



Welcome





SYNERGISM TO ENHANCE THE BIOEFFECTIVITY OF PESTICIDES

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SYNERGISM

Synergism is a phenomenon, which can be applied to cases where the toxicity of two compounds together is greater than that expected from the sum of their effects when applied separately.

The term antagonism is precisely the opposite phenomenon, in which the toxicity of two compounds applied together is less than that expected from the sum of their effect when applied separately.



Classification by Wilkinson (I 971)

1. Analogue synergists

- a. DDT analogues – DMC, F-DMC, chlorefenethol**
- b. Non-insecticidal organophosphates**
- c. Non-insecticidal carbamates**

2. Inhibitors of microsomal enzyme system

- a. Benzo (d) – 1, 3 – dioxoles**
- b. Aryloxyalkylamines (e.g) SKF 525 – A**
- c. Acetylene bonds**
- d. Oxime esters**
- e. Phthalimide**
- f. Phosphono esters.**

Synergists grouped based on their chemical nature as

1. DDT; analogucs e.g. DMC, F-DMC.
 2. Benzo (d), 1,3 –dioxolcs – peiperonyl butoxide
 3. organo phosphates
 - a. Insecticidal (e.g.) profenofos
 - b. Non – insecticidal e.g DEF (TBPT) IBP, TPP
 4. Carbamates
 5. Formamidines : Chlordimeforrn, amitraz, BTS
- 272711

Based on mode of action, the synergist are divided into two major groups (Regupathy, 2004)

1. Metabolic inhibitors (Antimetabolites)

a. Inhibitors of MFO

e.g. Seasmin, Sesamolin, PBO sesamex, pungamoil (Karanji)

b. Inhibitors of esterase's

e.g. TPP, DFF (TBPT), NIA, MGK 264, S 421, Profenofos.

c. Inhibitors of glutathione transferases

e.g. DMC, F-DMC, chlорfenetrol,DEM

2. Target site synergists

e.g. Chlordimefom, amitraz, BTS 27211

Insecticide Resistance Monitoring

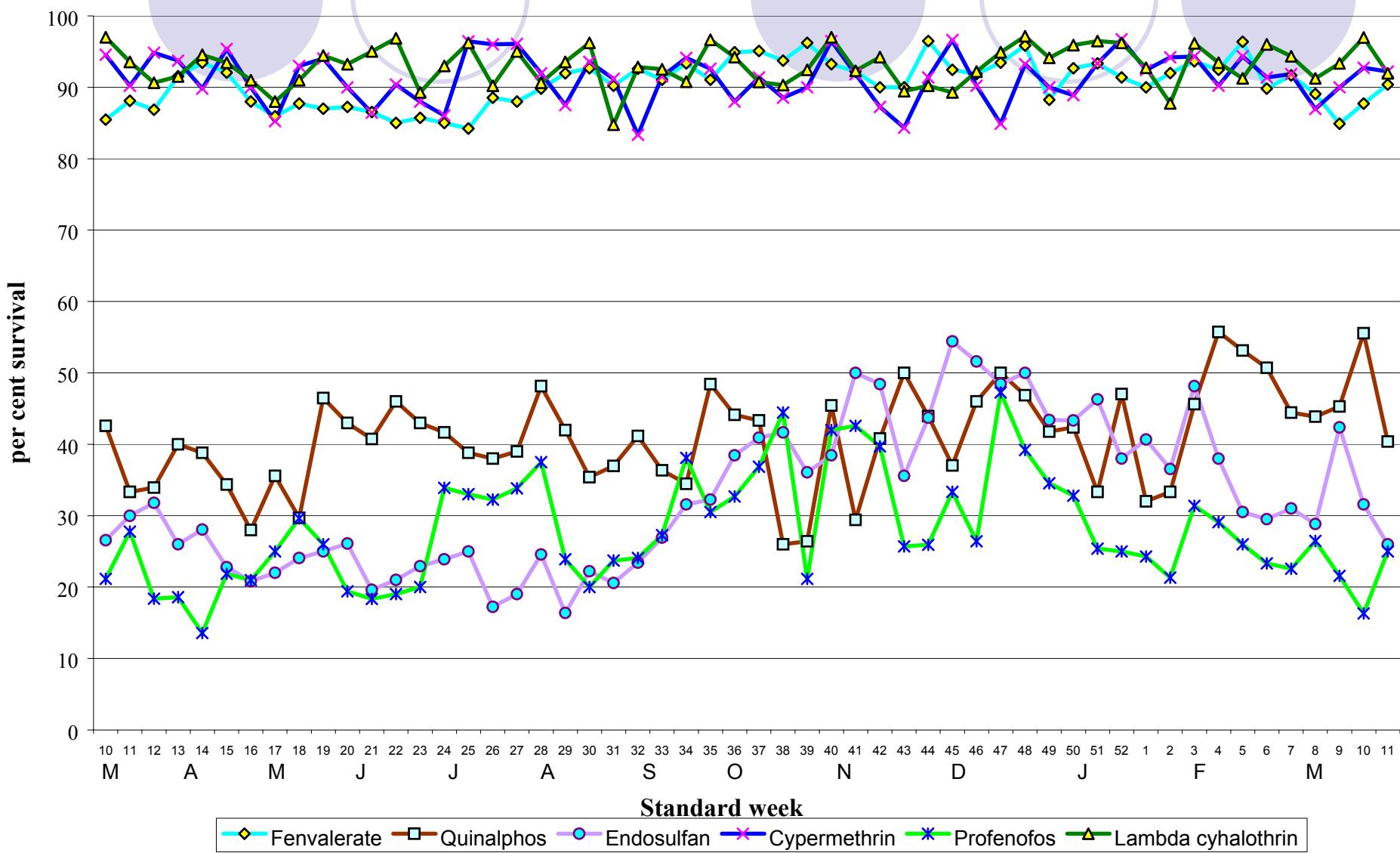
Discriminating doses (ug/uL)

Cypermethrin	0.1
Cypermethrin	0.1+ Pbo 50
Cypermethrin	0.1+ Profenofos 0.1
Fenvalerate	0.2
Fenvalerate	0.2+ Pbo 50.0
Fenvalerate	0.2+PP 25.0
Fenvalerate	0.2+Profenofos 0.1

Endosulfan	10.0
Quinalphos	0.75
Profenofos	2.0*
Chlorpyriphos	1.0
Lambda cyhalothrin	0.025*
Deltamethrin	0.0125
Beta cyfluthrin	0.2
Spinosad	10
Thiodicarb	1.5w/v

* The discriminating dose screen for profenofos and lambda cyhalothrin was adopted based on the work of Neil W. Forrester, 1993.

Fig. 1 Mean weekly resistance of *H. armigera* population from Coimbatore to different insecticides



Ramsubramanian and Regupathy, (2004)

Fig. 2 Mean weekly resistance of *H. armigera* population from Pongalur to different insecticides.

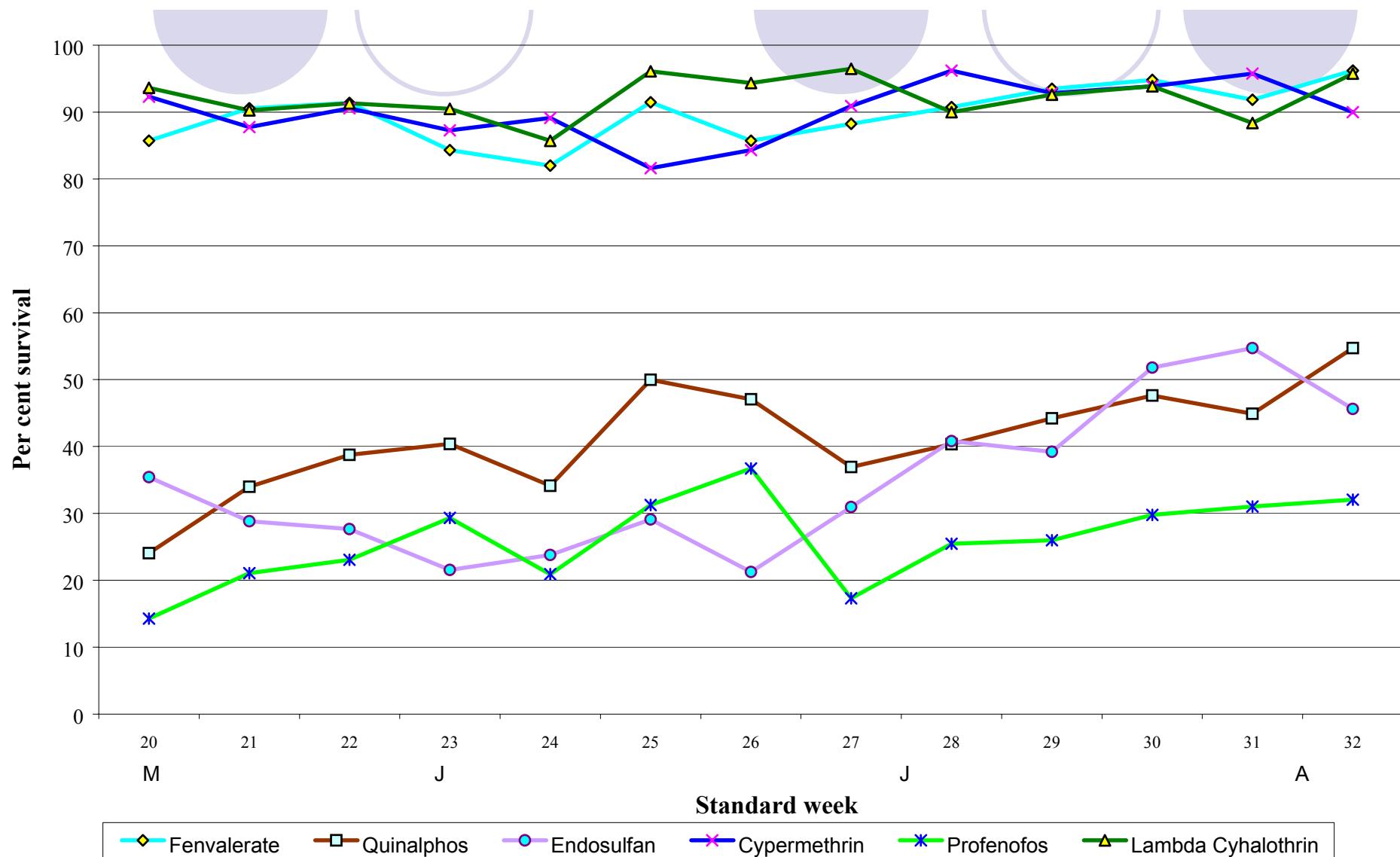


Fig. 3 Mean weekly resistance of *H. armigera* population from Kallapuram to different insecticides.

