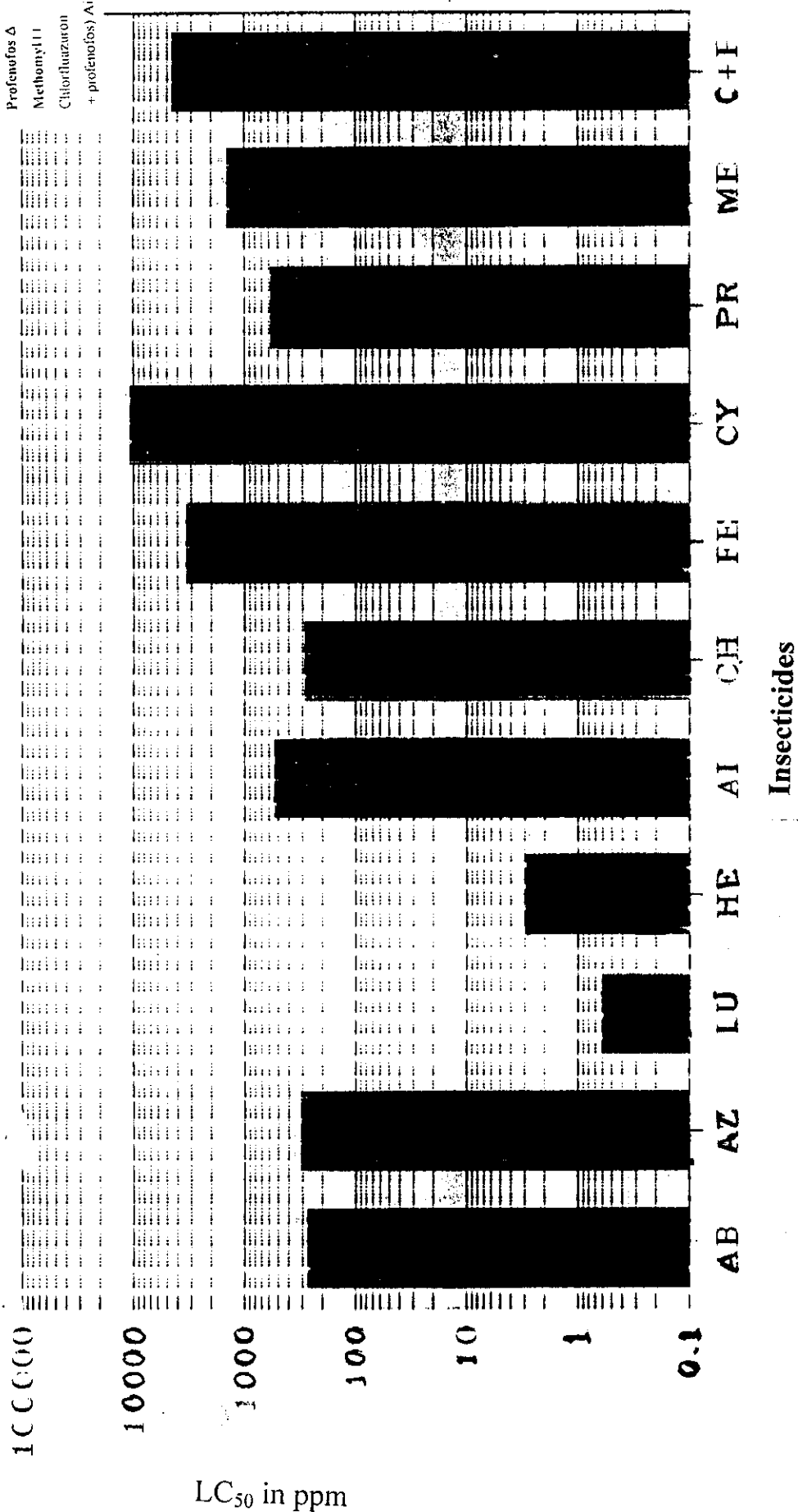
(**) : Insect Growth Regulator
 (ΔΔ) : pyrethroids
 (□) carbamates

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level : LC₅₀ field strain
 LC₅₀ Lab. strain.

AB
AZ
LU
HE
AL
CH
FE
CY
PR
ME
C+P

Abamectin *
Azadirachtin *
Lufenuron **
Hexaflumuron **
Alpha cypermethrin ΔΔ
Chlorpyrifos Δ
Fenvalerate ΔΔ
Cyanophos Δ
Profenofos Δ
Methomyl I I
Chlorfluazuron
+ profenofos) Aitax *

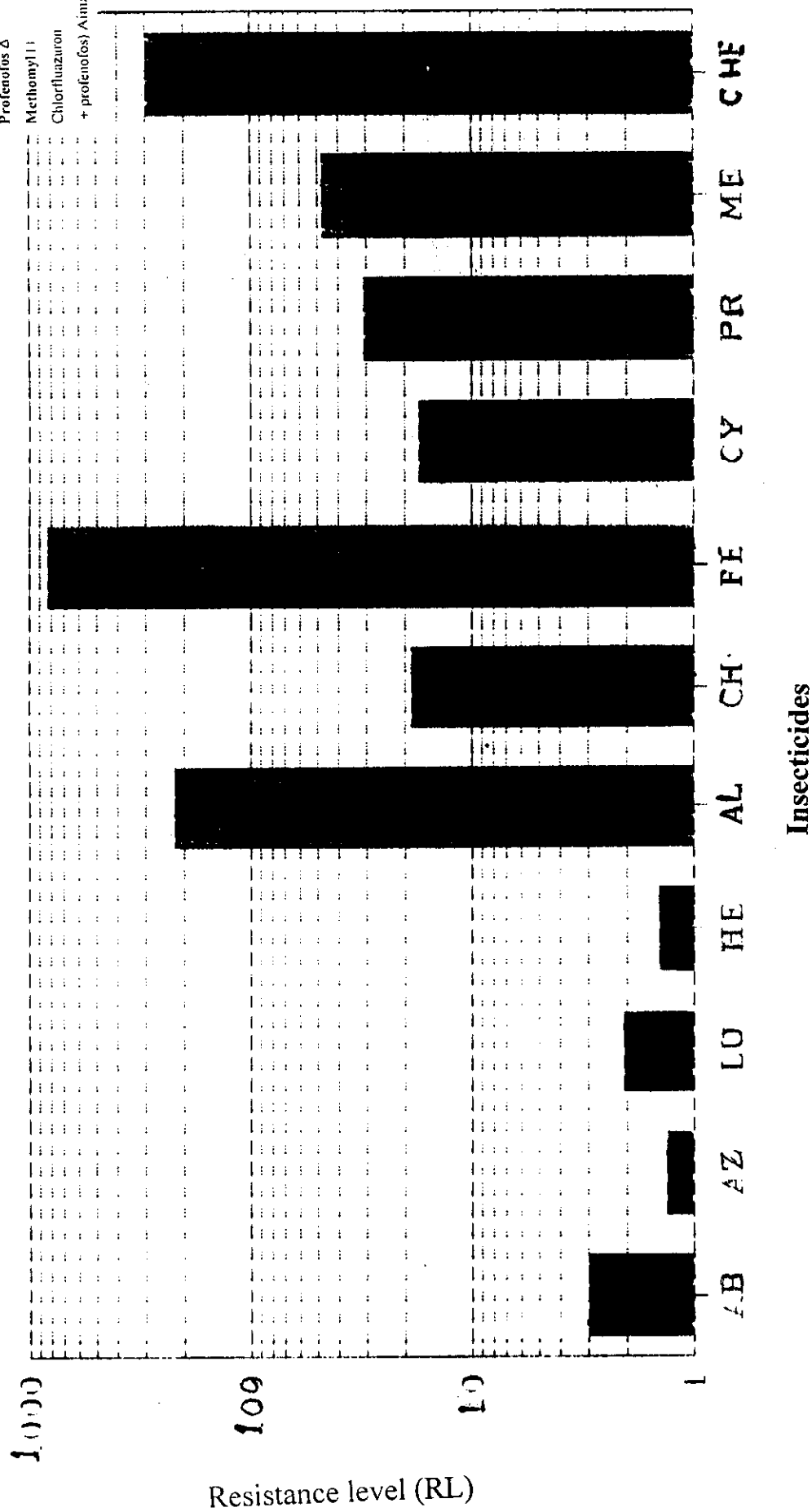
Fig(37) LC₅₀ values of the used insecticides to Fayom field strain of *Spodoptera littoralis* larvae during 1996.



AB
 AZ
 LU
 HE
 AL
 CH
 FE
 CY
 PR
 ME
 C+P

Abamectin *
 Azadirachtin *
 Lufenuron **
 Hexaflumuron**
 Alpha cypermethrin ΔΔ
 Chlorpyrifos Δ
 Fenvalerate ΔΔ
 Cyanophos Δ
 Profenofos Δ
 Methomyl I I
 Chlorfluazuron
 + profenofos) Aimx *

Fig(38) Resistance level of Fayom strain of *Spodoptera littoralis* (1996) based on LC₅₀.



LC₅₀ values of the organophosphorous chlorpyrifos, profenofos and cyanophos were 283.1, 579.5 and 10714 ppm, respectively. The carbamate, methomyl, was highly effective than the pyrethroids which showed LC₅₀ values of methomyl (1442.4 ppm) and aimx (4481.2 ppm), respectively. The resistance levels (RL) reflects the development of resistance to the organophosphates, chlorpyrifos (18.79 fold), profenofos (30.84 fold) and cyanophos (17.4 fold). While it still susceptible to the natural products and IGRs as abamectin (2.98 fold), azadirachtin (1.32 fold), lufenuron (2.07 fold) and hexaflumuron (1.43 fold). It was highly resistance to alpha cypermethrin (221.03 fold) and fenvalerate (828.67 folds). It was also showed highly resistant to methomyl (47.28 fold) and aimx (297.36 fold) (Fig. 38 and Table 20).

