The Andhra Agric. J 59(4): 593-599, 2012

Comparative Toxicity of Certain Novel Insecticides Against Rice Brown Planthopper, *Nilaparvata lugens* (Stal).

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ABSTRACT

Experiments were conducted during 2008-09 and 2009-10 to assess the bioefficacy of four novel insecticides viz., buprofezin 25 SC, pymetrozine 50 WG, imidacloprid+ethiprole-80 WG and ethiprole 10 SC against rice planthopper, *Nilaparvata lugens* (Stal). Buprofezin 25 SC was the most toxic (LC_{50} values - 0.00014 to 0.00015 Percent) and ethiprole was the least toxic (LC_{50} values - 0.00018 to 0.00035 per cent) against *N. lugens*. Buprofezin was 2.33-2.5; 1.26-1.28; 1.29-1.33 times more toxic than ethiprole, pymetrozine and imidacloprid + ethiprole at LC_{50}, respectively.

Key words : Buprofezin, Ethiprole, Imidacloprid+ethiprole, *Nilaparvata lugens,* Pymetrozine,Toxicity.

The Brown Planthopper (BPH), *Nilaparvata lugens* (Stal) (Homoptera: Delphacidae), is an economically important insect pest of rice in Asia (Heinrichs, 1994). The frequent higher dose application of some insecticides has led to the development of insecticide resistance in *N. lugens*. In early seventies and eighties organophosphates like monocrotophos and acephate, carbamates like carbaryl and fenobucarb and ether derivatives like ethofenprox have been extensively used in India as well as other countries. As a result, these hopper pests became resistant to these insecticides in Japan, Taiwan, China and Philippines. However, the insecticide resistance has been reported to be in incipient stage in India (Sarupa *et al*., 1998). To manage these resistant populations of *N. lugens*, there is a need to find alternatives.

Hence, the studies were conducted to assess comparative toxicity of four novel insecticides against *N. lugens* population of West Godavari district.

MATERIAL AND METHODS

The investigations were carried out under laboratory conditions at Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru, West Godavari district, Andhra Pradesh during 2008-2009 and 2009-2010.

The Insect

Field populations of *Nilaparvata lugens* (Stal) were collected from rice fields of West Godavari district of Andhra Pradesh and reared on susceptible rice variety TN1 for subsequent generations and tested for their susceptibility to various insecticides.

Insecticides

The new insecticide formulations *viz*., buprofezin 25 SC, ethiprole 10 SC, pymetrozine 50 WG and imidacloprid + ethiprole-80 WG were selected to test the toxicity against *N. lugens*.

Bioassay

The spray method was followed according to Krishnaiah (2004). The commercial formulations of test insecticides were dissolved in water to have different working concentrations. Later, the insecticides sprayed on 40 days old susceptible rice cultivars in serial concentrations. Immediately after drying of the spray deposit, 7-9 day old nymphs of the BPH (20 nos.) were released with aspirator and confined with the help of mylar cages. The treatments along with control (Water spray) were replicated thrice. Post treatment mortality was recorded at 24, 48 and 72 hrs after spray and the pooled mortality at 72 hrs after spray was subjected

to statistical analysis. For slow acting compounds such as buprofezin, the mortality data recorded at 120 hrs after the spray.

Relative Toxicity (RT)

It was calculated as per the formula, RT=LC value of the least toxic insecticide/LC value of the candidate insecticide.

Statistical analysis

The corrected mortality data was analyzed through MLP software (Ross, 1987) and LC50, LC_{90}, heterogeneity (χ^2), intercept (a), slope of regression line (b), Fiducial limits and log concentration probit lines (lcp) were deduced.

RESULTS AND DISCUSSION

1. Buprofezin

a. Toxicity of buprofezin 25 SC to BPH.