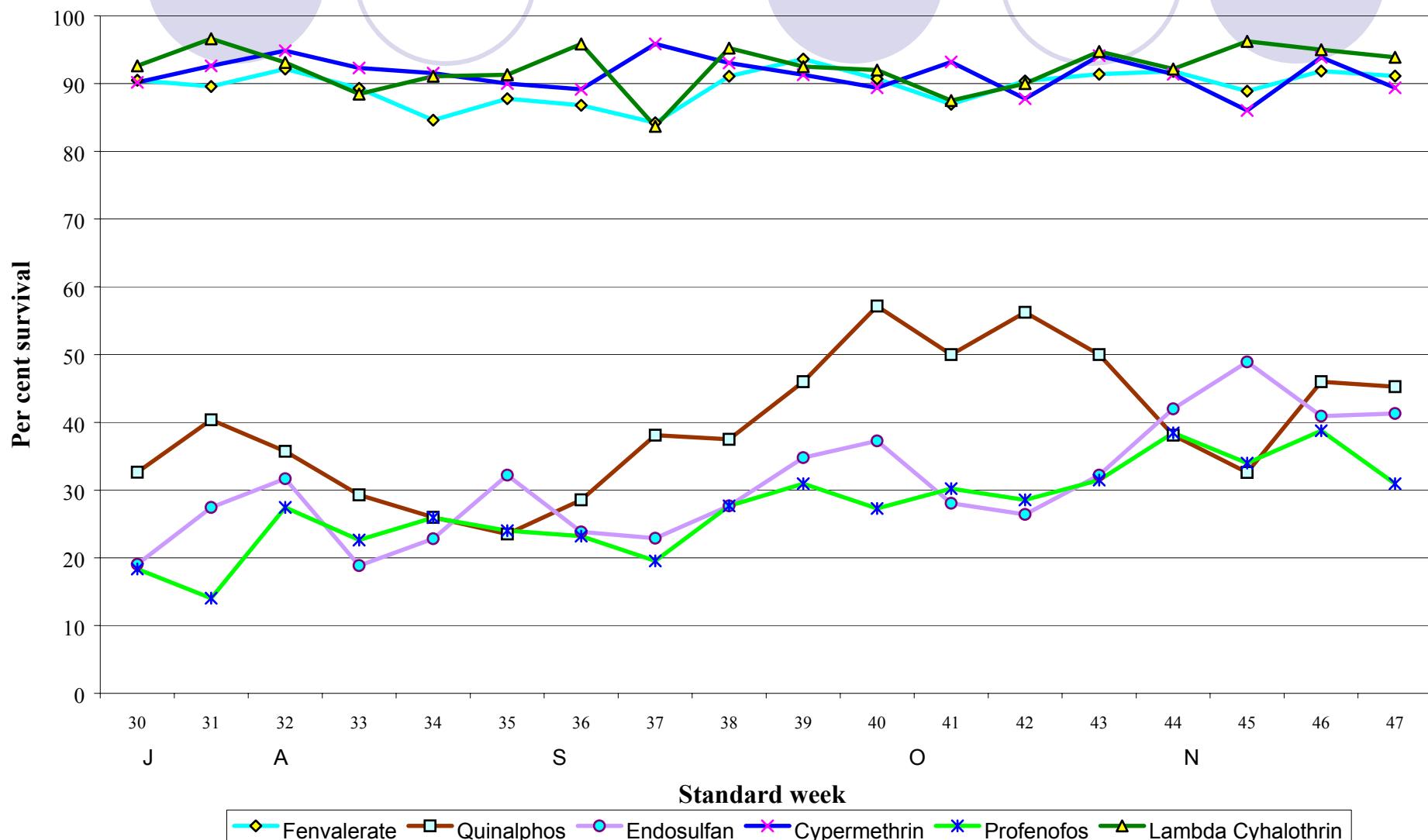


Fig. 4 Mean weekly resistance of *H. armigera* population from Vaigai Dam to different insecticides.

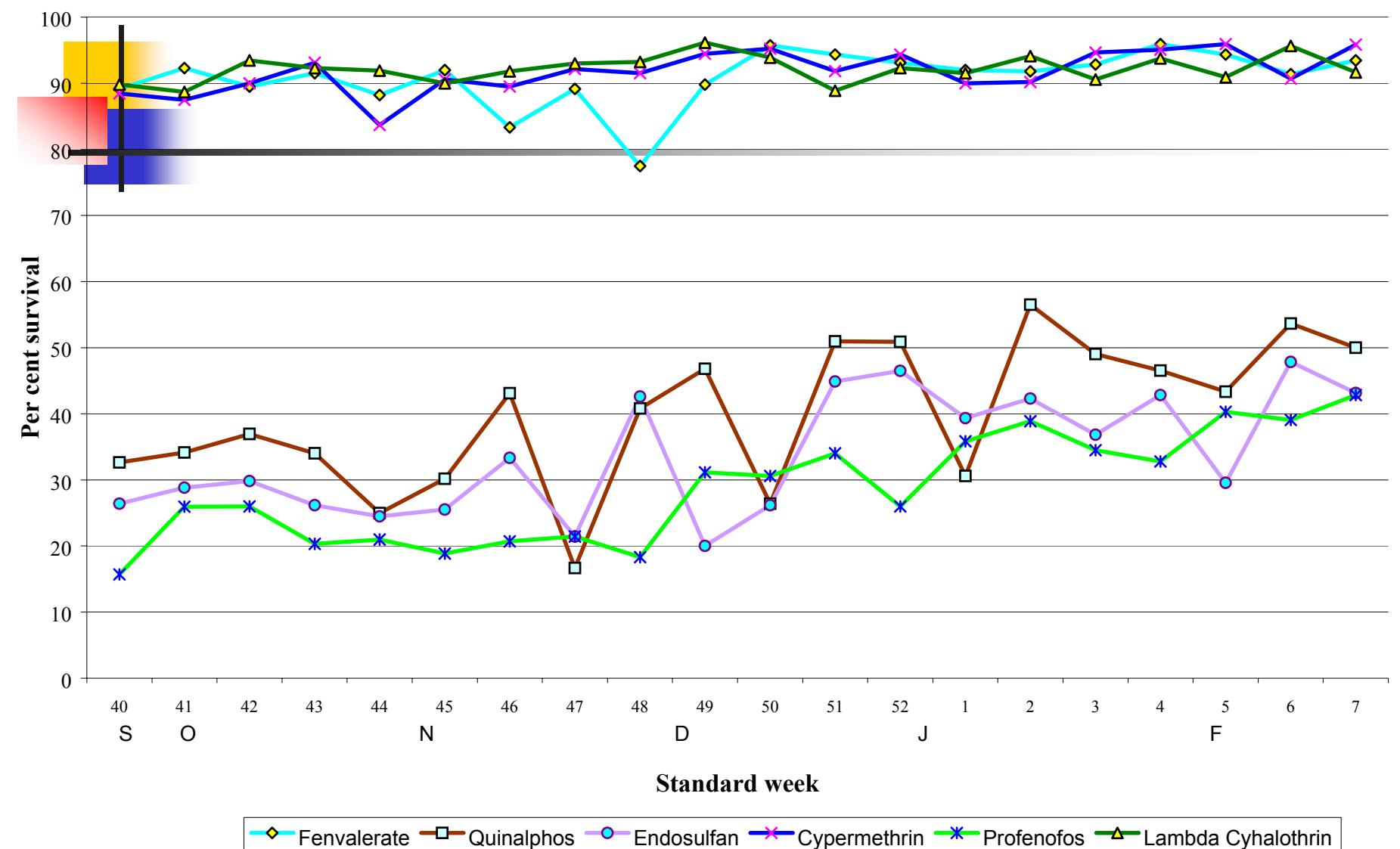


Fig. 5 Mean weekly resistance of *H. armigera* population from Srivilliputtur to different insecticides