C- The cotton aphids *Aphis gossypii*

1- Laboratory strain

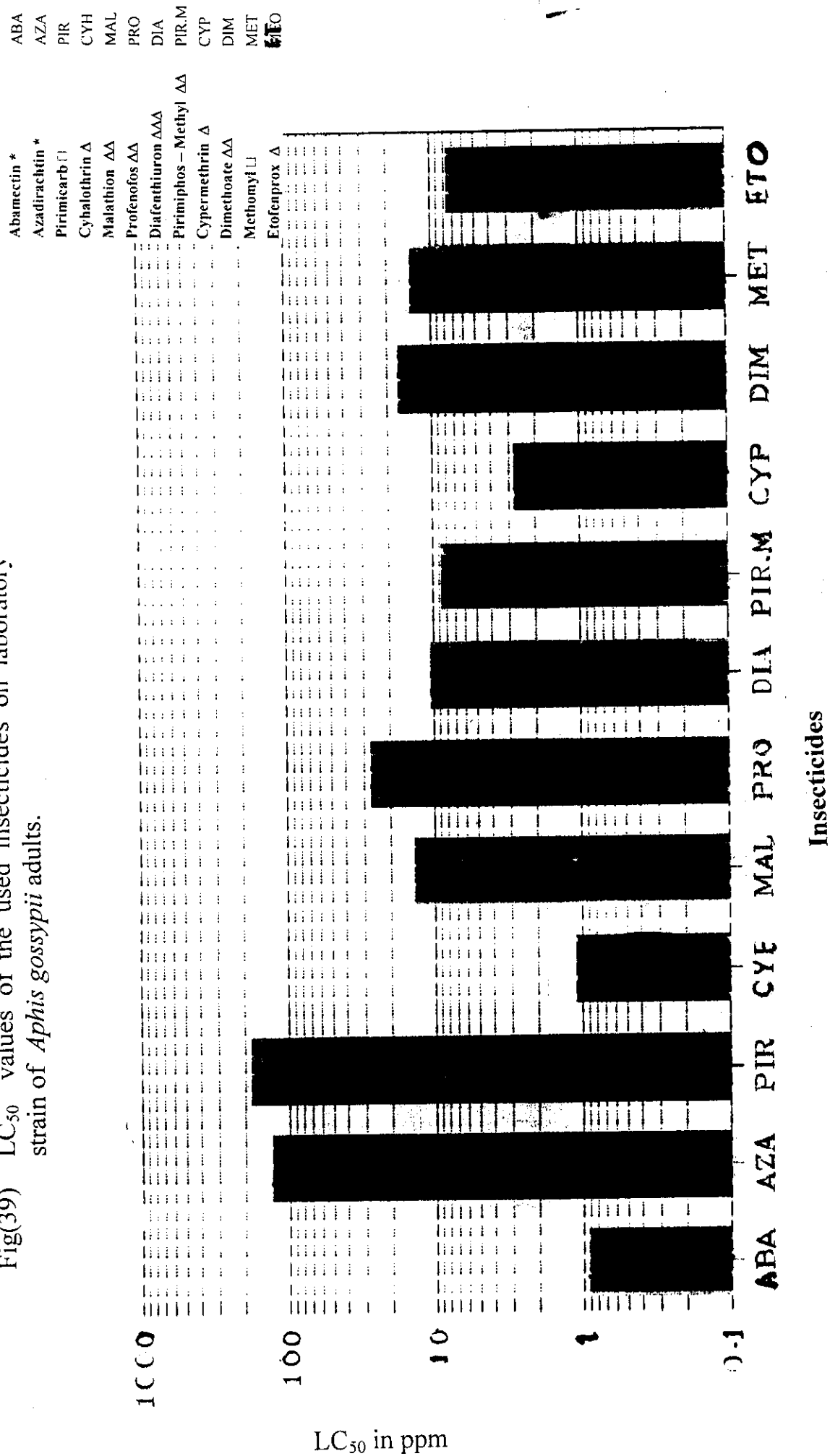
Results presented in Table (21) and illustrated in Fig. (39) showed that the LC₅₀ values for the most of the tested formulated products ranged between 0.92 to 180 ppm. Abamectin measured 0.92 ppm, cyhalothrin 1.11 ppm and cypermethrin 2.78 ppm. The LC₅₀s values of natural products abamectin and azadirachtin were varied between 0.92 and 130.55 ppm, respectively. The forementioned organophosphates, primphos-methyl, malathion, dimethoate and profenofos were recorded the most potent insecticides where the LC₅₀s values were of 8.8, 13.66, 16.68 and 27.2 ppm, respectively. The LC₅₀ values of the two carbamates methomyl and pirimicarb were 13.8 and 180.95 ppm, respectively. While the LC₅₀ values of the synthetic pyrethroids Cyhalothrin and Cypermethrin, were 1.1 and 2.78ppm, respectively. The thiourea diafenthiuron showed LC₅₀ value of 10.5 ppm. While etofenprox showed LC₅₀s value of 7.7 ppm.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits	
Abamectin *	1.48	0.92	0.53	1.35	6.74	4.13	15.78
Azadirachtin *	2.2	130.55	105.8	172.49	498.37	326.5	1028.6
Pyrimicarb □	0.93	180.95	88.13	326.7	4326.8	1513.4	64050
Cyhalothrin Δ	1.2	1.11	0.75	1.56	12.84	7.38	31.77
Malathion ΔΔ	1.54	13.66	9.73	18.24	93.5	58.45	211.1
Profenofos ΔΔ	3.31	27.2	21.9	33.18	66.47	50.7	108.38
Diafenthiuron ΔΔΔ	3.09	10.5	8.99	12.05	27.32	22.13	37.98
Pirimiphos – Methyl ΔΔ	2.75	8.8	6.09	11.6	25.6	18.63	42.6
Cypermethrin Δ	1.39	2.78	1.35	4.61	23.17	11.94	95.99
Dimethoate ΔΔ	2.18	16.68	13.14	20.53	64.4	49.1	94.32
Methomyl □	3.62	13.8	10.43	15.97	31.19	25.82	47.19
Etofenprox Δ	1.3	7.7	4.8	10.64	74.06	39.42	305.36

LC₅₀: Lethal concentration killed fifty percent
 LC₉₀: Lethal concentration killed ninety percent
 RL : Resistance level : LC₅₀ field strain
 LC₅₀ Lab. strain.

(*) Natural product
 (ΔΔΔ) Insect Growth Regulator
 (ΔΔ) organophosphates
 (□) carbamate
 (Δ) pyrethroids
 ppm : Part per million

Fig(39) LC_{50} values of the used insecticides on laboratory strain of *Aphis gossypii* adults.



2- Field strain

2-1- Kalubia strain

2-1-1- Susceptibility evaluation during 1995

This strain showed a wide range of susceptibility the LC_{50} values were 2.01 to 268.4 ppm which was similar in part to Dakahlia strain. The Kalubia strain was of low to moderate resistance to pyrethroids. Cypermethrin and cyhalothrin. Showed LC_{50} values of 22.84 ppm and 268.4 ppm, respectively, (Table 22, Fig. 40). Three organophosphate LC_{50} values of Primphos methyl showed 5.52 ppm, malathion 73.67 ppm and dimethoate 170.61 ppm. The susceptibility to the tested carbamate, methomyl showed LC_{50} of 24.86 ppm, and the thiourea diafenthiuron showed value of LC_{50} 60.36 ppm. The field strain of Kalubia strain exhibited degree of resistance to cyhalothrin equal to 244 fold while it was moderately resistance to dimethoate (10.2 fold) for the two natural products, azadirachtin (0.2 fold) and abamectin (2.2 fold). Kalubia strain was susceptible to the carbamates, pirimicarb (1.1 fold) and methomyl (1.8 fold). On the other hand cypermethrin indicate vigor tolerance (8.2 fold). According to the obtained results in Table (22) and illustrated in Fig. (41), this strain was still susceptible to pirimphos methyl (0.6 fold) and malathion was tolerance (5.39 fold).

2-1-2- Susceptibility evaluation during 1996

The obtained LC_{50} s values refer to a big range of variation (6.15 – 4888.9 ppm), (Fig. 42 and Table 23). Among the natural products the LC_{50} values of abamectin and azadirachtin were 6.15 ppm and 88.73 ppm, respectively. While the carbamates methomyl and pirimicarb showed LC_{50} values of 19.43 and 287.19 ppm, respectively. The two pyrethroids, cyhalothrin and cypermethrin showed LC_{50} values of 22.27 ppm and 174.68 ppm, respectively. The four members of

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	1.36	2.01	1.27 : 2.78		17.54	11.32 : 95		2.2
Azadirachtin *	1.9	19.08	14.35 : 24.77		90.41	59.07 : 197.32		0.2
Pirimicarb □	2.39	192.66	-		662.62	-		1.1
Cyhalothrin Δ	2.75	268.4	-		785.26	-		244
Malathion ΔΔ	2.57	73.67	-		231.89	-		5.39
Diafenthuiuron ΔΔΔ	1.95	60.36	36.08 : 87.49		274.72	171.92 : 705.49		5.8
Pirimiphos – Methyl ΔΔ	1.59	5.52	4.01 / 7.69		35.29	19.78 / 117.4		0.6
Cypermethrin Δ	1.34	22.84	16.0 / 31.29		207.27	119.83 / 546.48		8.2
Dimethoate ΔΔ	1.86	170.61	129.22 / 215.68		830.85	618.61 / 1249.75		10.2
Methomyl □	1.89	24.86	18.71 / 31.65		118.05	84.09 / 198.80		1.8

(*) Natural product
(ΔΔΔ) Insect Growth Regulator
(ΔΔ) organophosphates
(□) carbamate

(Δ) pyrethroids
ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent
LC₉₀: Lethal concentration killed ninety percent
RL : Resistance level : LC₅₀ field strain
LC₅₀ Lab. strain.

Fig(40) LC_{50} values of the used insecticides of to Kalubia field strain of *Aphis gossypii* adults during 1995.