The LC_{50} and LC_{90} values of buprofezin to the insecticide resistant West Godavari strain of *N. lugens* during 2008-09 were 0.00014 and 0.00091, respectively. The slope (b) value of lcp line was 1.5850. During 2009-10, the LC_{50} and LC_{90} values of buprofezin were 0.00015 and 0.00070, respectively. The slope (b) value of lcp line of was 1.9117. The chi-square (χ^2) test revealed that the population used in the study during 2008-09 as well 2009-10 was homogenous. Among the new insecticides buprofezin was first in its position at LC_{50} and LC_{90} during both the years of study. (Table 1 and Fig. 1).

b. Relative toxicity of buprofezin 25 SC.

During 2008-09, buprofezin 25 SC at LC_{50} and LC_{90} were 2.5 and 1.64; 1.28 and 1.64; 1.29 and 1.99 times more toxic than ethiprole, pymetrozine and imidacloprid + ethiprole, respectively. While, during 2009-10 at LC_{50} and LC_{90} values were 2.33 and 2.42; 1.26 and 2.14; 1.33 and 2.14 times more toxic than ethiprole 10 SC, pymetrozine 50 WG and imidacloprid + ethiprole 80 WG, respectively (Table 2 and Fig. 3). The present findings are in accordance with the reports available regarding the efficacy of buprofezin against BPH of Rice (Kendappa *et al*., 2005., Fukuda *et al*., 2007 and Shashank, 2009).

2. Imidacloprid + ethiprole 80 WG

a. Toxicity of imidacloprid + ethiprole 80 WG to BPH.

The LC_{50} and LC_{90} values of imidacloprid + ethiprole to the insecticide resistant West Godavari strain of *N. lugens* during 2008-09 were 0.00018 and 0.0.001816, respectively. The slope (b) value of lcp line of Imidacloprid + ethiprole was 2.2742 (Table 1 and Fig. 1).

During 2009-10, the LC_{50} and LC_{90} values of imidacloprid + ethiprole were 0.00020 and 0.0015, respectively. The slope (b) value of lcp line of imidacloprid + ethiprole was 1.4520 (Table 1 and Fig. 2).

b. Relative toxicity of imidacloprid + ethiprole.

During 2008-09, the relative toxicity of imidacloprid + ethiprole against the resistant West Godavari strain of *N. lugens* at LC_{50} and LC_{90} values indicated that it was 1.94 times more toxic at LC_{50} as compared to ethiprole but was less toxic than pymetrozine and buprofezin by 0.1 and 0.77 fold at LC_{50}, respectively (Table 1 and Fig. 3). During 2009-10, Imidacloprid + ethiprole were 1.75 and 1.13 times more toxic at LC_{50} and LC_{90} values than ethiprole. It was found inferior to pymetrozine and buprofezin at LC_{50} and on par with pymetrozine at LC_{90} (Table 2).

The combination product, imidacloprid + ethiprole showed better efficacy against BPH. The information on the comparative efficacy of this product against BPH under laboratory conditions was not available in literature. Better efficacy of imidacloprid alone was reported by Reddy and Krishnaiah (2003) and Seetharamu *et al*., (2005). Krishnaiah *et al*., (2004) reported that ethiprole at 50 ppm (0.005%) showed good persistent toxicity and the fumigant action of ethiprole also contributed towards the kill of BPH. Sekh *et al.,* (2007) also reported that the combination product of ethiprole and imidacloprid were effective in managing BPH of rice under field conditions.

3. Ethiprole 10 SC

a. Toxicity of ethiprole to BPH.

During 2008-09, the LC_{50} and LC_{90} values of ethiprole were 0.00035 and 0.0015 per cent, respectively to the resistant population of *N. lugens* of East Godavari district. The lcp line has slope value (b) of 1.9994. The chi-square test revealed non segregation of phenotypes (Table 1 and Fig.1). During 2009-10, the LC_{50} and LC_{90} values of ethiprole were 0.00035 and 0.0017, respectively. The slope (b) value of lcp line of ethiprole was 1.8680 (Table 1 and Fig. 2).

b. Relative toxicity of ethiprole 10 SC.