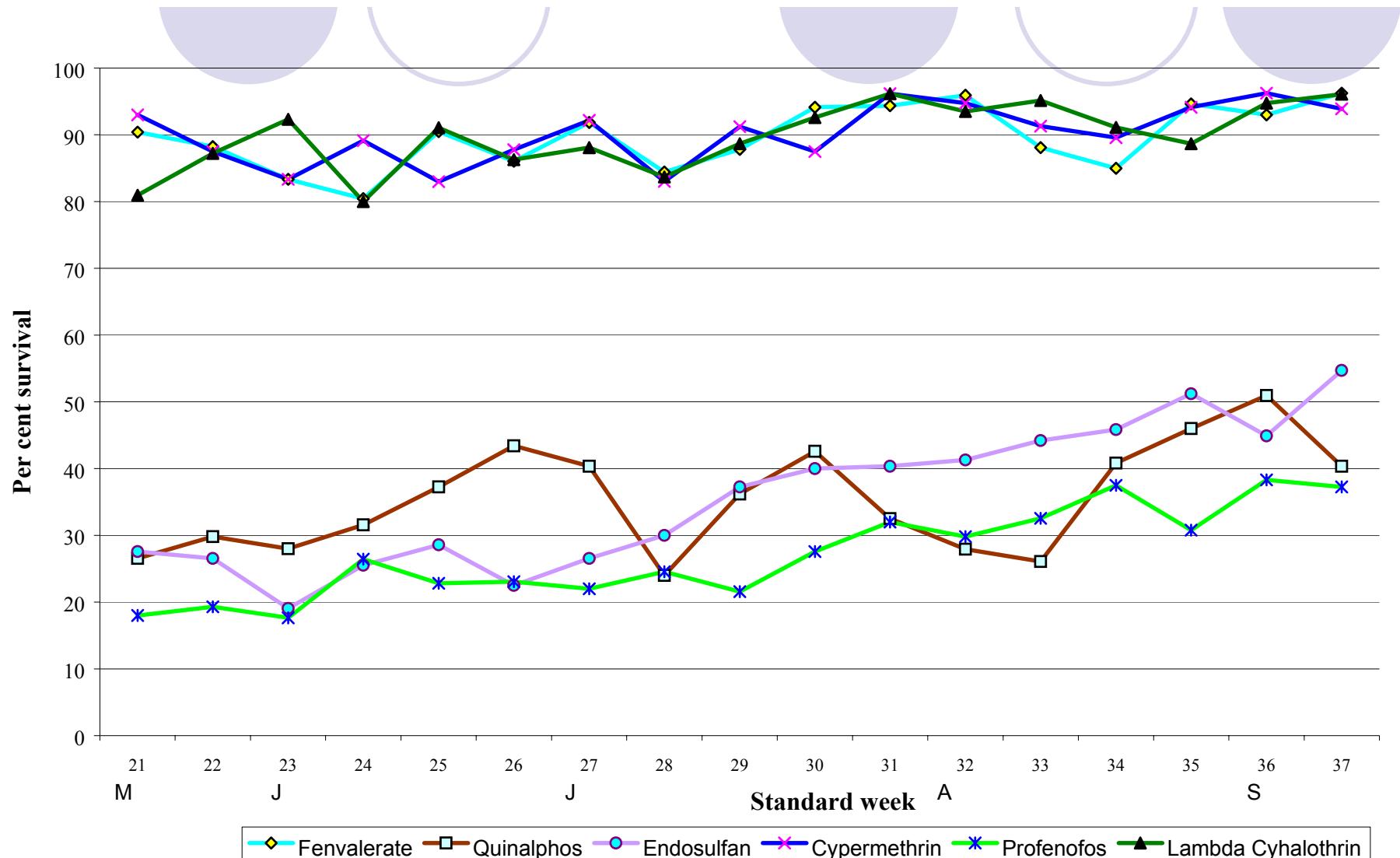
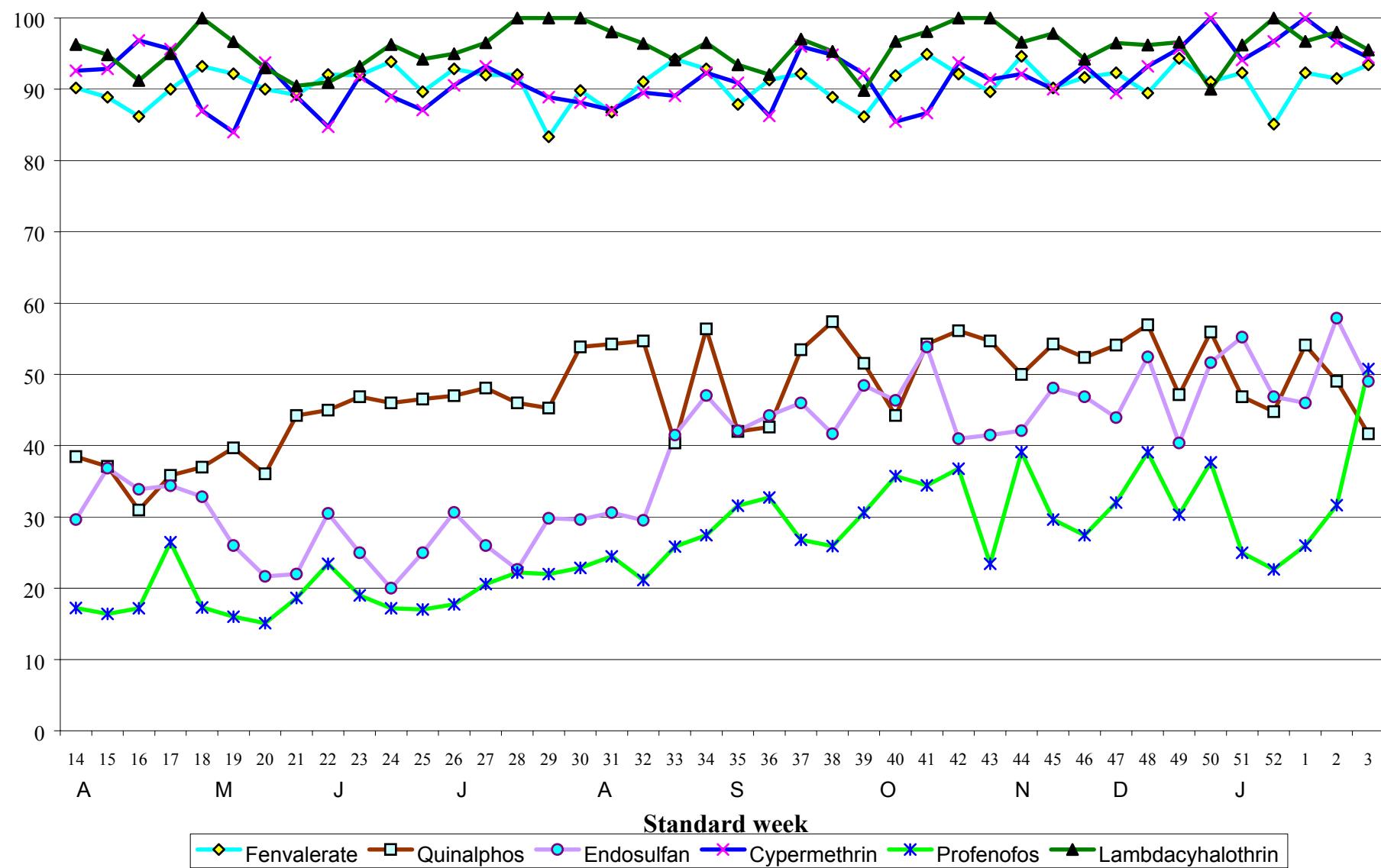


Fig. 6 Mean weekly resistance of *H. armigera* population from Thondamuthur to different insecticides.



Resistance Frequency - TNAU

	2000-2001	2002
	(Nov-Dec)	(Jan-Dec)
Endosulfan	30.7	34.2
Fenvalerate	85.4	90.7
Cypermethrin	89.0	84.2
Lambda cyhalothrin	95.9	85.4
Deltamethrin	----	91.6
Beta cyfluthrin	----	84.0
Quinalphos	38.6	45.4
Profenofos	20.8	22.3
Spinosad	----	0.0
Thiodicarb	----	33.3

Regupathy et al., (2003)

Resistance Summary (%) (Quinalphos)

TNAU	<u>2000-2001</u>		<u>2002</u>	
	35.6		45.4	

	HYD	GUNTUR	NAGPUR	TNAU	CICR
93-94	25.7	66.2	24.2	27.8	46.3
94-95	91.6	44.1	25.2	32.7	44.8
95-96	39.9	59.7	23.3	39	45.2
96-97	32	-	22.8	40.6	-

Chennai (Jan 95)	79.6
Aduthurai (April,95)	53.8
Madurai (Jan, 95)	30.9

Regupathy et al., (2003)

Resistance Summary (%) (cypermethrin)

TNAU	2000-2001			2002	
	HYD	GUNTUR	NAGPUR	TNAU	CICR
93-94	44.5	67.7	23.3	-	50.1
94-95	40.9	57.9	50.1	-	44.4
95-96	60.6	69.4	56.0	-	57.8
96-97	51.6	-	41.4	-	-

Regupathy et al., (2003)

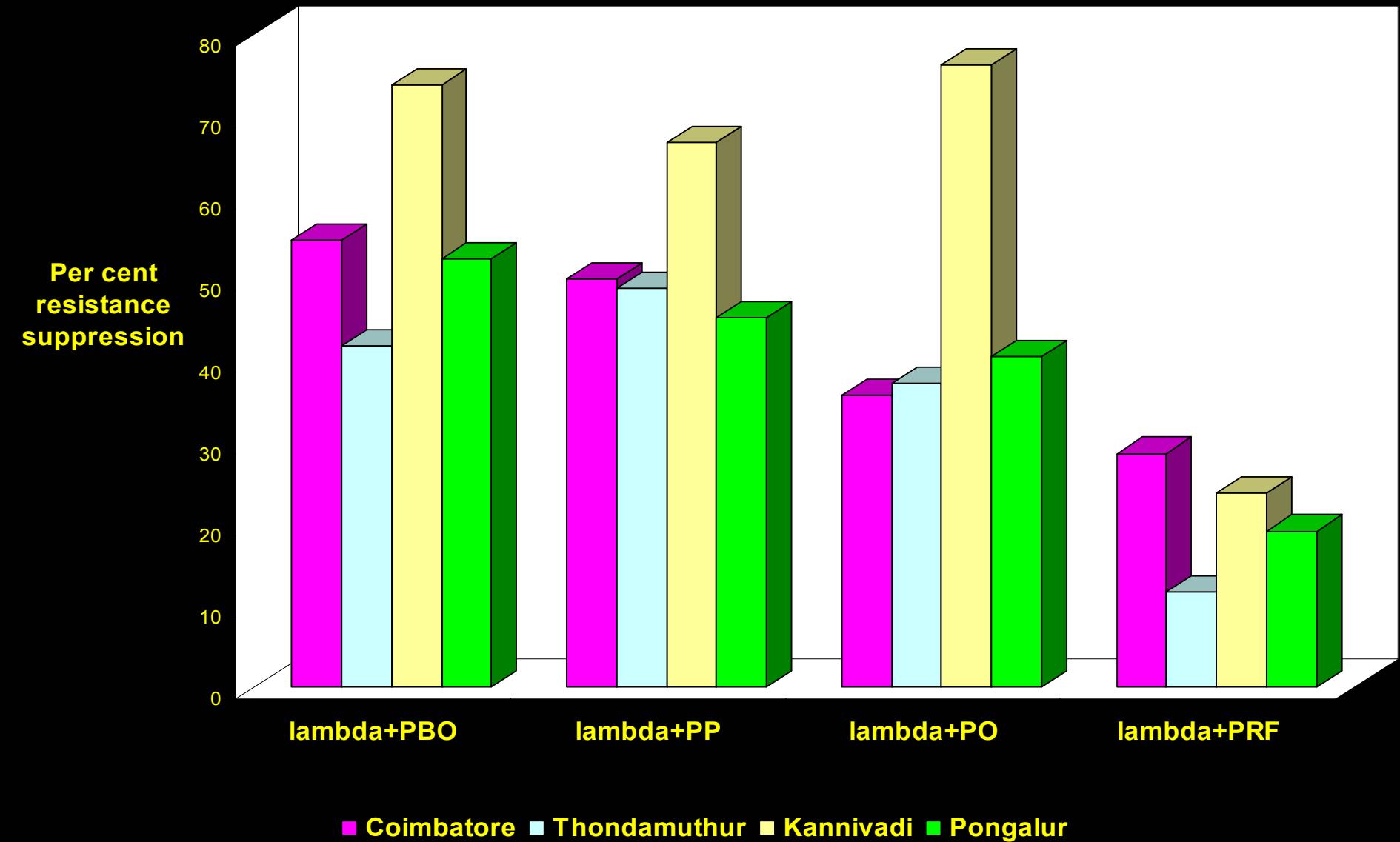
Resistance Summary (%) (Endosulfan)

	<u>2000-2001</u>	<u>2002</u>
TNAU	30.7	34.2

	HYD	GUNTUR	NAGPUR	TNAU	CICR
93-94	29.5	67.2	46.5	-	45.0
94-95	23.7	47.0	39.8	-	48.8
95-96	35.2	54.8	41.0	-	57.3
96-97	29.0	-	27.3	35.5	-