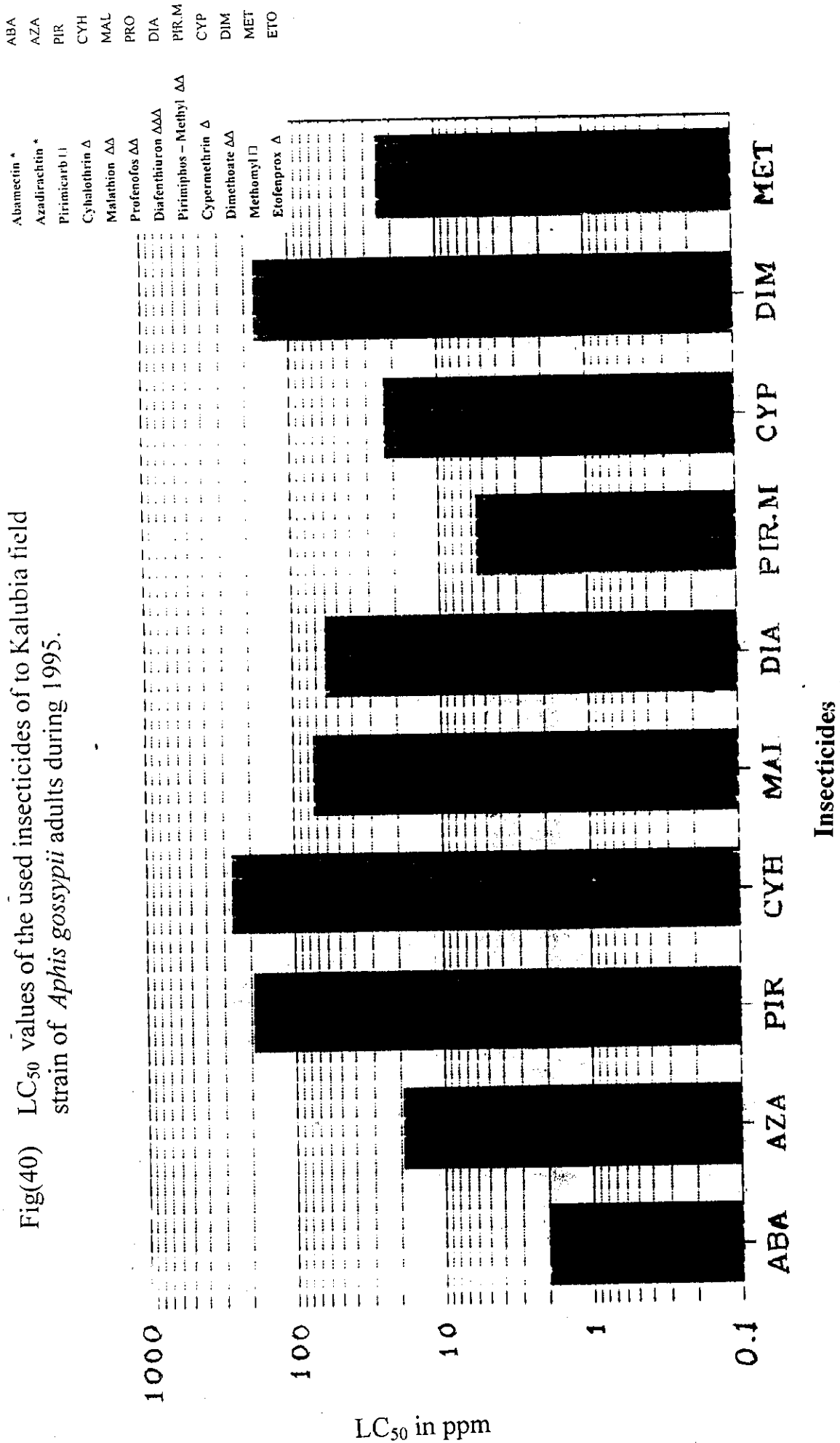


Table (23): Susceptibility of *Aphis gossypii* of Kalubia Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	1.54	6.15	4.36	8.47	41.66	24.85	104.76	6.7
Azadirachtin *	1.22	88.73	58.89	135.99	994.59	481.31	4082.4	0.7
Pirimicarb □	1.49	287.19	213.14	383.81	2065.6	2261.7	4720.2	1.6
Cyhalothrin Δ	2.35	22.27	17.50	27.34	78.21	60.02	114.69	20.1
Malathion ΔΔ	1.64	149.19	112.75	194.13	903.86	589.18	1803.93	10.9
Profenofos ΔΔ	2.53	160.37	127.96	194.62	513.05	401.9	725.84	5.9
Diafenthiuron ΔΔΔ	1.73	68.03	51.67	87.79	372.66	250.32	699.91	6.5
Pirimiphos – Methyl ΔΔ	1.85	58.86	46.07	73.19	290.96	210.75	467.6	6.7
Cypermethrin Δ	1.25	174.68	124.25	247	1851.6	995.22	5487.7	62.8
Dimethoate ΔΔ	1.45	430.6	318.23	578.23	3277.9	2031.7	6952.7	25.8
Methomyl □	1.7	19.43	14.68	25.50	110.24	71.25	226.07	1.5
Etofenprox Δ	1.78	4888.9	-	-	25783	-	-	634.9

(*) Natural product

(ΔΔΔ) Insect Growth Regulator

(ΔΔ) organophosphates

(□) carbamate

(Δ) pyrethroids

ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent

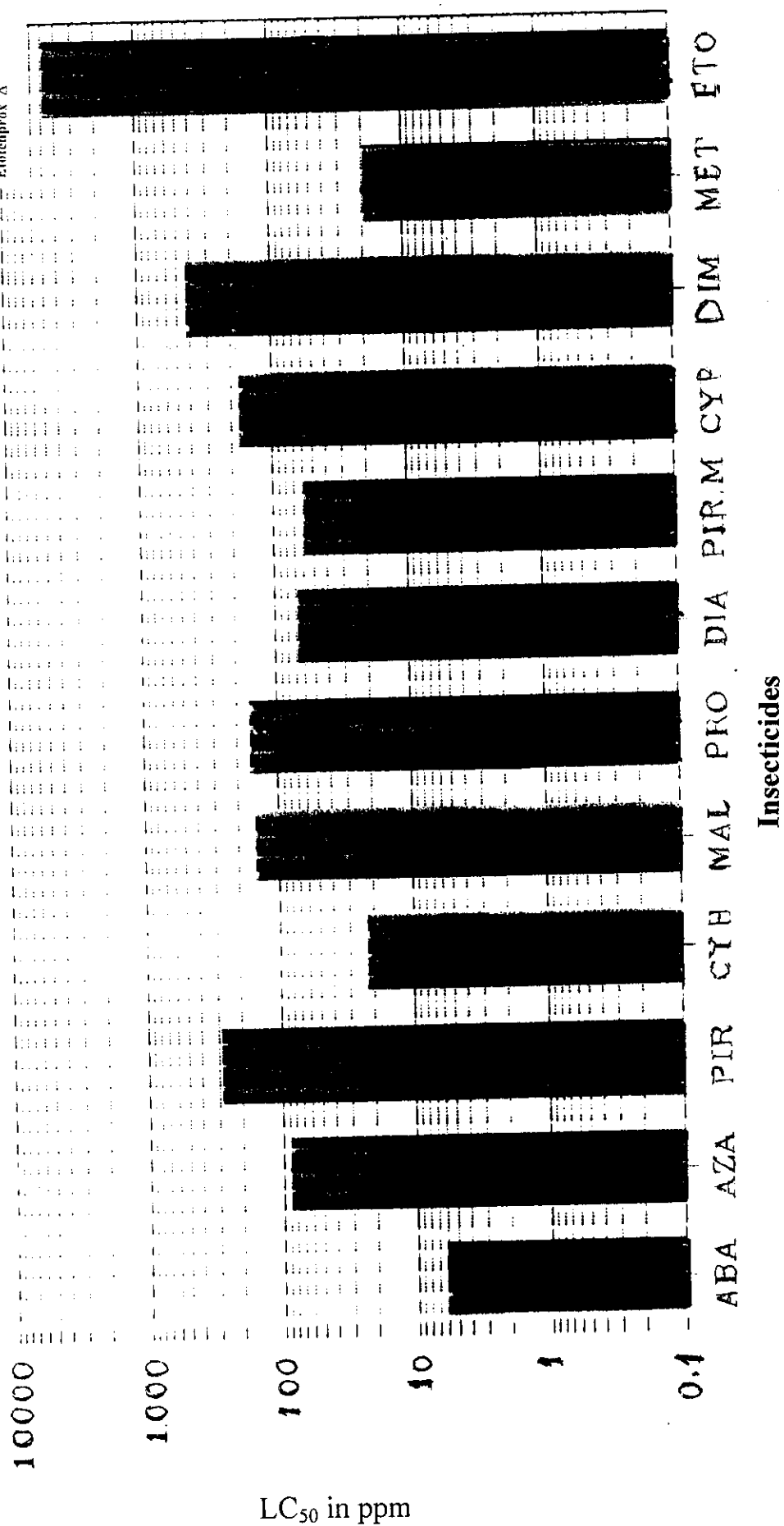
LC₉₀: Lethal concentration killed ninety percent

RL : Resistance level : LC₅₀ field strain

LC₅₀ Lab. strain.

Abamectin *
 Azadirachtin *
 Pirimicarb II
 Cyhalothrin Δ
 Malathion ΔΔ
 Profenofos ΔΔ
 Diafenthiuron ΔΔΔ
 Pirimiphos - Methyl ΔΔ
 Cypermethrin Δ
 Dimethoate ΔΔ
 Methomyl II
 Etofenprox Δ
 ABA
 AZA
 PIR
 CYH
 MAL
 PRO
 DIA
 PIR.M
 CYP
 DIM
 MET
 ETO

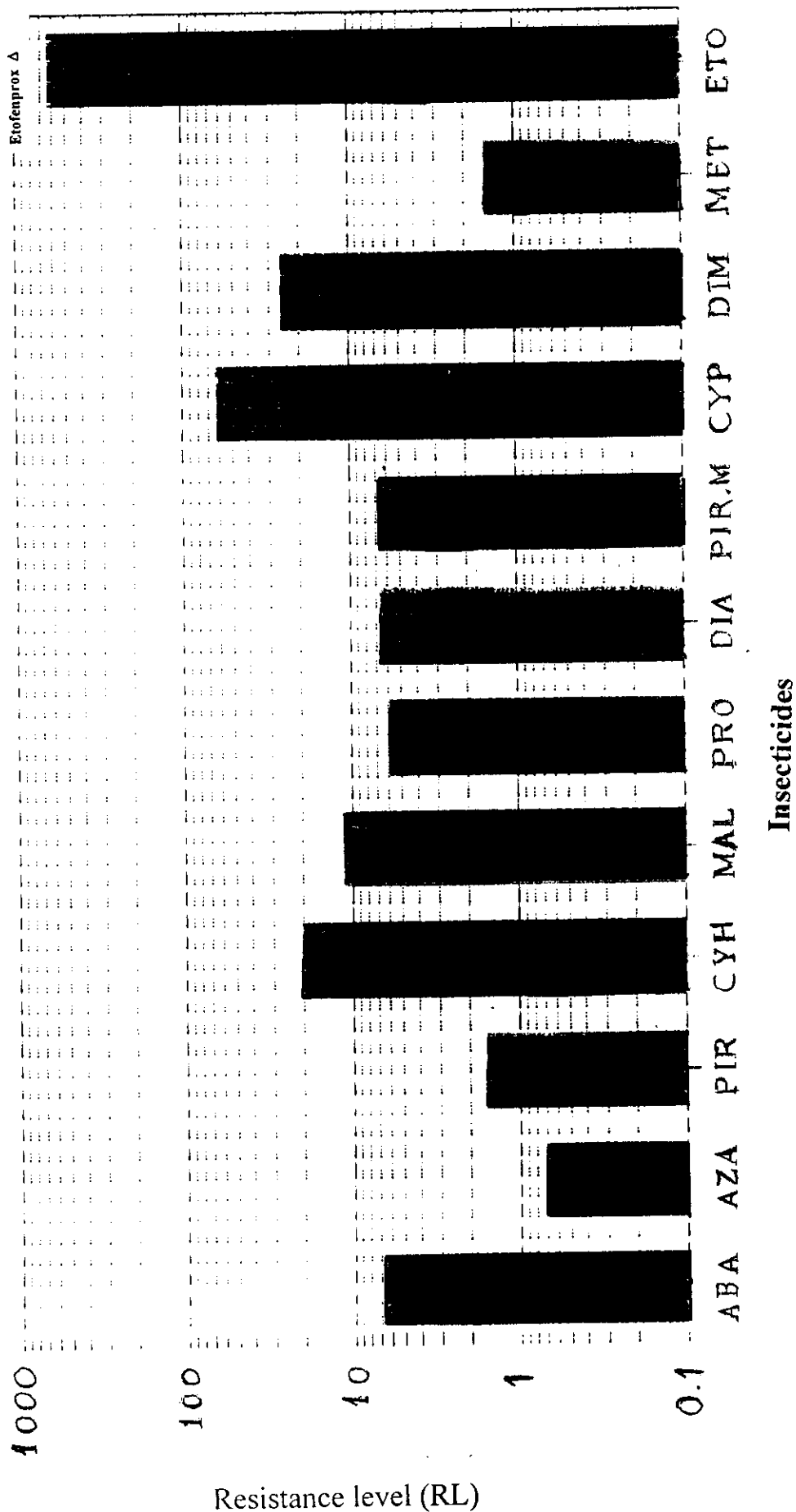
Fig(42) LC₅₀ values of the used insecticides of Kalubia field strain of *Aphis gossypii* adults during 1996.