During 2008-09, it was least effective among the new molecules tested and was inferior and less toxic than buprofezin, imidacloprid + ethiprole and pymetrozine at LC_{50} (Table 2 and Fig. 30. However, it was slightly toxic than imidacloprid + ethiprole at

Table 1. Toxicity of selected new insecticides to *N. lugens* population of West Godavari district.

S. No.	Insecticides	LC_{50} (95% FL)	LC_{90} (95% FL)	Slope ± S.E. (b)	Heterogeneity (χ^2)	Regression equation Y = a + bx
2008-09						
1	Buprofezin 25 SC	0.00014 (0.00009 - 0.00037)	0.00091 (0.0002 - 0.0012)	1.5850 ± 0.0470	3.58	Y = 11.099 + 1.5850x
2	Imidacloprid + Ethiprole (40 + 40) - 80 WG	0.00018 (0.000095 - 0.00024)	0.001816 (0.0008 - 0.0027)	2.2742 ± 0.0250	4.53	Y = 09.7740 + 1.2742x
3	Ethiprole 10 SC	0.00035 (0.00023 - 0.00048)	0.0015 (0.0008 - 0.0024)	1.9994 ± 0.0650	1.76	Y = 11.9080 + 1.9994x
4	Pymetrozine 50 WG	0.00018 (0.00009 - 0.00032)	0.0015 (0.00092 -0.0027)	1.4014 ± 0.0264	5.66	Y = 10.2387 + 1.4014x
2009-10						
1	Buprofezin 25 SC	0.00015 (0.000093 - 0.00032)	0.00070 (0.00023-0.00093)	1.9117 ± 0.0535	5.47	Y = 12.3023 + 1.9117x
2	Imidacloprid + Ethiprole (40 + 40) - 80 WG	0.00020 (0.000017- 0.00032)	0.0015 (0.0011 - 0.0021)	1.4520 ± 0.0296	2.20	Y = 10.3663 + 1.4520x
3	Ethiprole 10 SC	0.00035 (0.00021 - 0.00042)	0.0017 (0.00097 - 0.0023)	1.8680 ± 0.0587	3.12	Y = 11.4538 + 1.8680x
4	Pymetrozine 50 WG	0.00019 (0.00008 - 0.00025)	0.0015 (0.00096 - 0.0021)	1.4270 ± 0.0279	5.74	Y = 10.383 + 1.4270x

FL= Fiducial Limits. *Figures in parenthesis are Fiducial Limits. S. E. Standard Error.

LC_{90}. While, during 2009-10, it was least effective among the new molecules tested and was inferior and less toxic than buprofezin, imidacloprid + ethiprole and pymetrozine both at LC_{50} and LC_{90} (Table 2 and Fig. 4). The results of the present study are in accordance with the findings of earlier investigations revealing the efficacy of ethiprole against BPH (Kumaran *et al*., 2007 and Sekh *et al*., 2007). The insecticide belong to phenyl pyrazole group exhibit entirely different mode of action i.e. by acting as potential blockers of gama amino butyric acid (GABA) regulated chloride channels in nerve membrane of insect central nervous system. This might be the reason for no cross resistance to phenylpyrazoles in resistant populations from West Godavari district of Andhra Pradesh. The reason behind the effectiveness of ethiprole is its fumigant action, effective upward translocation and ovicidal action against plant hoppers (Krishnaiah *et al*., 2004).

4. Pymetrozine 50 WG

a. Toxicity of pymetrozine to BPH.