Aduthurai (April,95) 29.9
 Madurai (Jan, 95) 41.3

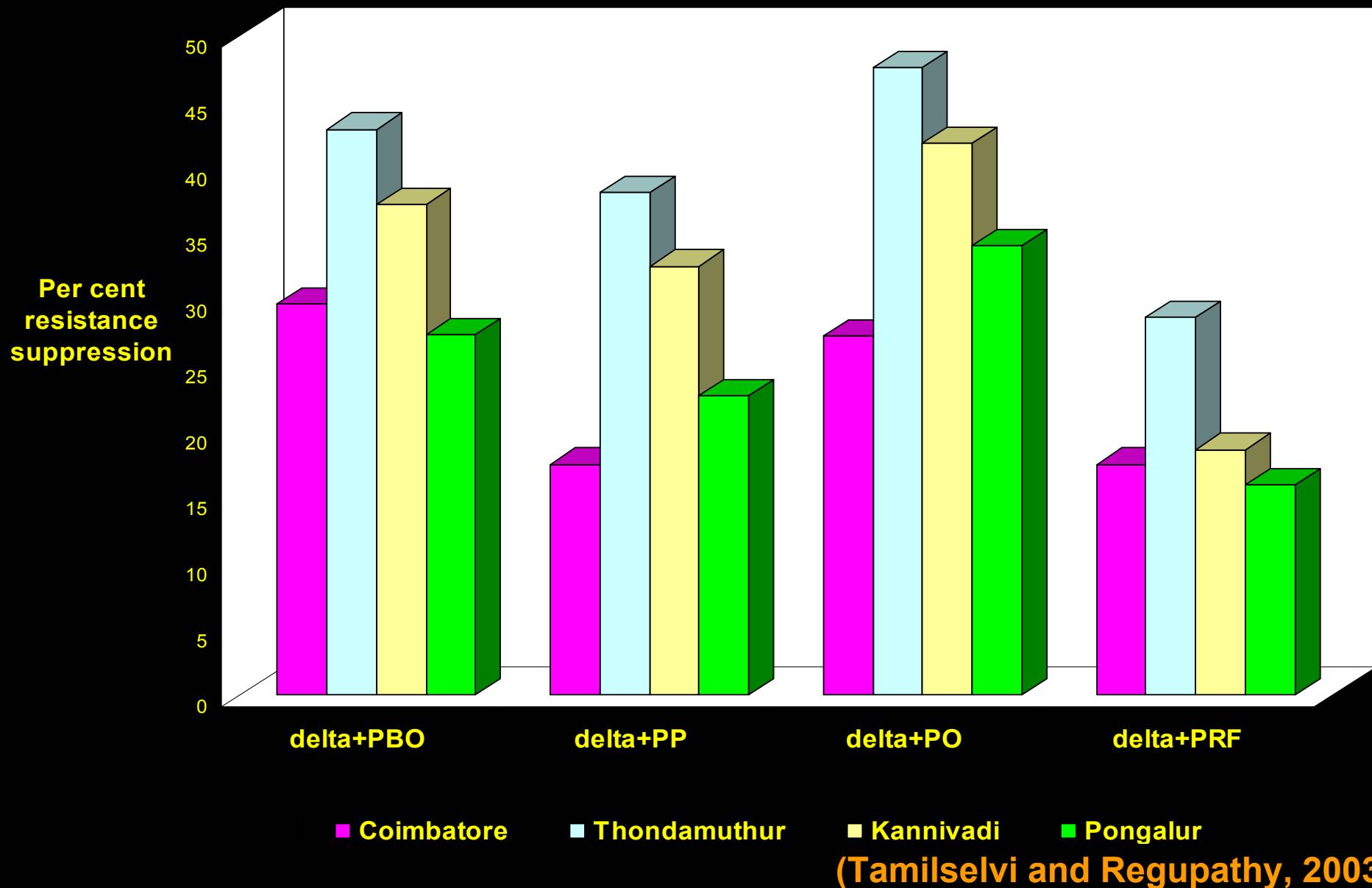
Suppression of lambda-cyhalothrin resistance by various synergists



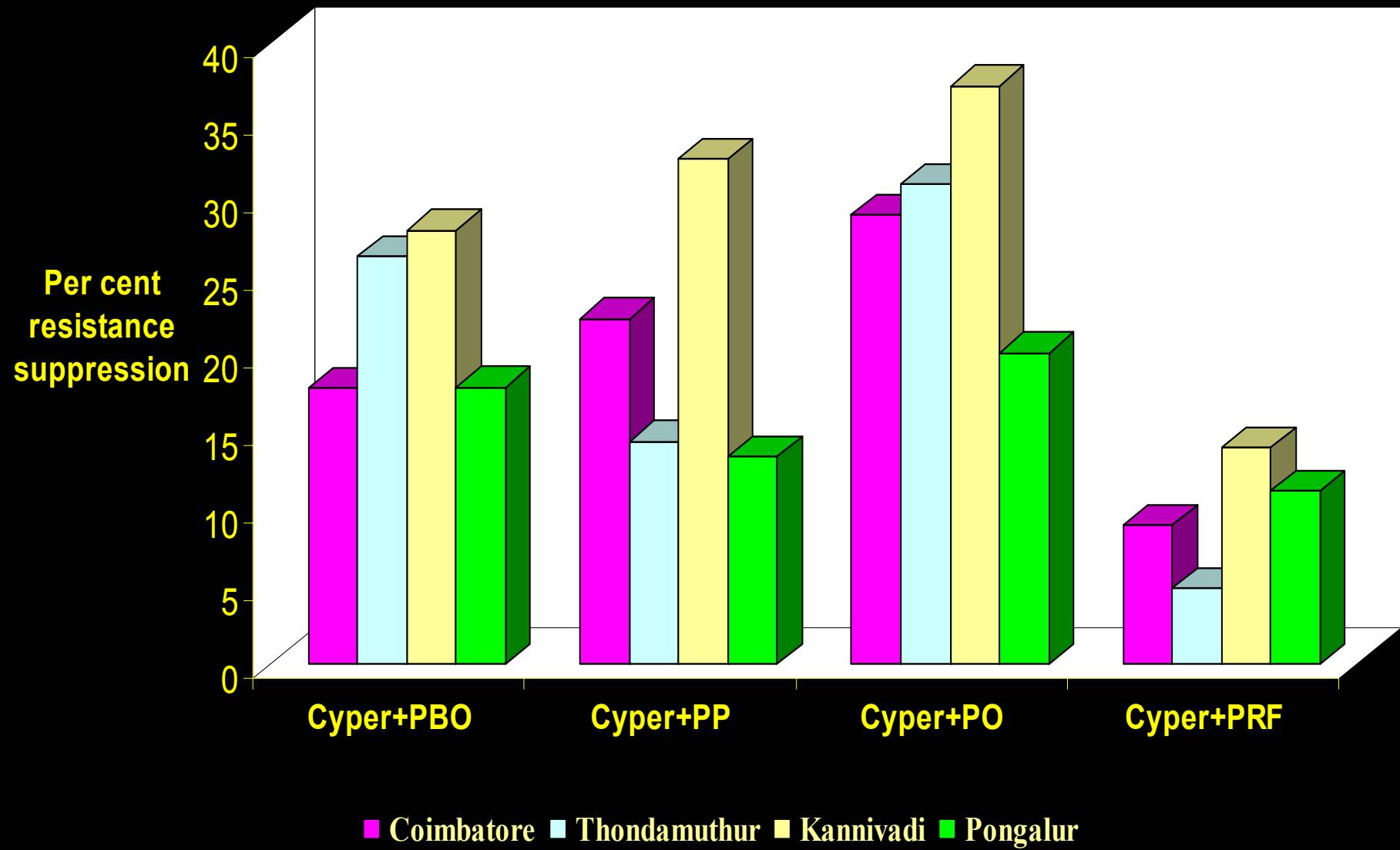
■ Coimbatore ■ Thondamuthur ■ Kannivadi ■ Pongalur

(Tamilselvi and Regupathy, 2003)

Suppression of deltamethrin resistance by various synergists



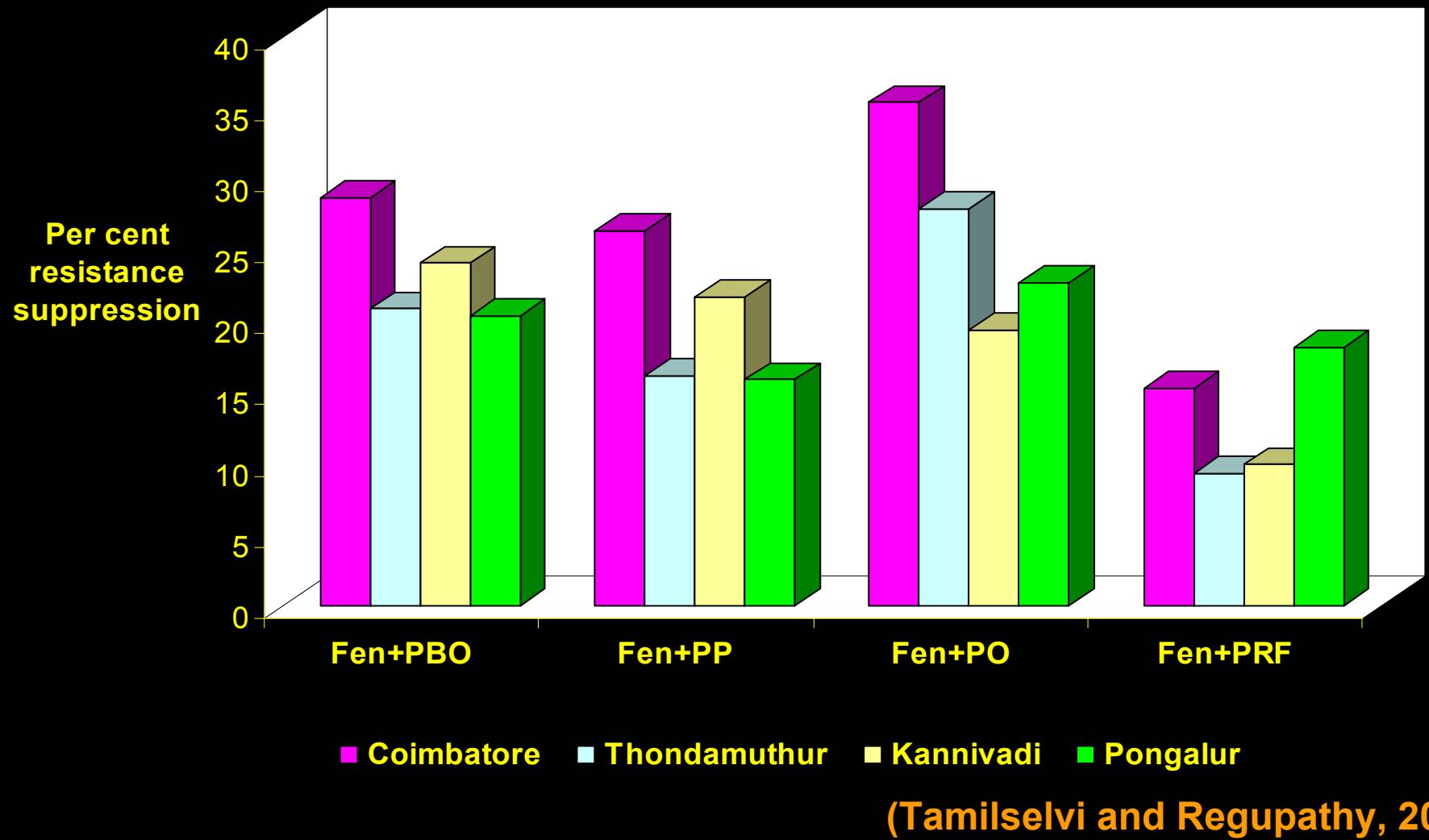
Suppression of cypermethrin resistance by various synergists