ABA
AZA
PIR
CYH
MAL
PRO
DIA
PIR.M
CYP
DIM
MET
ETO

Abamectin *
Azadirachtin *
Pirimicarb □
Cyhalothrin Δ
Malathion ΔΔ
Profenofos ΔΔ
Difenthiuron ΔΔΔ
Pirimiphos - Methyl ΔΔ
Cypermethrin Δ
Dimethoate ΔΔ
Methomyl □
Etofenprox Δ

Fig(43) Resistance level of Kalubia strain of *Aphis gossypii*.
(1996) based on LC₅₀.



organophosphorous, pirimiphos methyl, profenofos, malathion and dimethoate showed LC_{50} s values of 58.86ppm, 160.37ppm, 149.19ppm and 430.6 ppm, respectively. On the others hand, LC_{50} s the values of the thiourea, diafenthiuron and etofenprox were 68.03 ppm and 4888.9 ppm, respectively Comparison between field and laboratory strain RL revealed that this strain was still susceptible to azadirachtin (0.7 fold), pirimicarb (1.6 fold), methomyl (1.5 fold), tolerance to profenofos (5.9 fold), diafenthiuron (6.5 fold) abamectin (6.7 fold) and pirimiphos methyl (6.7 fold). but resistance to malathion (10.9 fold), cyhalothrin (20.1 fold) and dimethoate (25.8 fold), and highly resistance to cypermethrin 62.8 folds and etofenprox (634.9 fold) Table 23 and Fig. 53).

2-2- Dakahlia strain

2-2-1-Susceptibility evaluation during 1995

Table (24) and Fig. (44). The obtained LC_{50} values were characterized by a wide range of susceptibility (1.76 – 139.65 ppm). The two natural products showed very lower LC_{50} s values ranged between 1.76 to 6.88 ppm to abamectin and azadirachtin, respectively. Two members of the organophosphates showed LC_{50} s values of 4.28 – 18.12 ppm for pirimiphos methyl and malathion, respectively. The two members of the pyrethroids cypermethrin and cyhalothrin showed LC_{50} s values of 8.45 and 41.59 ppm. The thiourea showed LC_{50} s value of diafenthiuron 139.65 ppm and the carbamate, pirimicarb 51.54 ppm. The resistance level RL development of resistance to cyhalothrin (37.5 folds) and diafenthiuron (13.3 folds). The Dakahlia strain of *Aphis gossypii* was susceptible to abamectin (1.9 folds). It was tolerant to malathion (1.3 fold) and it susceptible to pirimiphos methyl (0.5 fold), and to pirimicarb (0.3 fold). The Dakahlia strain showed susceptible to azadirachtin (0.05 fold) as shown in Table (24) and illustrated in Fig. (45).

Table (24): Susceptibility of *Aphis gossypii* of Dakahlia Governorate to different insecticides during 1995.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	0.93	1.76	0.89 : 2.90		42.28	15.24 : 660.22		1.9
Azadirachtin *	1.38	6.88	4.67 : 9.91		58.48	31.53 : 194.46		0.05
Pirimicarb □	1.14	51.54	31.53 : 74.73		682.42	344.23 : 2795.2		0.3
Cyhalothrin Δ	0.98	41.59	19.75 : 194.13		854.59	187.12 : 0.12629E+07		37.5
Malathion ΔΔ	1.38	18.12	-		153.48	-		1.3
Diafenthiuron ΔΔΔ	1.88	139.65	102.98 : 202.81		672.23	383.65 : 2265.4		13.3
Pirimiphos – Methyl ΔΔ	1.74	4.28	3.11 : 6.18		23.40	13.07 : 82.77		0.5
Cypermethrin Δ	3.65	8.45	-		18.95	-		3.1

(*) Natural product

(ΔΔΔ) Insect Growth Regulator

(ΔΔ) organophosphates

(□) carbamate

(Δ) pyrethroids

ppm : Part per million

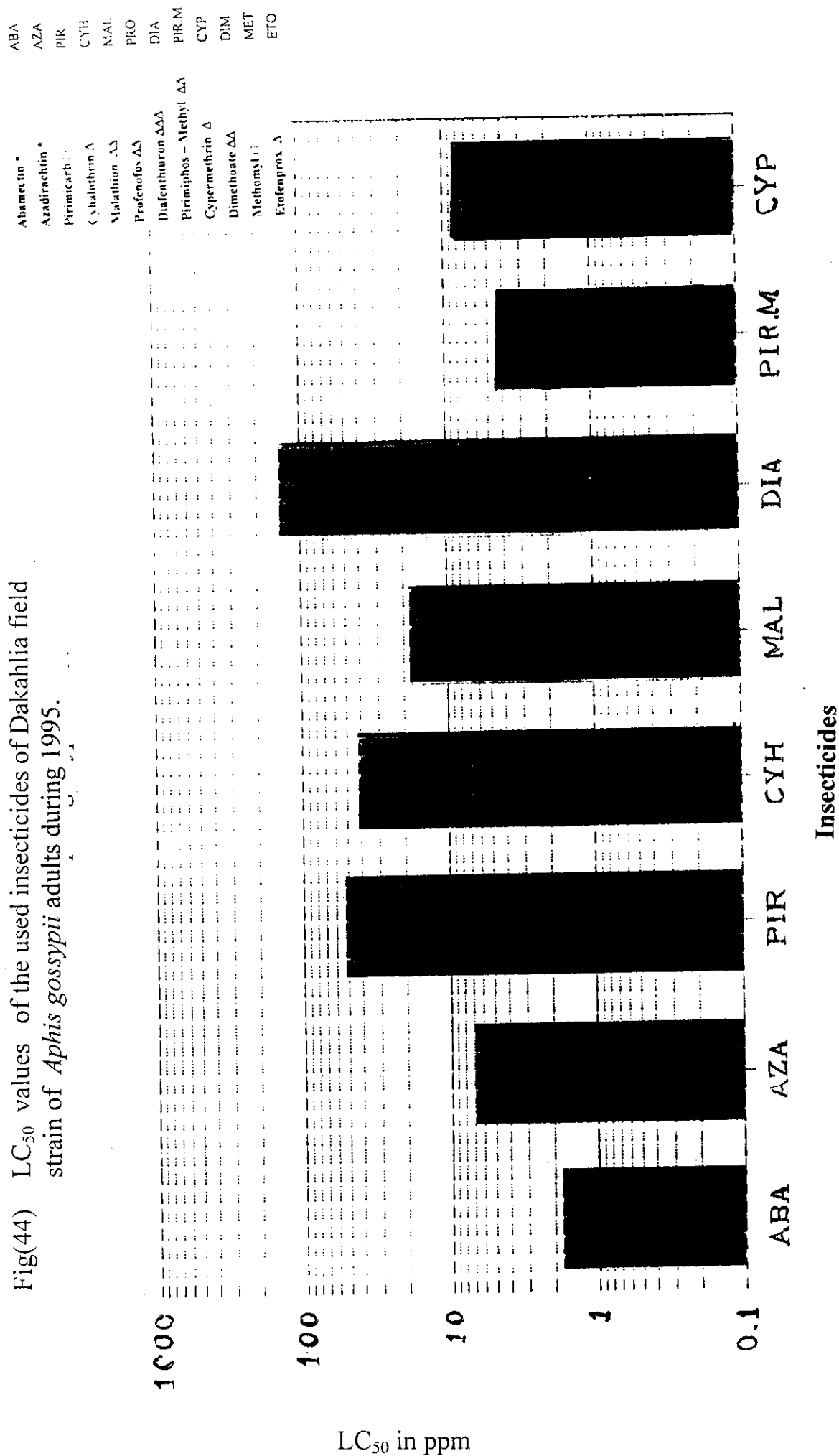
LC₅₀: Lethal concentration killed fifty percent

LC₉₀: Lethal concentration killed ninety percent

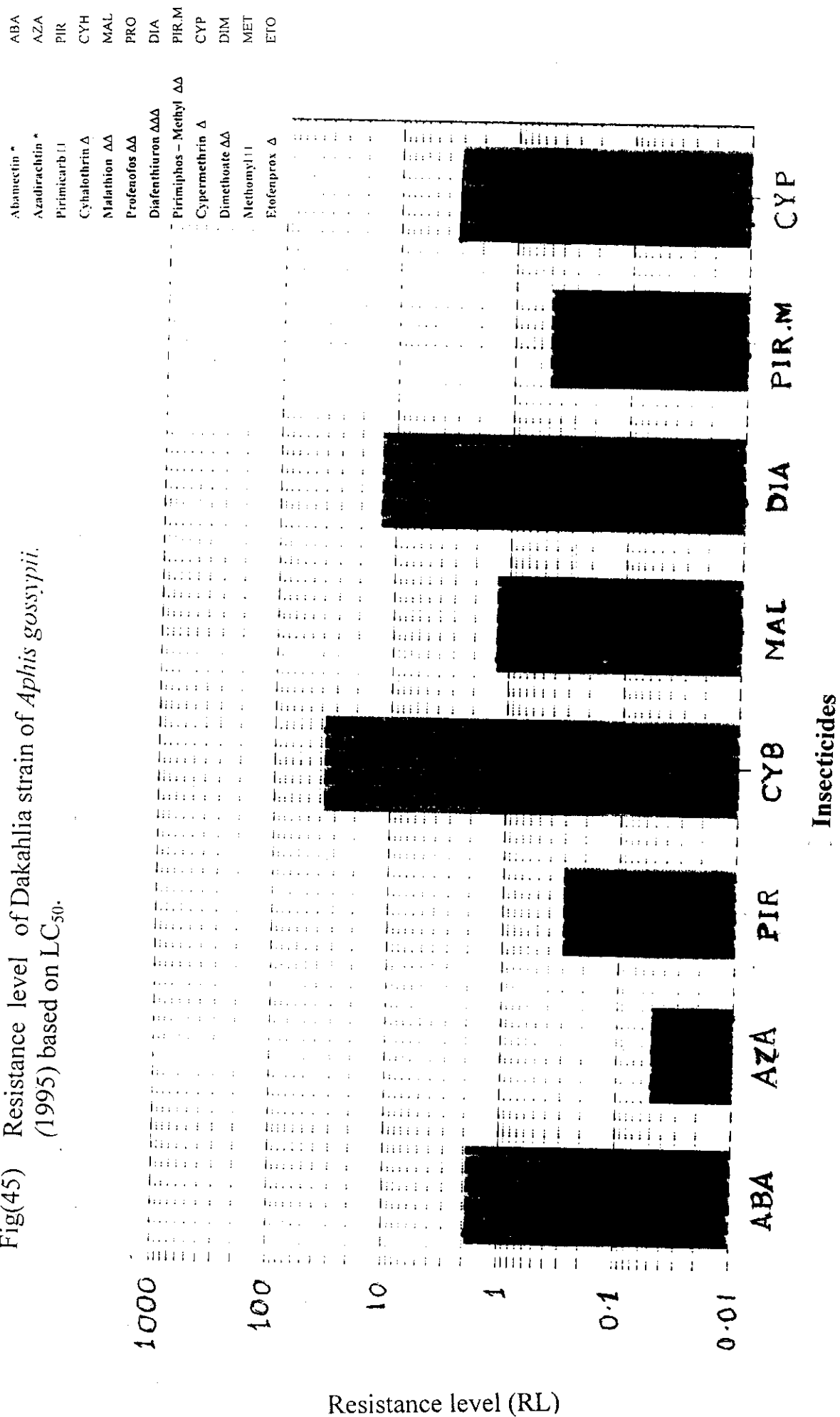
RL : Resistance level : LC₅₀ field strain

LC₅₀ Lab. strain.