The LC_{50} and LC_{90} values of pymetrozine to the insecticide resistant West Godavari strain of *N. lugens* during 2008-09 were 0.00018 and 0.0015, respectively. The slope (b) value of lcp line of pymetrozine was 1.4014. The chi-square test revealed that the population used in the study was homogenous (Table 1 and Fig. 1). During 2009-10, the LC_{50} and LC_{90} values of pymetrozine were 0.00019 and 0.0015, respectively. The slope (b) value of lcp line of buprofezin was 1.4270. Among the new insecticides pymetrozine was second in its toxicity at LC_{50} and LC_{90} levels during both the years of study (Table 1 and Fig. 2).

b. Relative toxicity of pymetrozine 50 WG

During 2008-09 the relative toxicity of pymetrozine against the resistant West Godavari strain of *N. lugens* at LC_{50} and LC_{90} values indicated

Table 2. Relative toxicity of new insecticides against relatively resistant *N. lugens* population of West Godavari district.

S. No.	Insecticides	Number of folds toxic in comparison with			
		Ethiprole	Pymetrozine	Imidacloprid + Ethiprole	Buprofezin
2008-09					
1	Buprofezin				
	LC_{50} – 0.00014%	*2.5	1.28	1.29	—
2	LC_{90} – 0.00091%	**1.64	1.64	1.99	—
	Imidacloprid + Ethiprole				
3	LC_{50} – 0.00018%	1.94	0.10	—	0.77
	LC_{90} – 0.001816%	0.82	0.04	—	0.50
4	Pymetrozine				
	LC_{50} – 0.00018%	1.94	—	1.00	0.77
	LC_{90} - 0.0015%	1.00	—	1.21	0.60
2009-10					
1	Ethiprole				
	LC_{50} – 0.00035%	—	0.51	0.51	0.40
2	LC_{90} – 0.0015%	—	1.00	1.21	0.60
	Buprofezin				
3	LC_{50} – 0.00015%	2.33	1.26	1.33	—
	LC_{90} – 0.00070%	2.42	2.14	2.14	—
4	Imidacloprid + Ethiprole				
	LC_{50} – 0.00020%	1.75	0.95	—	0.75
	LC_{90} – 0.0015%	1.13	1.00	—	0.46
	Pymetrozine				
	LC_{50} – 0.00019%	1.84	—	1.05	0.79
	LC_{90} – 0.0015%	1.13	—	1.00	0.47
	Ethiprole				
	LC_{50} – 0.00035%	—	0.54	0.57	0.42
	LC_{90} – 0.0017%	—	0.88	0.88	0.41

* Number of folds toxic at LC_{50} level. ** Number of folds toxic at LC_{90} level.

that it was 1.94 and 1.00; 1.00 and 1.21times more toxic than ethiprole and imidacloprid+ethiprole, respectively. However, it was inferior to buprofezin by 0.77 and 0.5 fold at LC_{50} and LC_{90}, respectively. The toxicity was on par with imidacloproid + ethiprole at LC_{50} but was slightly more toxic at LC_{90} (Table 2 and Fig. 3). During 2009-10, at LC_{50} and LC_{90} values pymetrozine was 1.84 and 1.13; 1.05 and 1.0 times more toxic than ethiprole and imidacloprid + ethiprole, respectively. It was inferior to buprofezin both at LC_{50} and LC_{90} (Table 2 and Fig. 4). Polston and Sherwood (2003) reported that pymetrozine provided protection against tomato yellow leaf curl virus by viruliferous white flies (*Bemisia tabaci* (Gennadius). The superior efficacy of pymetrozine was also reported by Wyss and Balsinger (1997)., Slosser *et al*. (2000) and Muralibaskaran *et al.,* (2009) against different pests.

In conclusion, the data on LC_{50} values revealed that buprofezin, imidacloprid + ethiprole and pymetrozine were more toxic and ethiprole was less toxic to *N. lugens*.