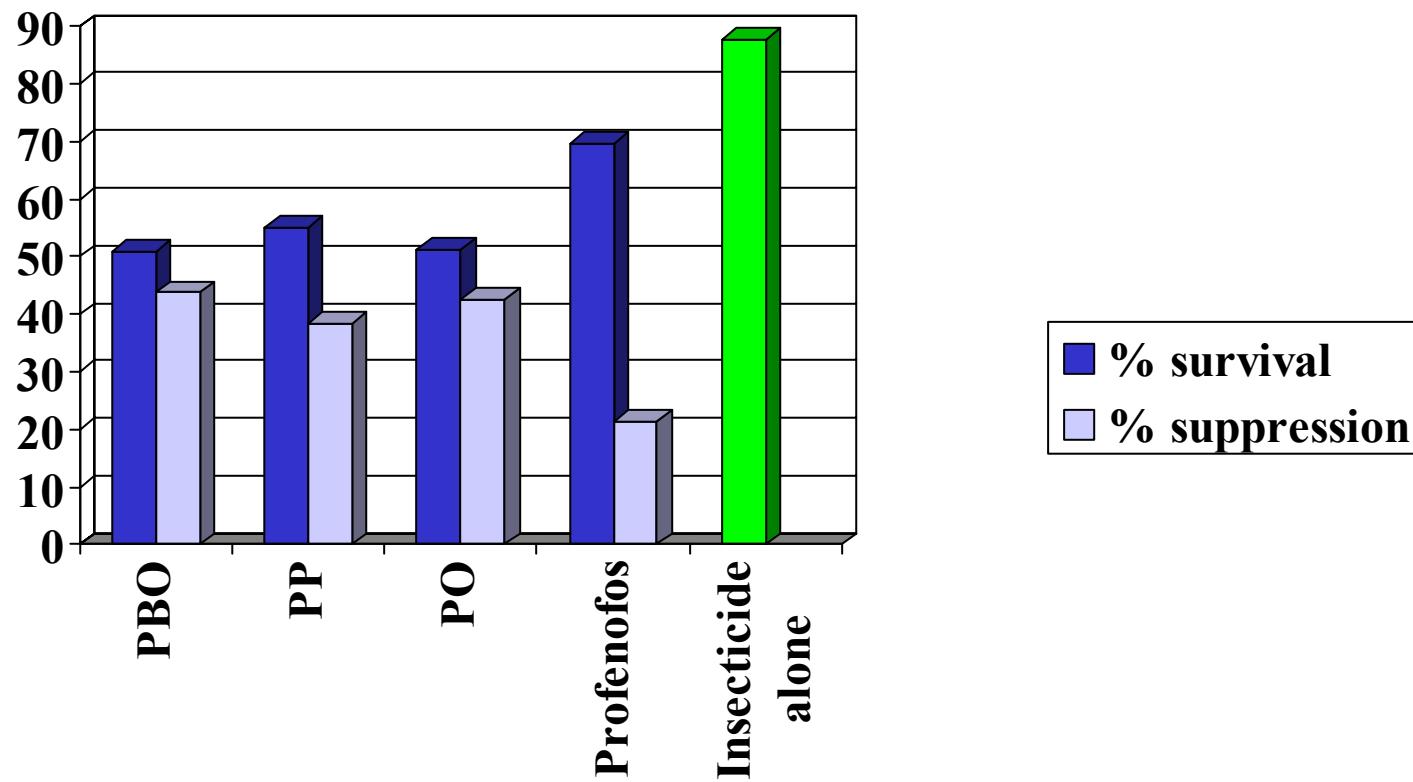
■ Coimbatore ■ Thondamuthur ■ Kannivadi ■ Pongalur

(Tamilselvi and Regupathy, 2003)

Suppression of fenvalerate resistance by various synergists



Synergistic suppression of pyrethroid resistance



(Tamilselvi and Regupathy, 2003)

CONCLUSION

Resistance (locations and hosts)

Lambda-cyhalothrin > cypermethrin > fenvalerate > deltamethrin > β -cyfluthrin

Resistance suppression: Pbo > PP > PO > PPF

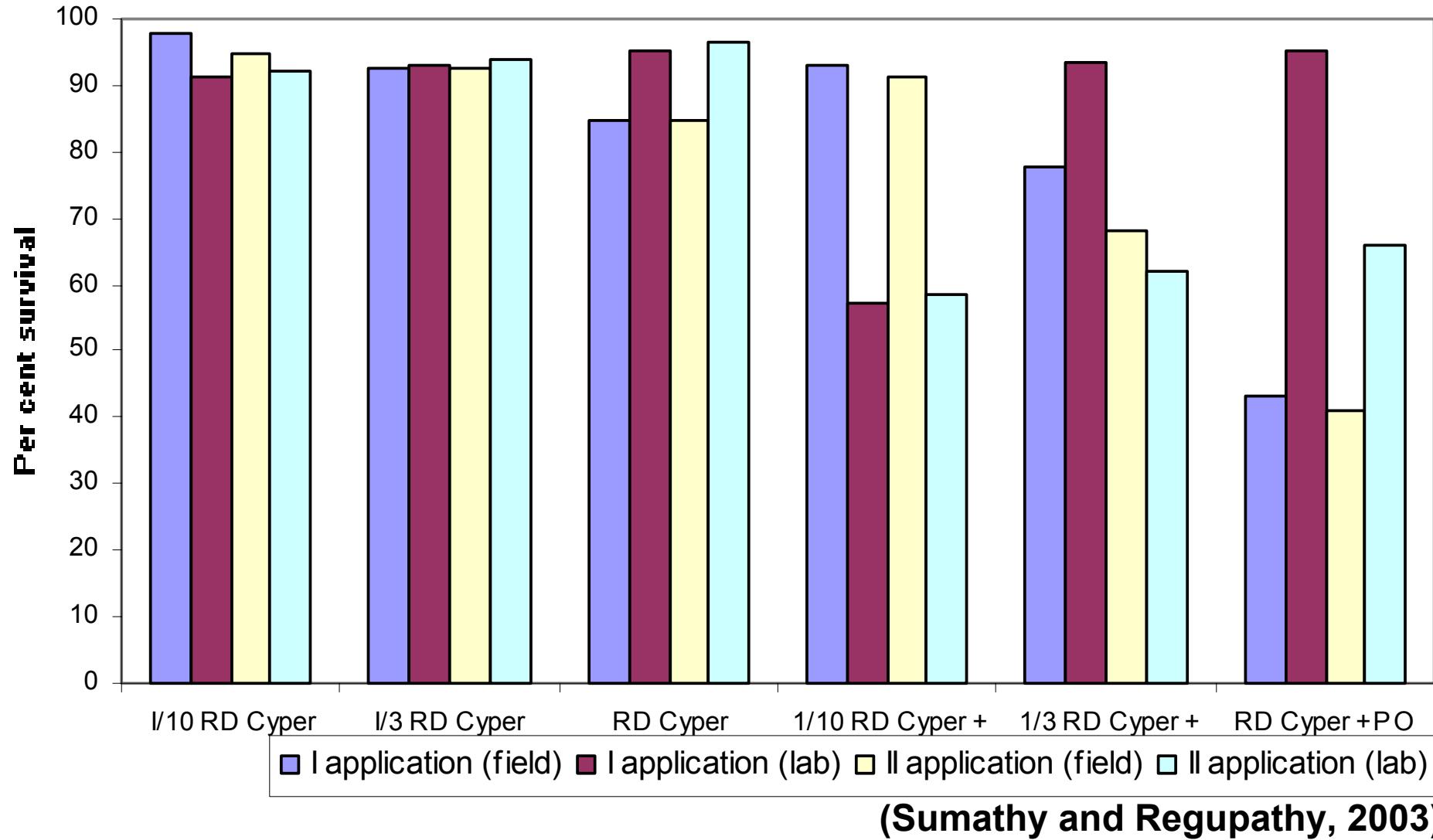
SYNERGISM

β -cyfluthrin > lambda-cyhalothrin > deltamethrin > cypermethrin > fenvalerate

Induction of enzyme activity more clearly observed 3 h than on days 3 and 5.

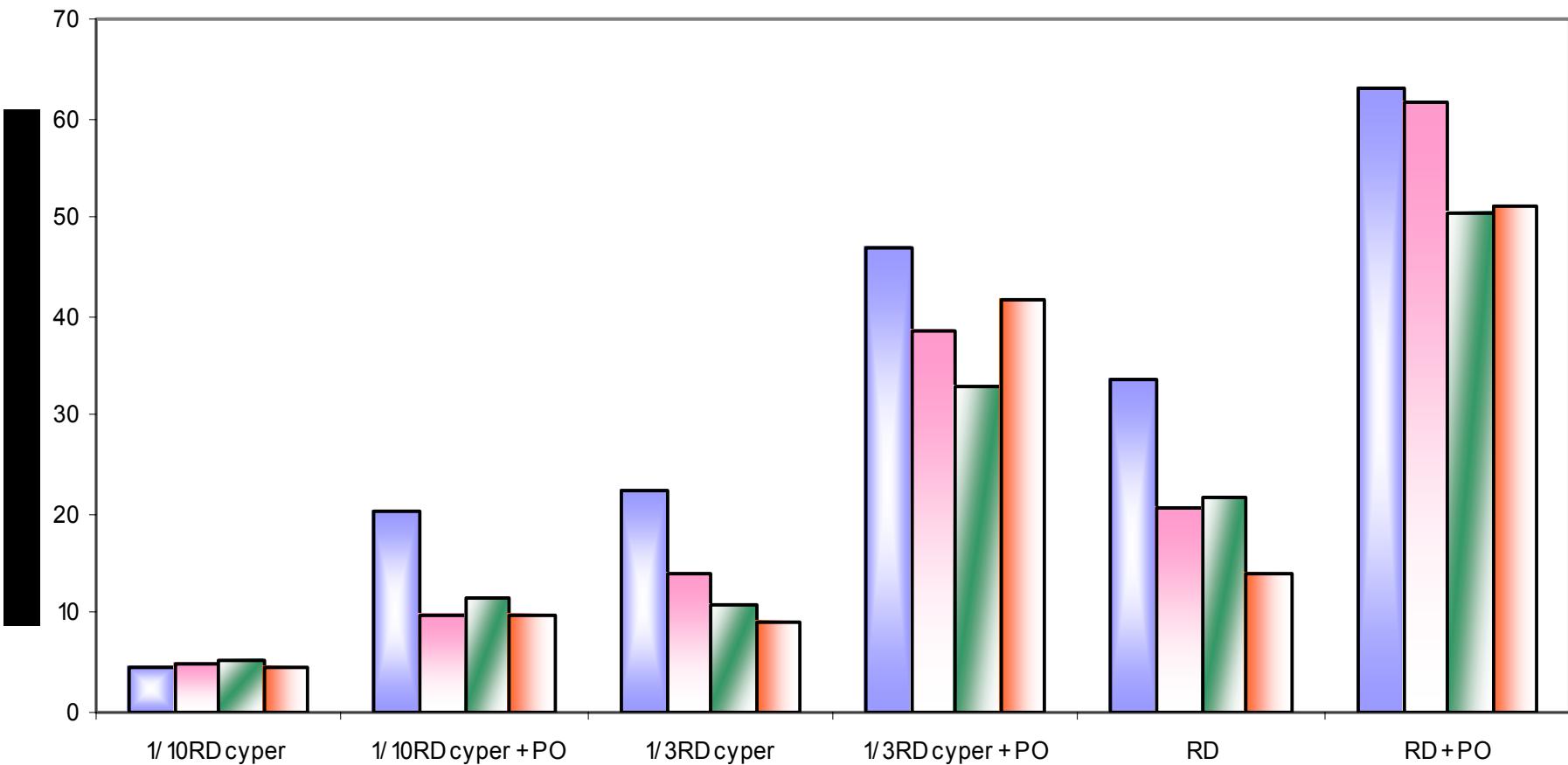
Inhibition of enzyme activity more clearly observed 3 h than on days 3 and 5.