Fig(44) LC₅₀ values of the used insecticides of Dakahlia field strain of *Aphis gossypii* adults during 1995.



Fig(45) Resistance level of *Dakahlia* strain of *Aphis gossypii*.
(1995) based on LC₅₀.



2-2-2- Susceptibility evaluation during 1996

This strain showed a wide range of susceptibility, (2.2 – 3434.4 ppm) which similar in part to Behera. Strain the Dakahlia strain was of low to moderately resistance to the natural products, abamectin and azadirachtin showed LC_{50} s values, of 2.2ppm and 15.36 ppm, respectively, (Table 24 Fig. 47). Four members of organophosphates, pirimiphos methyl, malathion, profenofos and dimethoate showed LC_{50} values of 20.61ppm, 116.98ppm, 118.9ppm, and 290.52 ppm, respectively. The two carbamates showed LC_{50} values of 14.73 ppm, for methomyl and 169.56 ppm for pirimicarb. The two pyrethroids, i.e. cyhalothrin and cypermethrin showed lowest to highest LC_{50} values (15.14 ppm and 1258.16 ppm, respectively). Etofenprox showed LC_{50} values 3434.4 ppm. The thiourea diafenthiuron showed LC_{50} s of 61.19 ppm. The results obtained in Fig. (48) and Table (24), showed the highest sensitivity of the strain to natural products, abamectin (2.4 fold) and azadirachtin (0.1 fold) while this strain showed pyrethroid resistance to cyhalothrin (13.6 fold) cypermethrin (452.6 fold). It was still susceptible , to pirimicarb (0.9 fold) and methomyl (1.1 fold). Etofenprox showed of high resistance (446 fold) and tolerance to the thiourea diafenthiuron (5.8 fold). Among organophosphates. pirimiphos methyl, profenofos, malathion and dimethoate had RR and were showed development of resistance in this strain.

2-3-Behera strain

2-3-1- Susceptibility evaluation during 1995

LC_{50} s values for various used insecticides were more or less similar to other Governorates as shown in Table (26) and Fig. (48). Among the tested natural product this strain showed LC_{50} s values of abamectin and azadirachtin are 0.23 and 1.85 ppm, respectively. On the

Table (25): Susceptibility of *Aphis gossypii* of Dakahlia Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀	
Abamectin *	1.78	2.2	1.6 : 3		11.7	7.9 : 21.9		2.4	
Azadirachtin *	1.97	15.36	11.11 : 20.18		68.56	47.53 : 123.22		0.1	
Pirimicarb □	1.53	169.56	121.6 : 222.27		1153.5	767.06 : 2218.9		0.9	
Cyhalothrin Δ	1.36	15.14	10.07 : 21.06		131.92	70.37 : 527.94		13.6	
Malathion ΔΔ	1.24	116.98	80.03 : 177.47		1260	612.11 : 5138		8.6	
Profenofos ΔΔ	2.25	118.9	95.45 : 143.7		394.8	310.3 : 552.14		4.4	
Diafenthuiuron ΔΔΔ	1.74	61.19	45.97 : 78.86		332.25	226.28 : 608.7		5.8	
Pirimiphos – Methyl ΔΔ	1.4	20.61	11.29 : 33.25		168.24	86.28 : 695.39		2.3	
Cypermethrin Δ	3.07	1258.16	1048.7 : 1457.64		3280.8	2475.4 : 6174.6		452.6	
Dimethoate ΔΔ	1.67	290.52	211.18 : 377.33		1700.1	1165.47 : 3081.95		17.4	
Methomyl □	1.86	14.73	11.2 : 18.79		71.96	50.27 : 125.72		1.1	
Etofenprox Δ	2.11	3434.4	1947.83 : 5239.9		13839	7993 : 71919		446	

(*) Natural product

(ΔΔΔ) Insect Growth Regulator

(ΔΔ) organophosphates

(□) carbamate.

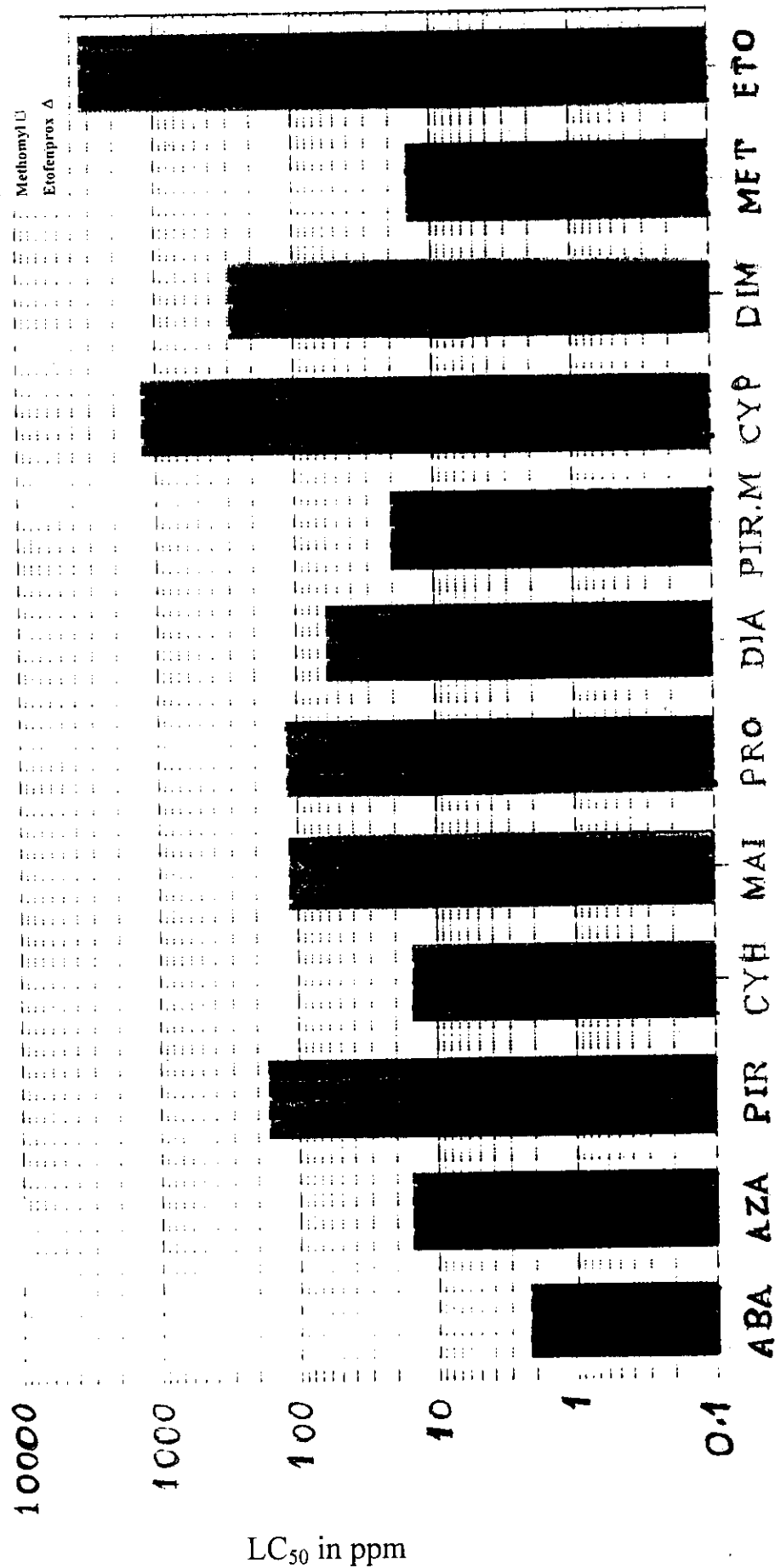
(Δ) pyrethroids

ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent.
 LC₉₀: Lethal concentration killed ninety percent.
 RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

Abamectin *
 Azadirachtin *
 Pirimicarb □
 Cyhalothrin Δ
 Malathion ΔΔ
 Profenofos ΔΔ
 Diafenthiuron ΔΔΔ
 Pirimiphos - Methyl ΔΔ
 Cypermethrin Δ
 Dimethoate ΔΔ
 Methomyl □
 Etofenprox Δ

Fig(46) LC₅₀ values of the used insecticides of *Dakahlia* field strain of *Aphis gossypii* adults during 1996.