Fig. 1. Log concentration probit lines of certain novel insecticides for the management of resistant population of *N. lugens* (2008-09)

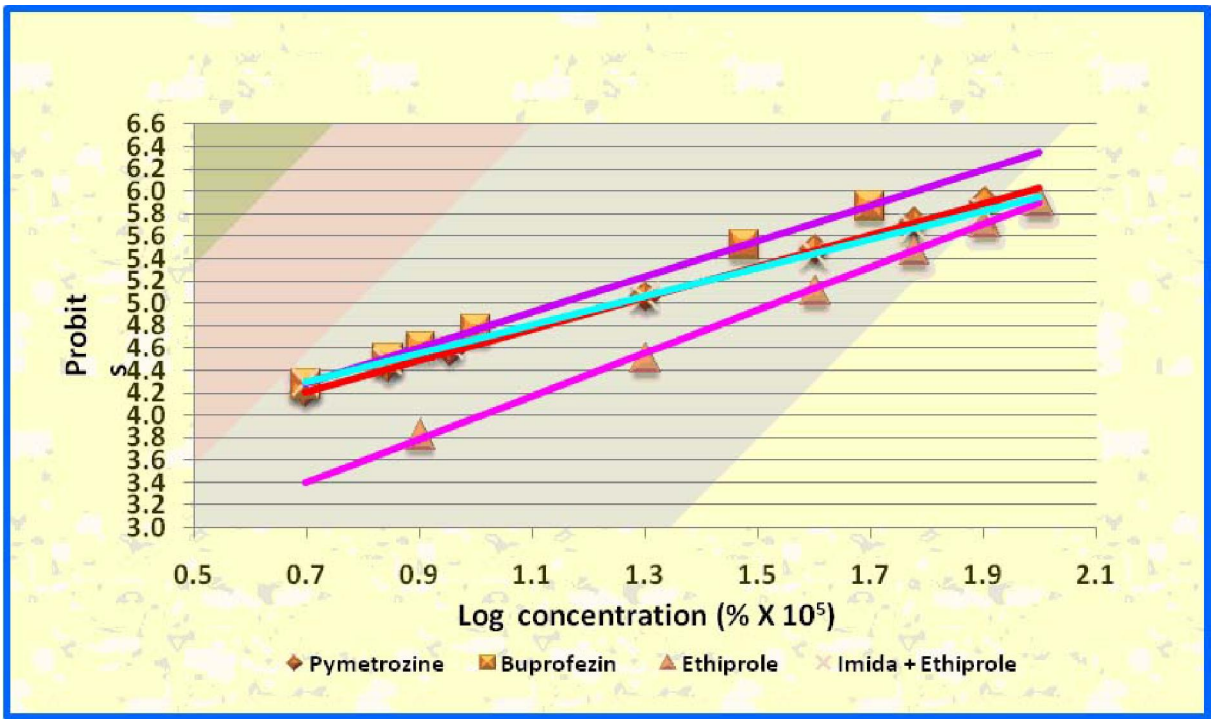


Fig. 2. Log concentration probit lines of certain novel insecticides for the management of resistant population of *N. lugens* (2009-10)