**Per cent survival of cypermethrin with Pongamia oil treated
H. armigera larvae in the field vs laboratory**



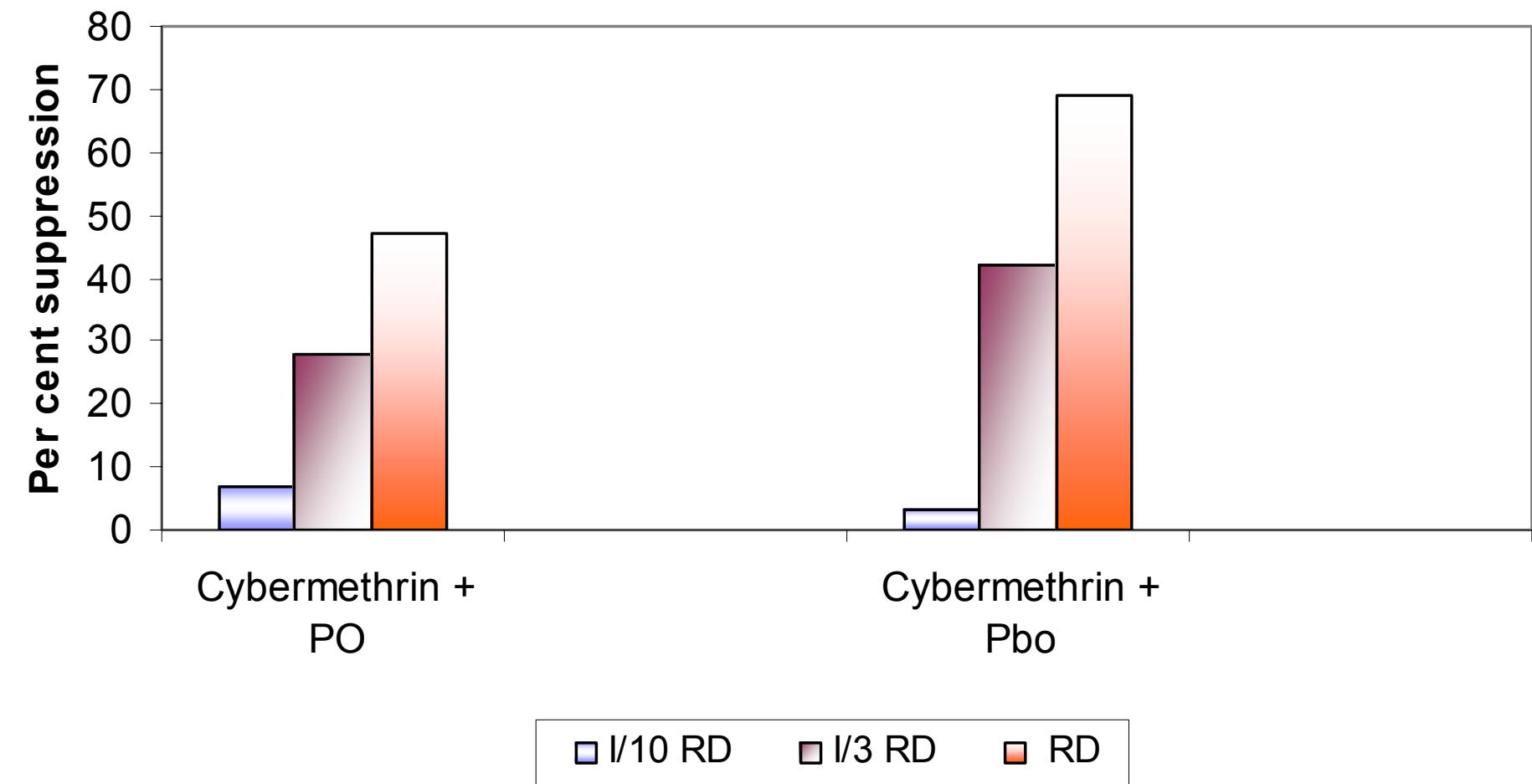
Synergistic action of Pongamia oil with cypermethrin on bollworm incidence

Cypermethrin + PO



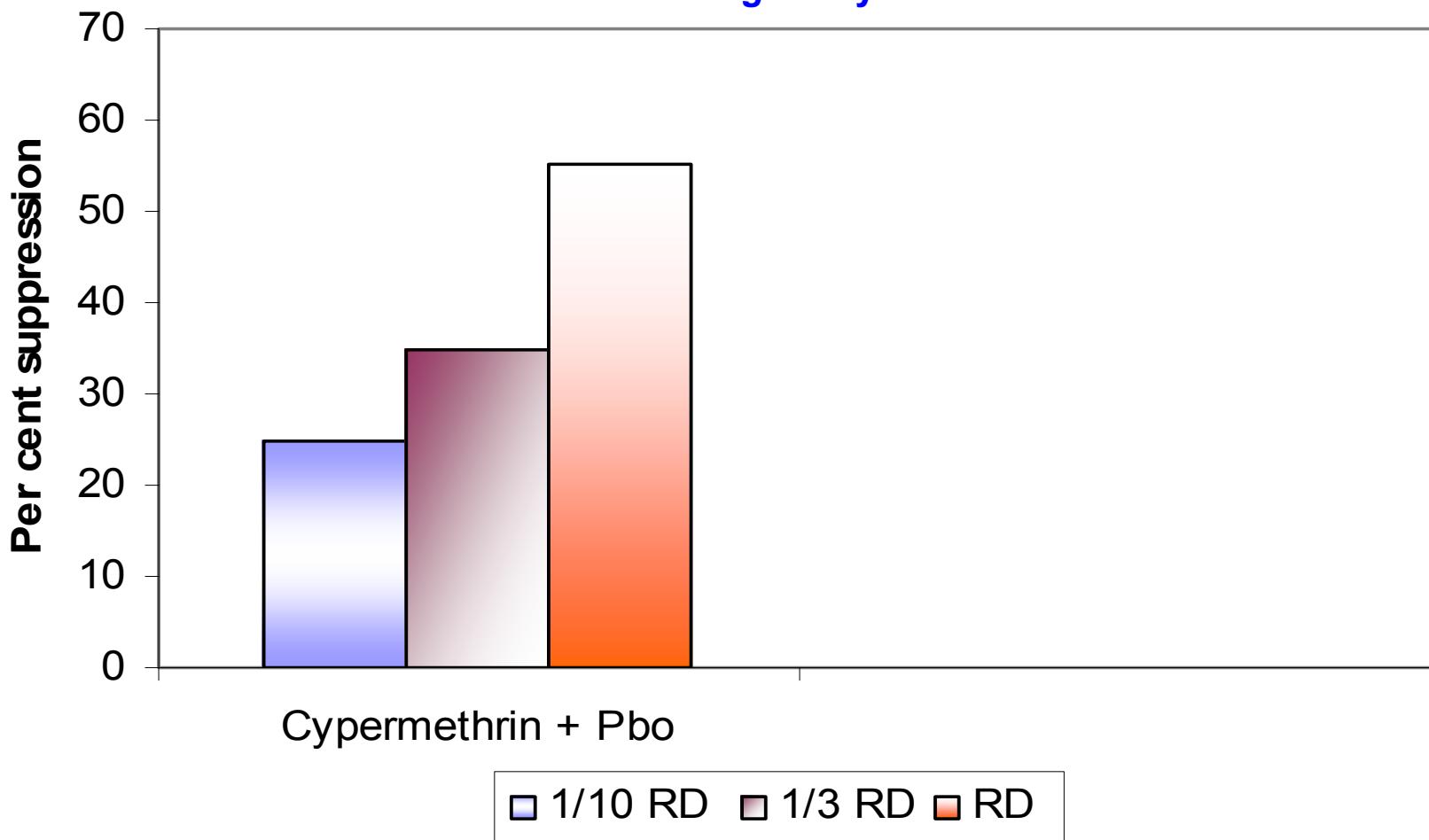
(Sumathy and Regupathy, 2003)

Per cent suppression of MFO activity in cypermethrin treated *H. armigera* by PO and Pbo



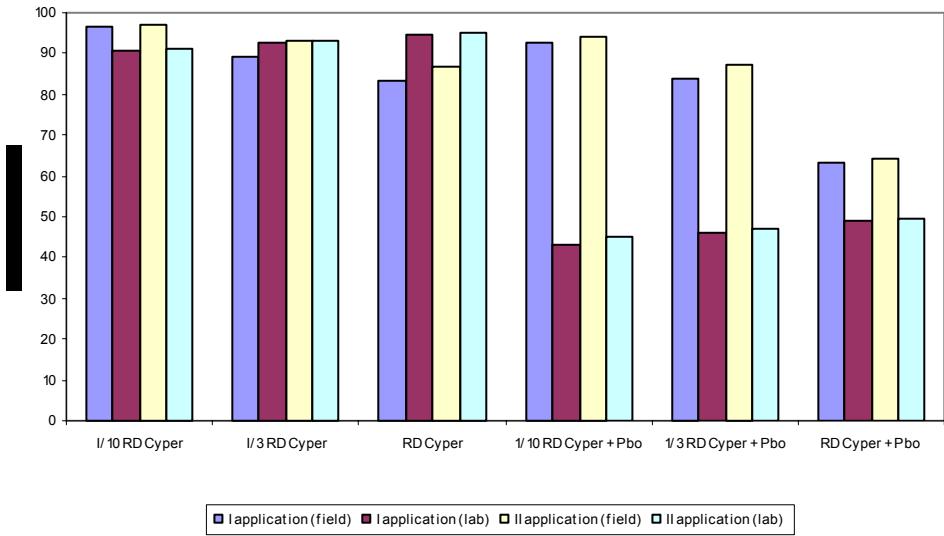
(Sumathy and Regupathy, 2003)