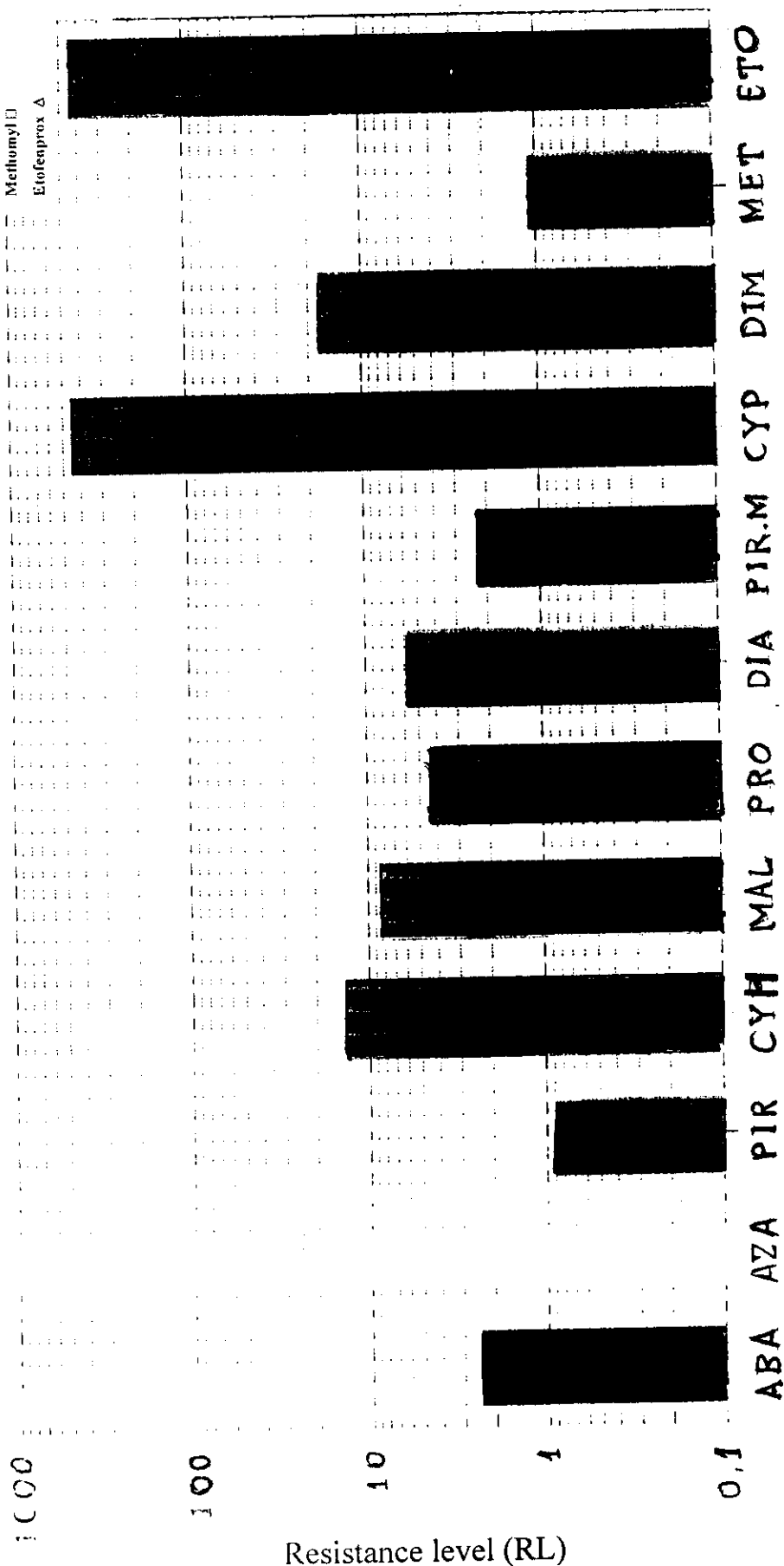


Insecticides

ABA
AZA
PIR
CYH
MAL
PRO
DIA
PIR.M
CYP
DIM
MET
ETO

Abamectin *
Azadirachtin *
Pirimicarb □
Cyhalothrin Δ
Malathion ΔΔ
Profenofos ΔΔ
Difenthiuron ΔΔΔ
Pirimiphos - Methyl ΔΔ
Cypermethrin Δ
Dimethoate ΔΔ
Methomyl □
Etofenprox Δ

Fig(47) Resistance level of *Dakahlia* strain of *Aphis gossypii*.
(1996) based on LC₅₀.



Insecticides

Table (26): Susceptibility of *Aphis gossypii* of Behera Governorate to different insecticides during 1995.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	0.88	0.23	0.13 : 0.38		6.51	2.15 : 107.87		0.2
Azadirachtin *	1.26	1.85	-		19.18	-		0.01
Pirimicarb □	2.2	29.9	21.59 : 39.2		114.2	78.58 : 223.59		0.2
Cyhalothrin Δ	1.23	0.43	0.28 : 0.58		4.73	2.70 : 13.42		0.4
Malathion ΔΔ	2.78	256.59	166.42 : 333.68		743.08	553.10 : 1308.59		18.8
Diafenthiuron ΔΔΔ	3.09	58.21	35.92 : 85.03		151.3	98.74 : 603.64		5.5
Pirimiphos – Methyl ΔΔ	2.07	4.64	3.70 : 5.71		19.29	13.81 : 33.18		0.5
Cypermethrin Δ	1.44	1.27	0.96 : 1.65		9.93	6.23 : 21.40		0.6
Methomyl □	1.12	15.75	-		220.51	-		1.1

(*) Natural product

(ΔΔΔ) Insect Growth Regulator

(ΔΔ) organophosphates

(□) carbamate

(Δ) pyrethroids

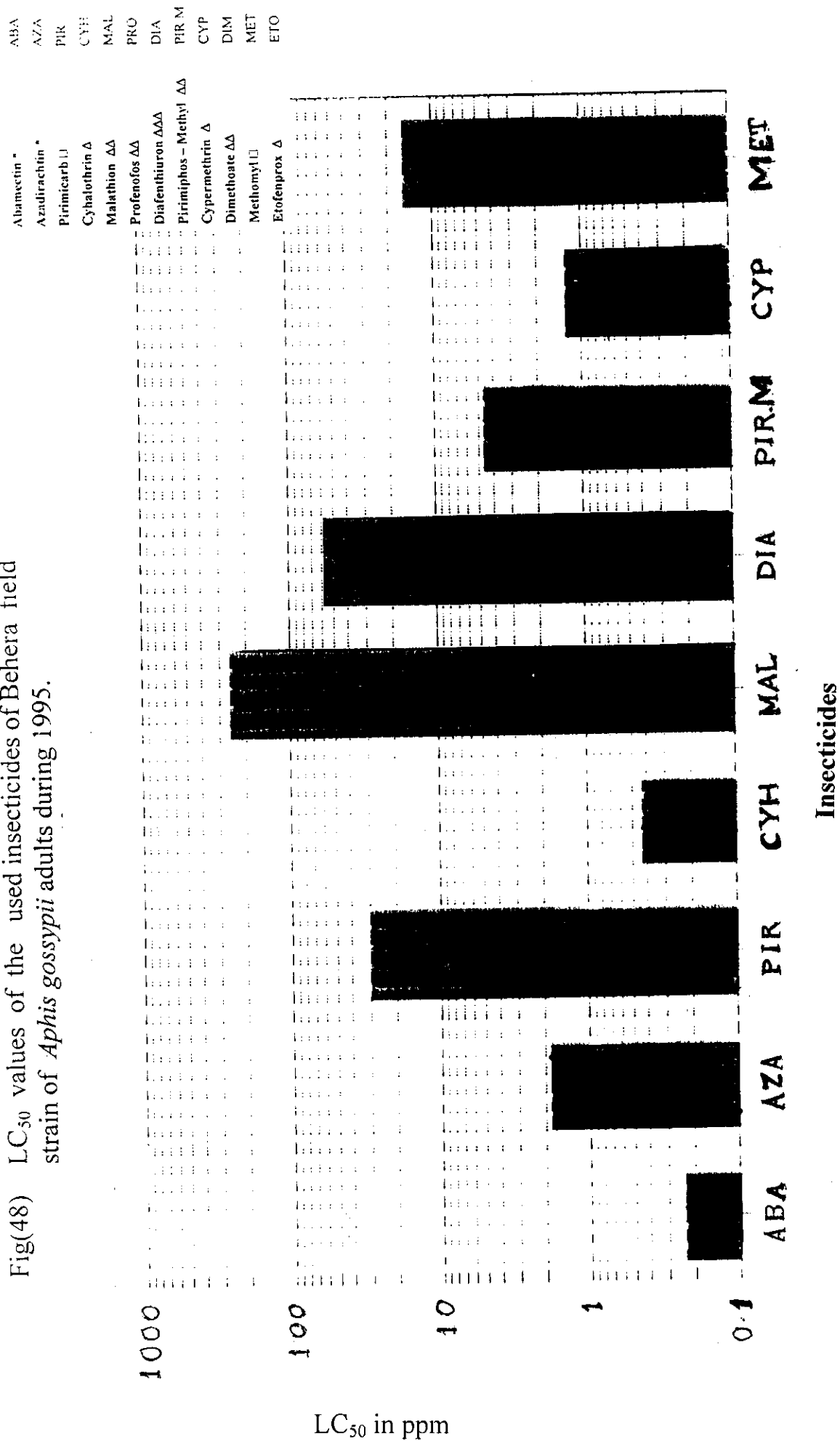
ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent.

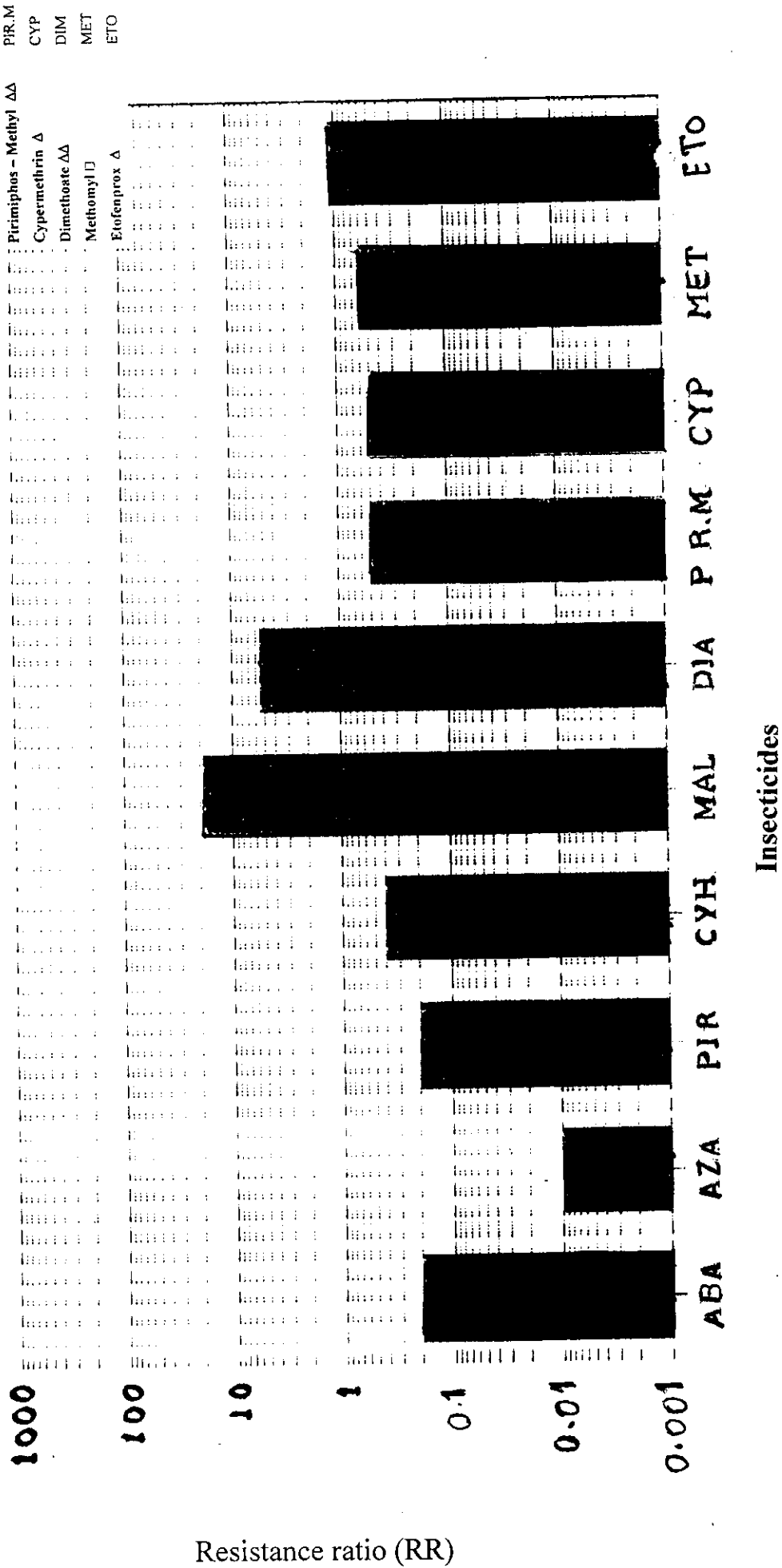
LC₉₀: Lethal concentration killed ninety percent.

RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

Fig(48) LC_{50} values of the used insecticides of Behera field strain of *Aphis gossypii* adults during 1995.



Fig(49) Resistance level of Behera strain of *Aphis gossypii*.
(1995) based on LC₅₀.



contrary the carbamates, methomyl showed LC_{50} value of 15.75 ppm and pirimicarb 29.90 ppm. The organophosphorous, pirimiphos methyl showed LC_{50} value of 4.64 ppm. While LC_{50} s values of cyhalothrin and cypermethrin were 0.43 and 1.27 ppm, respectively. The thiourea, diafenthiuron showed LC_{50} value, of 58.2ppm. Both the pirimiphos methyl and malathion showed LC_{50} values of 4.64 ppm and 256.59 ppm, respectively. The obtained results clearly indicated the development of resistance to many insecticides. Table (26) and illustrated in Fig. (49) showed that the field strain of Behera Governorate was still susceptible insecticides than laboratory strain. This strain was highly susceptible to, abamectin and azadirachtin (0.2 fold, 0.01 fold, respectively). The pyrethroids, cyhalothrin and cypermethrin were also of low levels (0.4 and 0.6 fold).The carbamates, methemyl and primicarb were also effective (1.1 and 0.2 fold).This strain, showed tolerance to diafenthiuron (5.5 fold) and resistance to malathion (18.8 fold) and still susceptible to pirimiphos methyl (0.5 fold).

2-3-2- Susceptibility evaluation during 1996

The obtained LC_{50} values were characterized by relatively higher values a wide range of susceptibility.(5.5 – 3591.44 ppm) as indicated in the Table (27) and illustrated Fig. (50). To two natural products showed LC_{50} values of abamectin and azadirachtin were 5.5and 47.64 ppm, respectively. The organophosphorous pirimiphos methyl, profenofos, malathion, dimethoate showed LC_{50} values of 51.9, 83.62, 239.42 and 634.43 ppm, respectively. The pyrethroids showed LC_{50} s values of 53.03 and 1053.4 ppm for cyhalothrin and cypermethrin, respectively. The two carbamates i.e. methomyl and pirimcarb were less effective than the pyrethroids being 13.84 and 617.09 ppm, respectively. The thiourea diafenthiuron indicate values of LC_{50} s of 63.32 ppm and the etofenprox

Table (27): Susceptibility of *Aphis gossypii* of Behera Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Abamectin *	1.7	5.5	3.81 : 7.45		31.3	20.04 : 68.20		5.9
Azadirachtin *	2.32	47.64	36.89 : 59.26		169.19	128.29 : 252.79		0.4
Pirimicarb □	1.5	617.09	484.1 : 804.77		4438.4	2719.6 : 9871.3		3.4
Cyhalothrin Δ	1.52	53.02	39.42 : 68.88		370.59	255.98 : 625.97		48.2
Malathion ΔΔ	2.6	239.43	196 : 280.16		746.25	591.66 : 1030.96		17.5
Profenofos ΔΔ	1.68	83.62	66.62 : 103.02		483.43	351.27 : 755.43		3.1
Diafenthuiuron ΔΔΔ	1.68	63.32	49.12 : 80.64		366.57	245.99 : 684.90		6.1
Pirimiphos – Methyl ΔΔ	2.19	51.9	41.78 : 199.16		199.06	151.36 : 294.39		5.9
Cypermethrin Δ	1.17	1053.4	796.18 : 1417.36		13222	6927 : 41896		63.2
Dimethoate ΔΔ	2.09	634.43	503.35 : 783.53		2600.90	1913.22 : 4108.75		38
Methomyl □	1.45	13.84	10.47 : 17.75		105.72	67.53 : 220.06		1
Etofenprox Δ	2.05	3591.44	2999.52 : 4334.38		15132	10780 : 25901		466.42

(*) Natural product

(ΔΔΔ) Insect Growth Regulator

(ΔΔ) organophosphates

(□) carbamate

(Δ) pyrethroids

ppm : Part per million

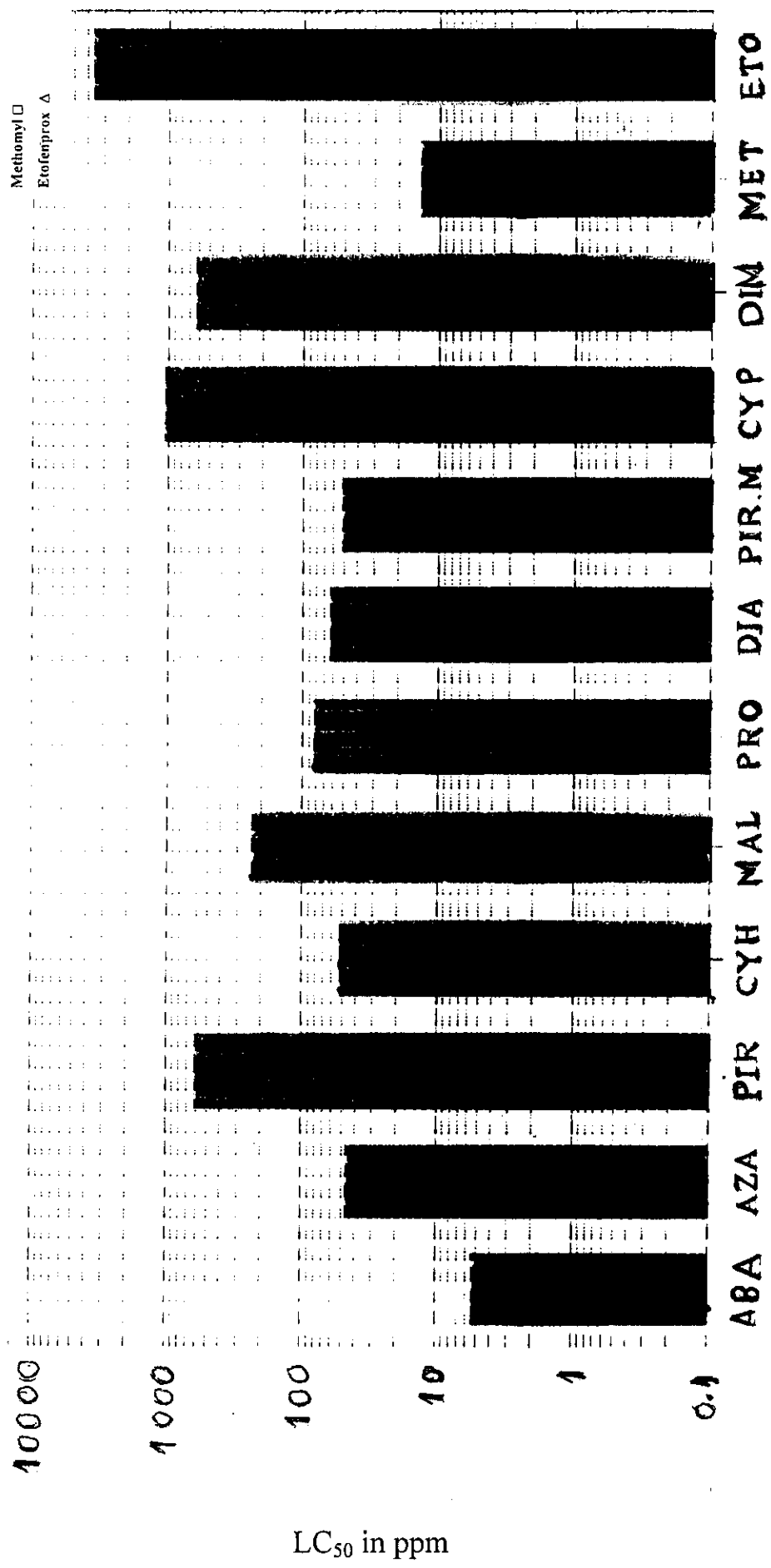
LC₅₀: Lethal concentration killed fifty percent.

LC₉₀: Lethal concentration killed ninety percent.

RL : Resistance level : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

Abamectin *
 Azadirachtin *
 Pirimicarb □
 Cyhalothrin Δ
 Malathion ΔΔ
 Profenofos ΔΔ
 Diafenthiuron ΔΔΔ
 Pirimiphos - Methyl ΔΔ
 Cypermethrin Δ
 Dimethoate ΔΔ
 Methomyl □
 Etofenprox Δ
 ABA
 AZA
 PIR
 CYH
 MAL
 PRO
 DIA
 PIR.M
 CYP
 DIM
 MET
 ETO

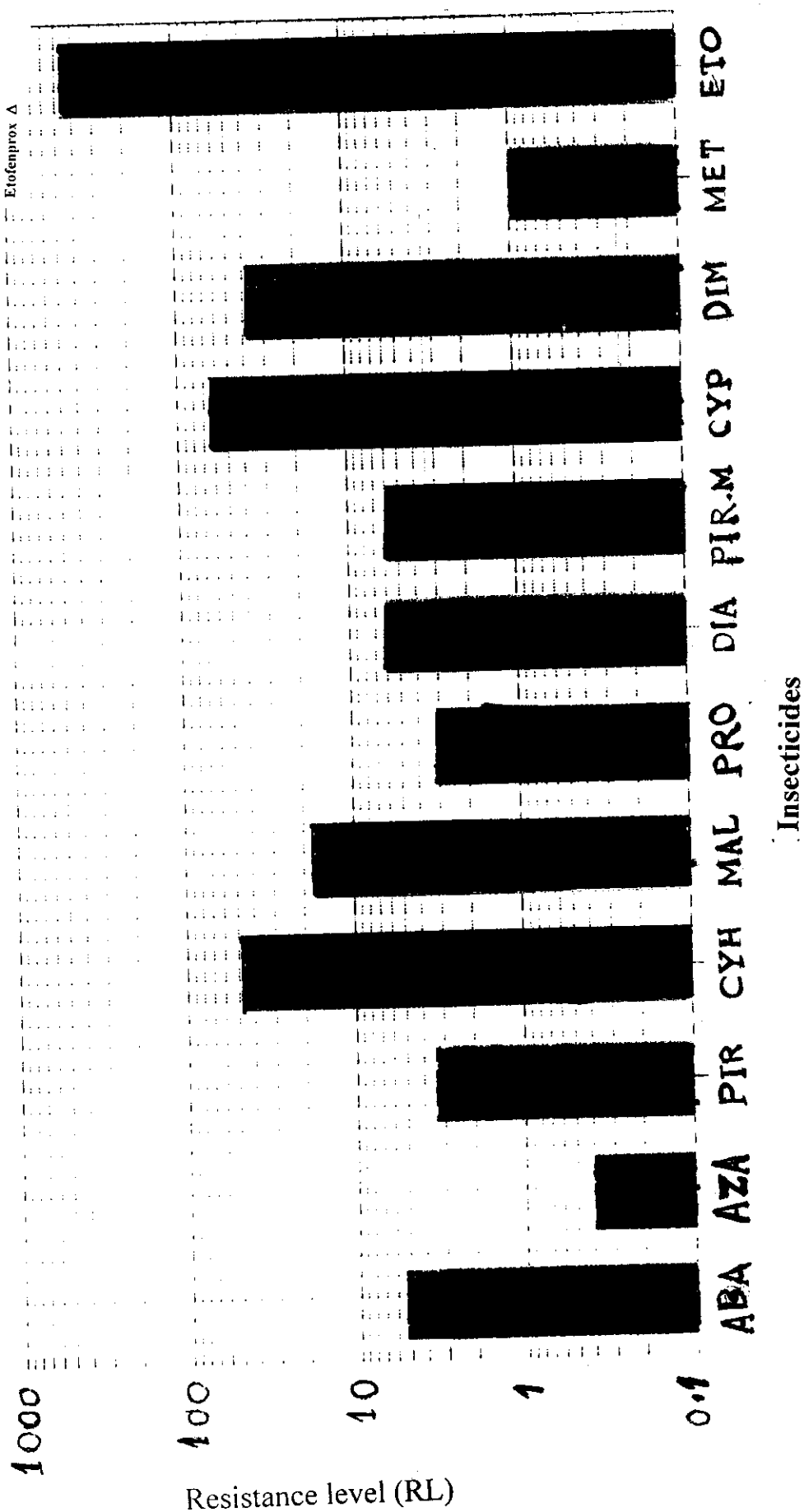
Fig(50) LC₅₀ values of the used insecticides of Behera field strain of *Aphis gossypii* adults during 1996.