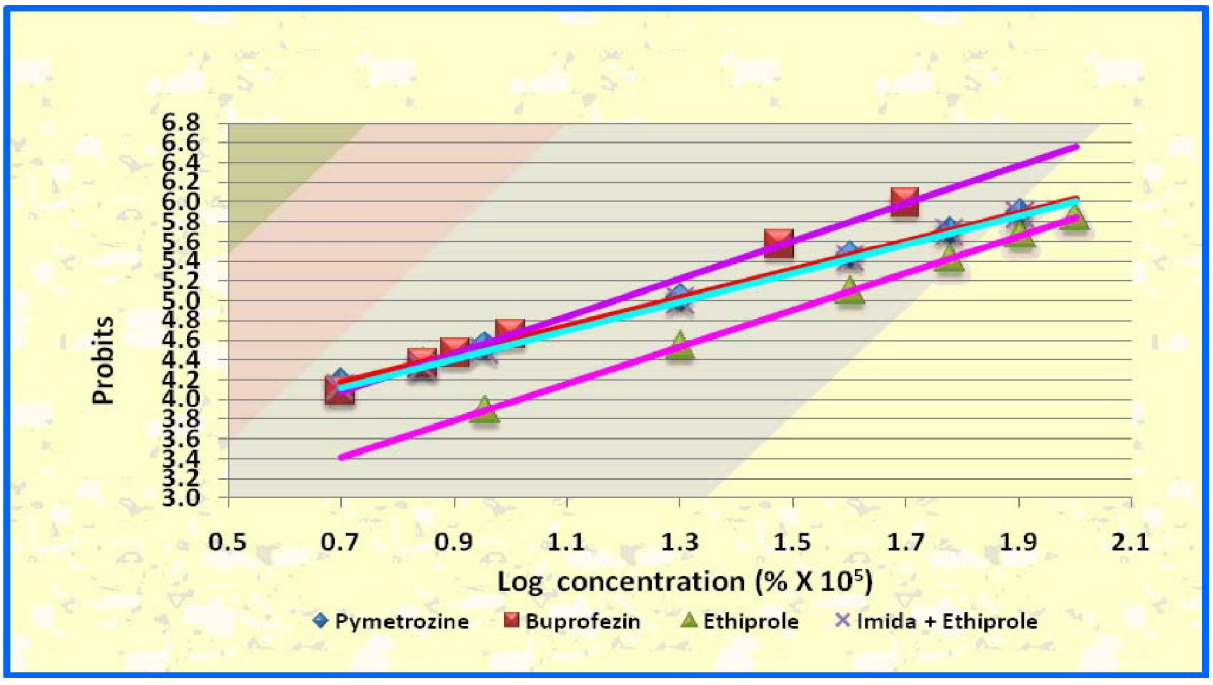


Fig. 3. Relative toxicity of novel insecticides against resistant population of *N. lugens* (2008-09)