**Per cent suppression of CE activity in cypermethrin treated
H. armigera by Pbo**

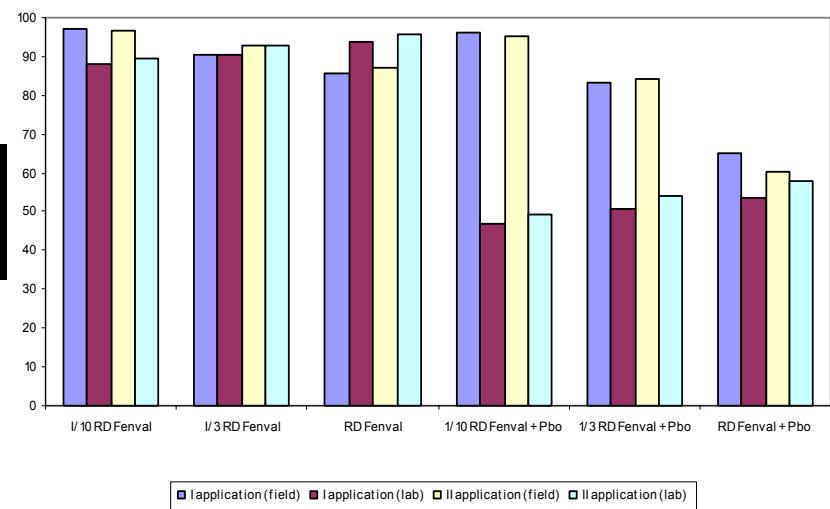


(Sumathy and Regupathy, 2003)

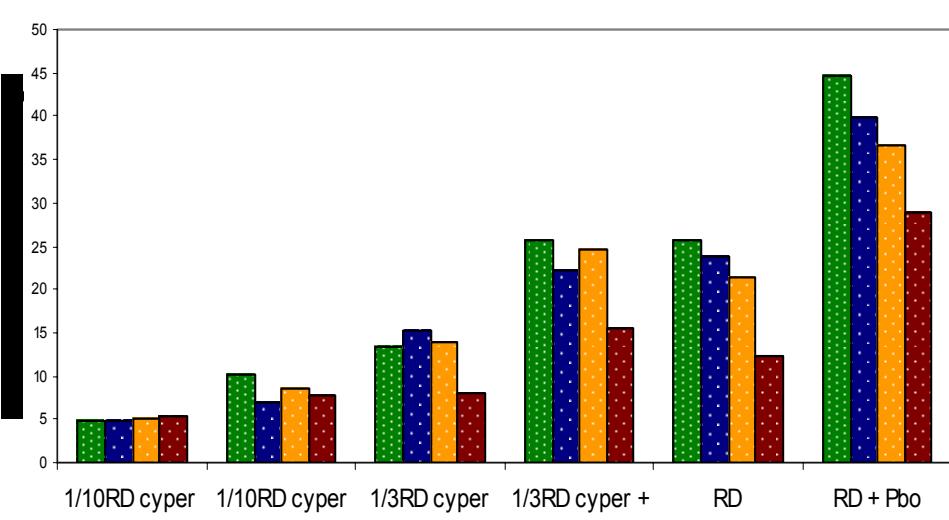
Per cent survival of cypermethrin / fenvaleate with Pbo treated *H. armigera* larvae in the field vs laboratory



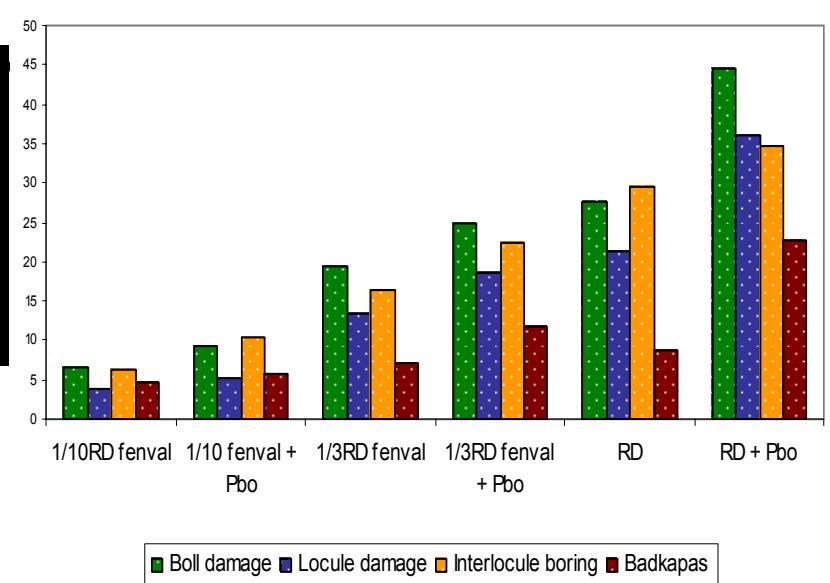
4b. Fenvaleate + Pbo



Synergistic action of Pbo with cypermethrin/fenvaleate on bollworm incidence



Fenvaleate + Pbo



(Sumathy and Regupathy, 2003)

Boll damage Locule damage Interlocule boring Badkapas

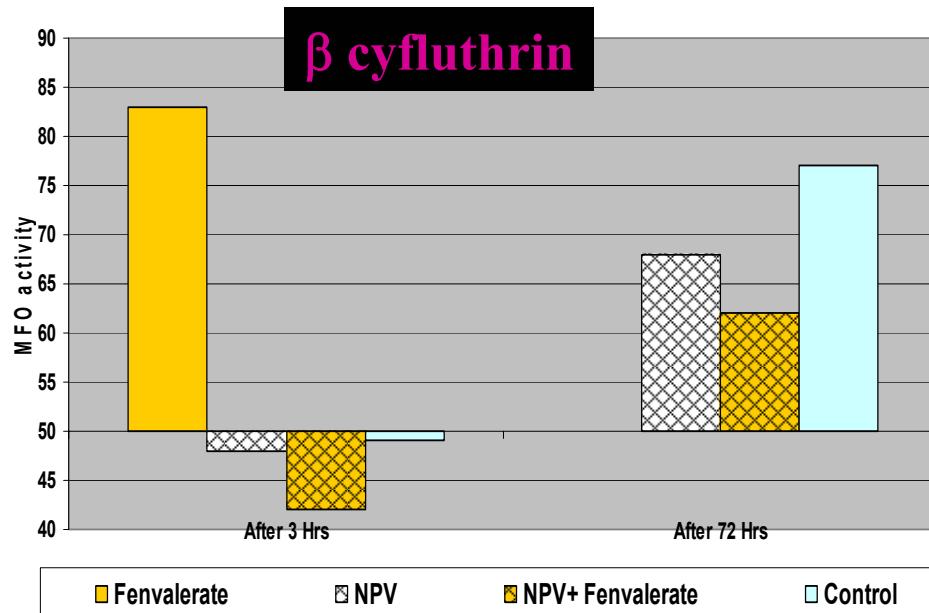
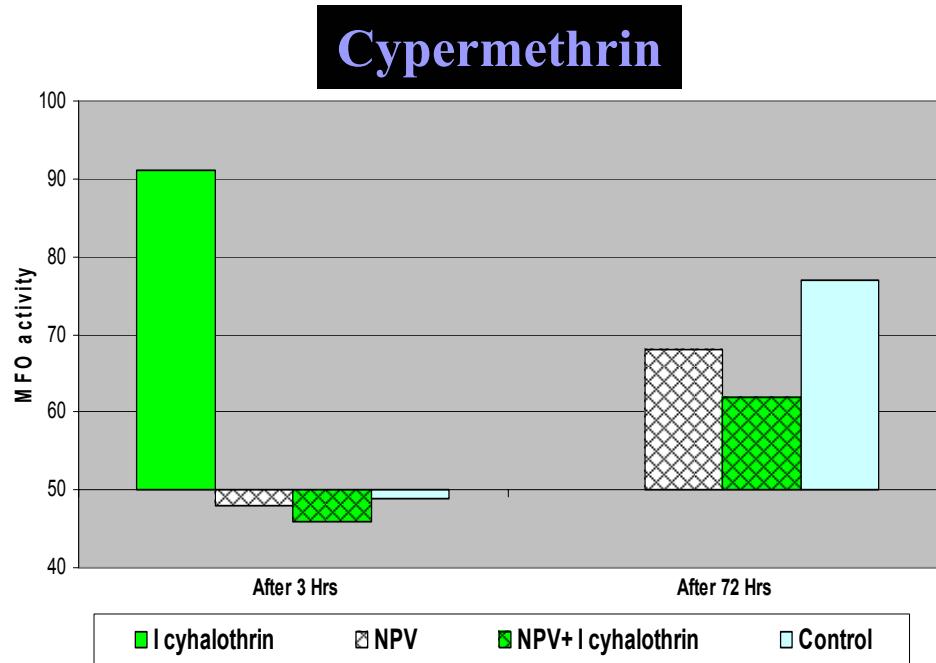
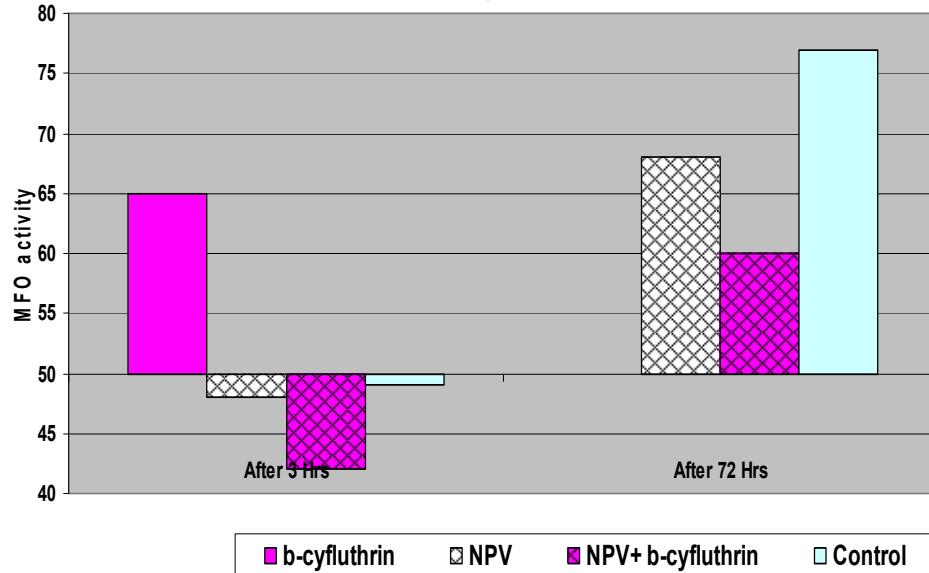
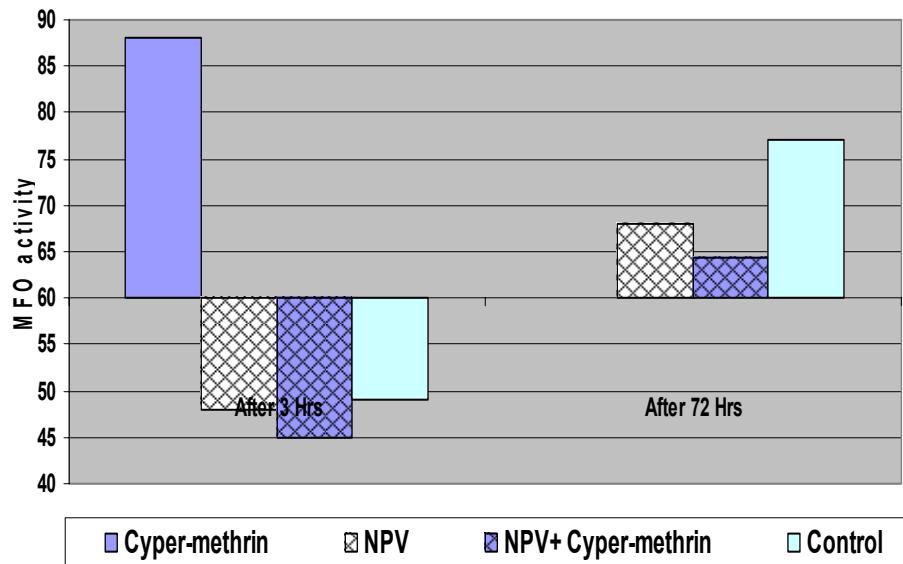
CONCLUSION