Insecticides

Abamectin *
 Azadirachtin *
 Pirimicarb □
 Cyhalothrin Δ
 Malathion ΔΔ
 Profenofos ΔΔ
 Diafenthiuron ΔΔΔ
 Pirimiphos - Methyl ΔΔ
 Cypermethrin Δ
 Dimethoate ΔΔ
 Methomyl □
 Etofenprox Δ
 ABA
 AZA
 PIR
 CYH
 MAL
 PRO
 DIA
 PIR.M
 CYP
 DIM
 MET
 ETO

Fig(51) Resistance level of Behera strain of *Aphis gossypii*.
(1996) based on LC₅₀.



indicates the value of LC_{50} of 3591.44 ppm. The relative resistance level RL reflects natural products abamectin (5.9 fold) and the susceptibility to azadirachtin (0.4 fold). The field strain of *Aphis gossypii* in Behera was tolerant to, profenofos (3.1 fold) and pirimiphos methyl (5.9 fold) except malathion and dimethoate showed higher RL of (38 fold) and (17.5 fold), respectively. The carbamates Behera strain showed susceptible to methomyl (1 fold) and pirimicarb (3.4 fold), highly resistance to cyhalothrin (48.2 fold), cypermethrin (63.2 fold) while this strain was tolerant to diafenthiuron (6.1 fold) and resistant to etofenprox (466.42 fold) according to the data presented in Table 27 and illustrated in Fig. 51).

2-4- Beni Suef strain

2-4-1- Susceptibility evaluation during 1996

The LC_{50} s values for various insecticides were more or less similar to other Governorates as shown in Fig. (52) and Table (28), the strain was found tolerance to the organophosphorous, pirimiphos methyl, profenofos, malathion and dimethoate as showed from their LC_{50} values (5.6 ppm, 32.33ppm, 38.44ppm and 91.88 ppm, respectively). On the contrast, methomyl and pirimcarb showed LC_{50} value of 19.7 ppm and 144.44 ppm, respectively. Among the tested thiourea diafenthiuron showed LC_{50} values of (33 ppm). The pyrethroid cyhalothrin showed LC_{50} value 58.9 ppm. The results clearly indicated susceptibility to methomyl (1.4 fold), malathion (2.8 fold), profenofos (1.2 fold), dimethoate (5.5 fold), this field strain was still susceptible to pirimiphos methyl (0.7 fold) and pirimcarb (0.8 fold) while it exhibited resistance to cyhalothrin (53.1 fold).

Table (28): Susceptibility of *Aphis gossypii* of Beni Suef Governorate to different insecticides during 1996.

Insecticides used	Slope function	LC ₅₀ ppm	90% Fiducial limits		LC ₉₀ ppm	90% Fiducial limits		RL based on LC ₅₀
Pirimicarb □	1.16	144.44	100.74 : 215.71		1852.1	847.4 : 9382.1		0.8
Cyhalothrin Δ	1.19	58.9	35.69 : 228.62		706.8	196.59 : 445.36		53.1
Malathion ΔΔ	2.02	38.44	29.15 : 98.6		165.26	113.66 : 323.64		2.8
Profenofos ΔΔ	1.87	32.33	8.9 : 52.27		156	86.57 : 1769.07		1.2
Diafenthuiuron ΔΔΔ	1.68	33	25.49 : 43.1		191.4	122.2 : 402.39		3.1
Pirimiphos – Methyl ΔΔ	1.73	5.6	3.8 : 7.3		30.43	19.75 : 71.63		0.7
Dimethoate ΔΔ	1.99	91.88	40.66 : 145.44		405.4	225.56 : 3255.66		5.5
Methomyl □	1.73	19.7	15.36 : 26.06		108	67.83 : 234.06		1.4

(*) Natural product

(ΔΔΔ) Insect Growth Regulator

(ΔΔ) organophosphates

(□) carbamate

(Δ) pyrethroids

ppm : Part per million

LC₅₀: Lethal concentration killed fifty percent.

LC₉₀: Lethal concentration killed ninety percent

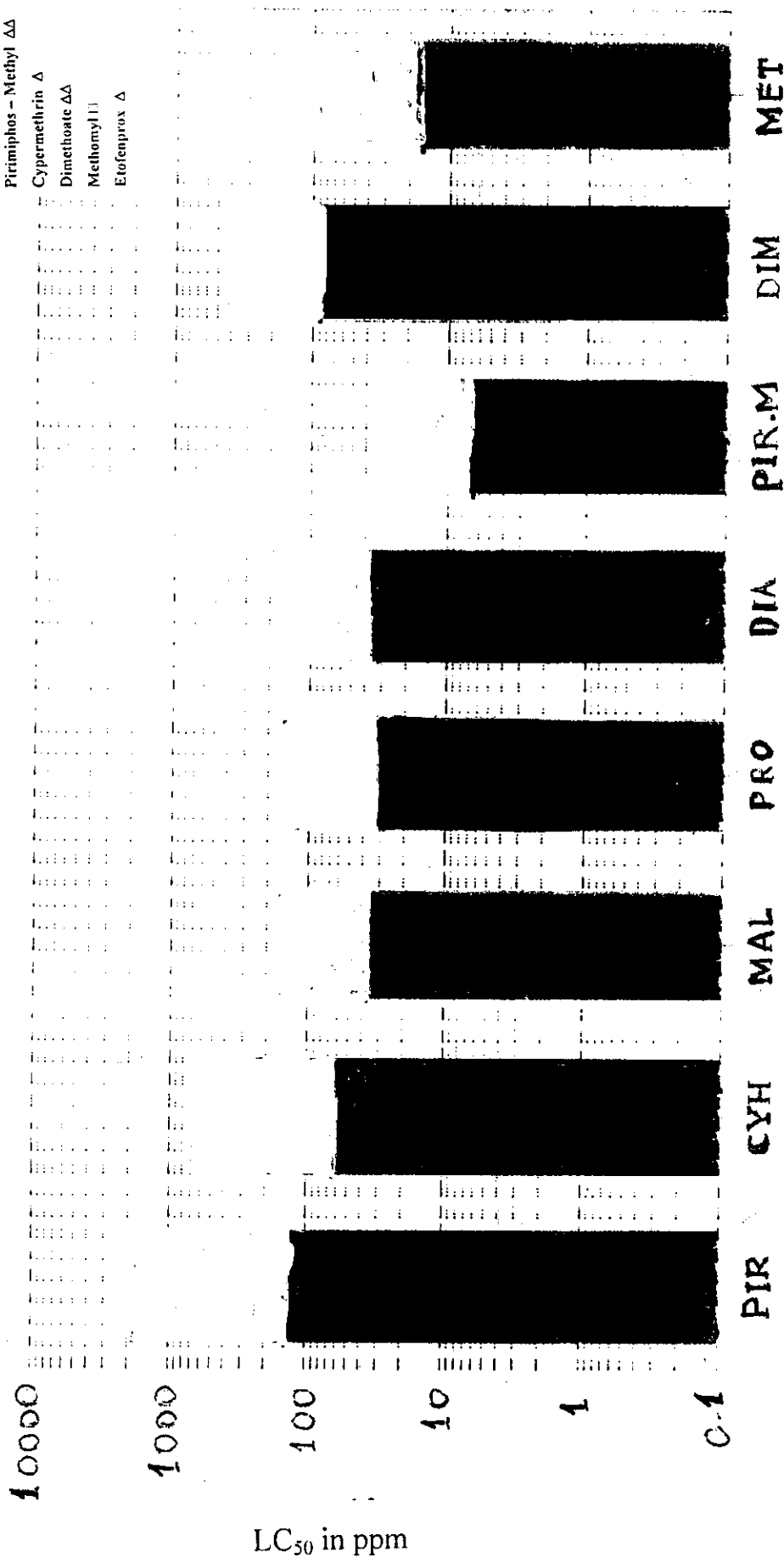
RL : Resistance : $\frac{LC_{50} \text{ field strain}}{LC_{50} \text{ Lab. strain}}$

LC₅₀ Lab. strain.

Abamectin *
 Azadirachtin *
 Pirimicarb I
 Cyhalothrin Δ
 Malathion ΔΔ
 Profenofos ΔΔ
 Diafenthiuron ΔΔΔ
 Pirimiphos - Methyl ΔΔ
 Cypermethrin Δ
 Dimethoate ΔΔ
 Methomyl I
 Etofenprox Δ

ABA
 AZA
 PIR
 CYH
 MAL
 PRO
 DIA
 PIR.M
 CYP
 DIM
 MET
 ETO

Fig(52) LC₅₀ values of the used insecticides of Beni suef field strain of *Aphis gossypii* adults during 1996.



Insecticides

LC₅₀ in ppm

ABA
AZA
PIR
CYH
MAL
PRO
DIA
PIR.M
CYP
DIM
MET
ETO

Abamectin *
Azadirachtin *
Pirimicarb □
Cyhalothrin Δ
Malathion ΔΔ
Profenofos ΔΔ
Difenthiuron ΔΔΔ
Pirimiphos - Methyl ΔΔ
Cypermethrin Δ
Dimethoate ΔΔ
Methomyl □
Etofenprox Δ

Fig(53) Resistance level of Beni suef strain of *Aphis gossypii*.
(1996) based on LC₅₀.