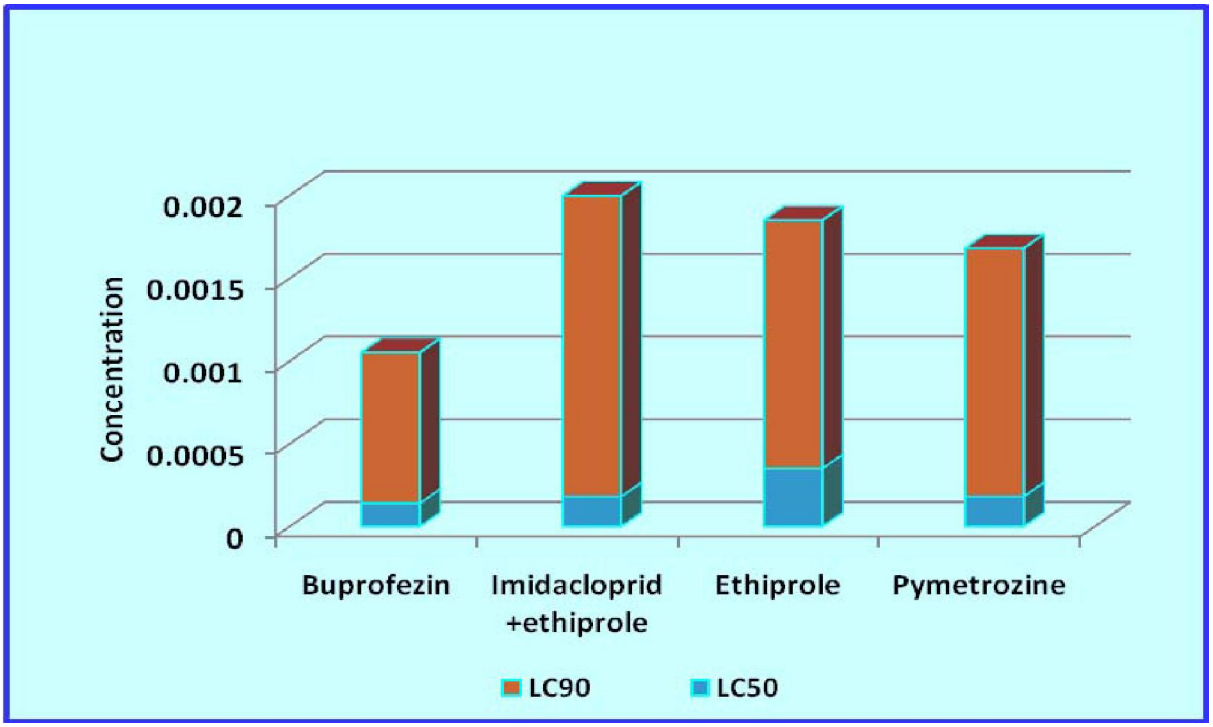
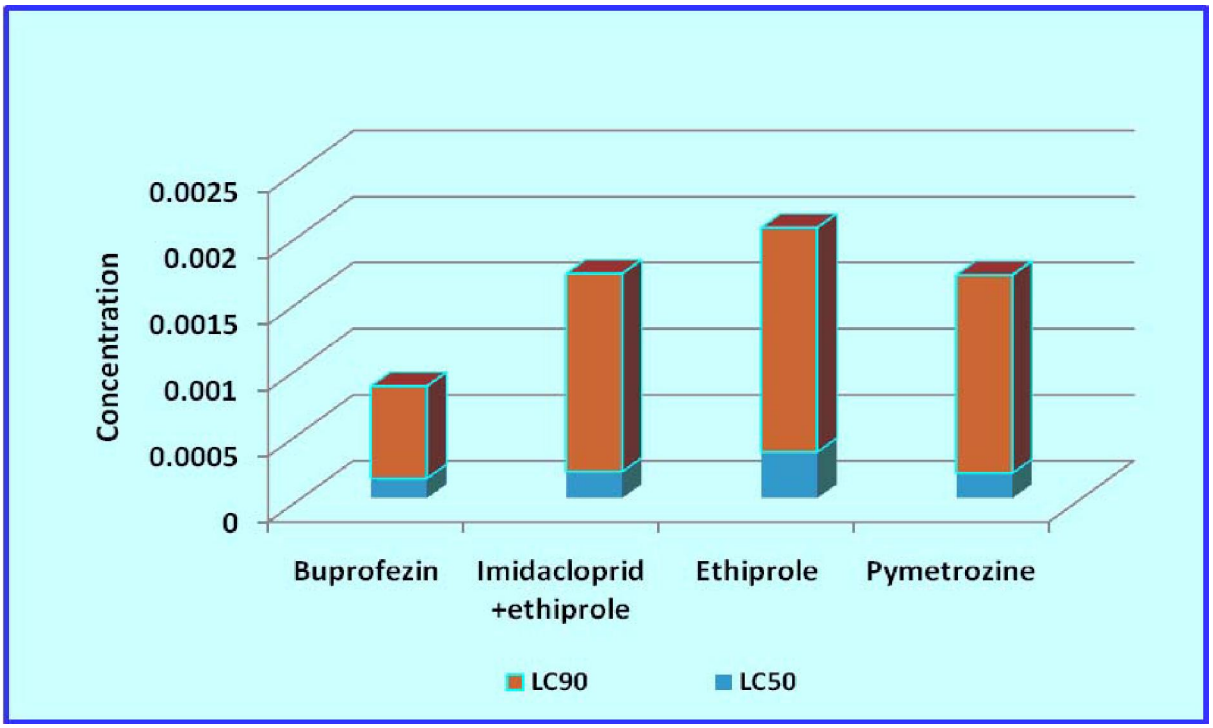


Fig. 4. Relative toxicity of novel insecticides against resistant population of *N. lugens* (2009-10)



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(Received on 02.09.2011 and revised on 06.07.2012)