- Addition of Pbo/PO improved the efficacy of cypermethrin/fenvalerate
- The synergistic suppression was maximum at RD > 1/3 RD > 1/10 RD
- Pbo and PO suppressed MFO activity
- Pbo but not PO suppressed CE activity
- Suppression was maximum at RD > 1/3 RD > 1/10 RD

4.7. The comparative susceptibility of pesticide resistant strains of *H. armigera* to two HaNPV isolates were tested.

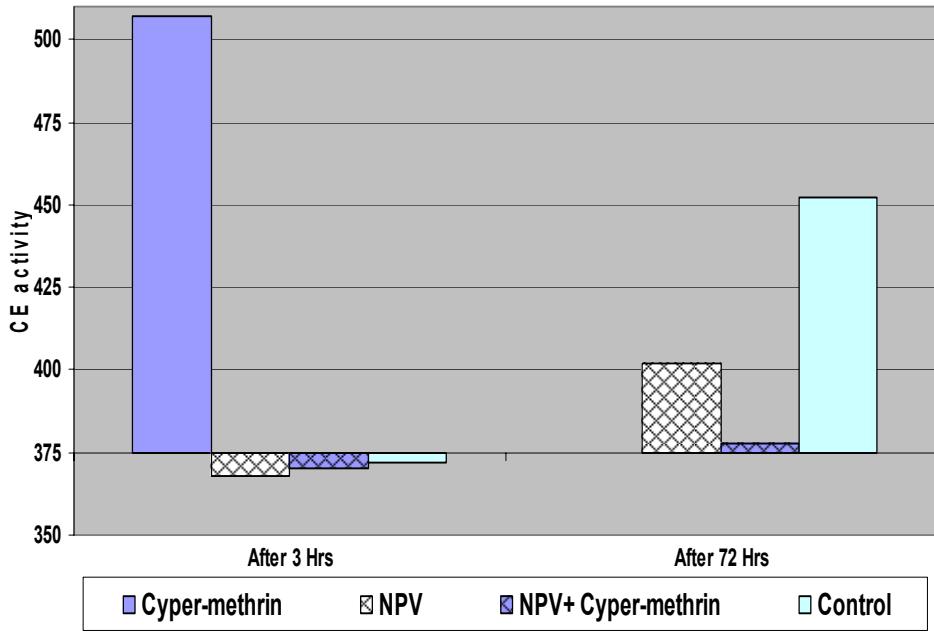
4.8. The enzyme suppression effect of HaNPV in pyrethroid resistant *H. armigera* studied

MFO activity in third instar *H. armigera*

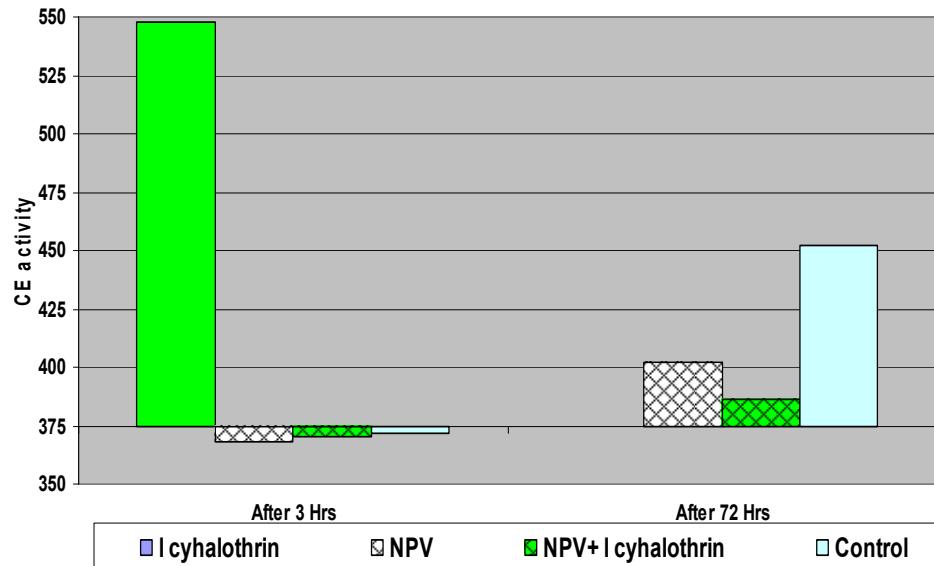


(Paraisy lethial & Reguaphry, 2001)

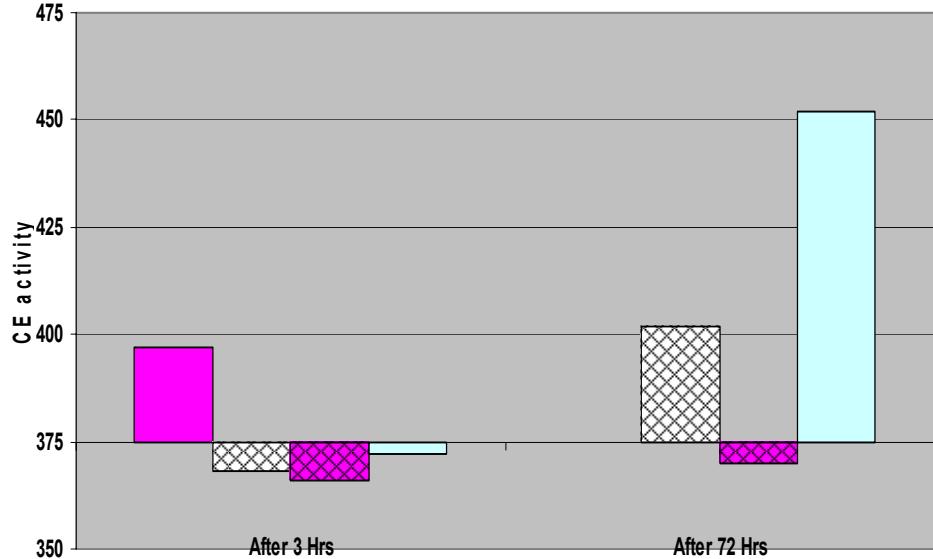
Carboxyl Esterase activity in third instar *H. armigera*



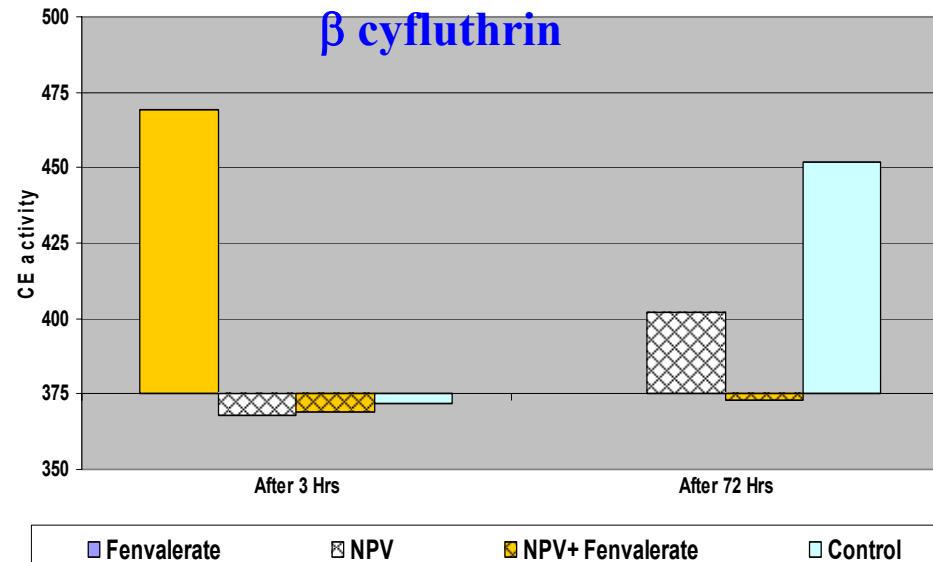
Cypermethrin



λ cyhalothrin



β cyfluthrin



Fenvalerate
(Praisy lethial & Reguapthy, 2001)

CONCLUSION

- pyrethroids induced the mixed function oxidases (MFO)
- pyrethroids induced the carboxyl esterase (CE)
- HaNPV infection reduced the MFO activity
- HaNPV infection reduced the CE activity
- HaNPV could be utilised as time mosaic (alternation) or as mixtures with insecticides

(Praisy lethial & Reguapthy, 2001)

THANK YOU

