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Bio- Efficacy of Newer Insecticide Against Green Leaf Hopper and Brown Plant Hopper of Rice and their Effects on Natural Enemies

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ABSTRACT

Field experiment was conducted at research farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur to know the bio-efficacy of insecticides against sucking pests of rice during two *kharif* season 2011-12 and 2012-13. The new chemical insecticide CPIL -01SC was evaluated for its bio efficacy against sucking insect pests likes BPH and GLH of rice. During this period CPL 2005 @ 3000 ml/ha was found to be the best effective treatment and minimized the in rice GLH and BPH population, whereas Fenobucarb 50% EC @ 1500 ml/ha was recorded the least effective treatment. The spider **population was ranged between 0.80 (1.14) to 1.03 (1.23) and 0. 30 (0.93) to 0.50 (1.00) per hill during season 2011-12 and 2012-13 respectively. It was also observed that CPIL -01SC at all dosages levels tested for bio efficacy has no influence/effect on the natural enemy under field condition.**

Key words *Rice pests, rice, CPIL -01SC*

Chhattisgarh State is known as the rice bowl of India because nearly 74-76 per cent area during rainy season is under rice cultivation. In Chhattisgarh there are 5 gro-ecosystems in which rice is cultivated with different practices. Two species of green leaf hopper, *Nephotettix virescens* (Distant) and *N. nigropictus* (Stal.), white backed plant hopper and Brown plant hopper (*Nilaparavta lugens* stall.) are most common in rice ecosystem at Raipur. Both nymphs and adults suck the sap from the plant. While direct damage seldom causes economic loss, viral disease transmitted by pests results in economic loss (Anonymous, 2009).

Rice plant hoppers are major pests across the country especially in irrigated rice. Two species *viz.,* Brown plant hopper (BPH), *Nilaparvata lugens* (Stal.), white backed plant hopper (WBPH), *Sogatella furcifera* (Horvath) (Hemiptera: Delphacidae) are of economic importance. Besides direct damage to crop by nymphs and adults sucking phloem sap and leading to hopper burn, BPH also transmits viral disease like rice ragged stunt virus and rice grassy stunt virus virus (Watanabe & Kitagawa, 2000). In Chhattisgarh, BPH has assumed greater importance due to its severe outbreak in 1975 and consequent yield losses reported to the extent of 34.3 per cent (Gangrade *et al.*, 1978). In 1960s and 1970s, with the beginning of green revolution, the cropping systems and cultural practices were mostly focused to achieve higher yield using huge amount of chemical fertilizers in rice varieties, while the excessive use of nitrogen fertilizer was considered to be one of the key factors in shifting of BPH from minor to major insect pest (Dyck and Thomas, 1979).

Natural enemies of rice insect pest include a wide range of predators and parasitoids that are important biological agents. Spiders are potential biological control agents in agro-ecosystems. Mirid bug, *Cyrtorhinus lividipennis* Reuter (Hemiptera: Miridae) is an important egg and nymph predator of plant and leaf hoppers both tropical and temperate rice fields. The aim of this study was to determine the Bio- efficacy of newer insecticide against green leaf hopper and brown plant hopper of rice and their effects on natural enemies. It is hoped that the findings from the study can contribute to the more ecological precise ways in dealing with outbreaks and control of insect pests of rice.

MATERIAL AND METHODS

Observations on population of Brown plant hopper (*Nilaparavta lugens*) and Green leaf hopper, *Nephotettix sp.* was recorded at pretreatment and post treatment from ten randomly selected plants and the data were converted into population per hill. Yield per plot (size 4 x 6 m^2) was recorded and converted into quintal/ha. Phytotoxicity symptoms on epinasty, hyponasty, yellowing and stunting etc. were recorded in 0 – 10 scale at 1, 3, 7and 14 days after treatment, where 0 = No phytotoxicity and 100 = complete killed were also recoded. Rice variety swarna were growing with spacing 10X15 cm in both *kharif* season 2011-12 and 2012-13. Randomized block design were used with three replication and 8 treatments. The cumulative data were statistically analyzed after appropriate transformation (Gomez and Gomez, 1984).

Table 1. Insecticidal treatments (name) along with dosages.

S. No.	Insecticides	Dosage (ml / ha)
1.	CPL2005	1000
2.	CPL2005	1500
3.	CPL2005	2000
4.	CPL2005	3000*
5.	CPL2005	4000*
6.	Buprofezin 25%SC	800
7.	Fenobucarb 50% EC	1500
8.	Control	-

* For phytotoxicity and effect on natural enemies only

Table 2. Average number of Brown plant hopper population per hill after first and second spray during *kharif* 2011-12

Treatments	Dose ml/ha	Pre trea-tment	Post treatments									
			First Spray					Second Spray				
			1 days	3 days	7 days	14 days	Mean	1days	3 days	7 days	14 days	Mean
CPL2005	1000	5.00	2.53	2.00	2.13	2.60	2.32	2.33	2.00	1.90	1.73	1.99
		(2.34)	(1.74)	(1.58)	(1.62)	(1.76)	(1.68)	(1.68)	(1.58)	(1.54)	(1.49)	(1.57)
CPL2005	1500	5.13	2.03	1.67	1.50	1.43	1.66	1.63	1.70	1.60	1.40	1.58
		(2.37)	(1.59)	(1.47)	(1.41)	(1.38)	(1.46)	(1.45)	(1.48)	(1.44)	(1.59)	(1.49)
CPL2005	2000	4.87	1.70	1.37	1.03	1.00	1.28	1.00	1.03	0.90	0.93	0.97
		(2.31)	(1.48)	(1.36)	(1.23)	(1.22)	(1.32)	(1.22)	(1.23)	(1.18)	(1.19)	(1.21)
CPL2005	3000	4.93	1.43	1.03	0.87	0.80	1.03	0.90	0.70	0.77	0.80	0.79
		(2.33)	(1.38)	(1.23)	(1.17)	(1.14)	(1.23)	(1.18)	(1.09)	(1.12)	(1.44)	(1.21)
Buprofezin 25%SC	800	5.17	2.33	1.70	1.73	1.73	1.87	1.80	1.90	1.80	1.60	1.78
		(2.38)	(1.68)	(1.48)	(1.49)	(1.49)	(1.54)	(1.51)	(1.54)	(1.51)	(1.55)	(1.53)
Fenobucarb 50% EC	1500	5.67	2.50	1.90	1.80	2.13	2.08	2.00	2.03	2.03	1.93	2.00
		(2.67)	(1.73)	(1.54)	(1.51)	(1.62)	(1.60)	(1.58)	(1.59)	(1.59)	(1.49)	(1.56)
Control	-	5.70	5.60	5.73	5.87	5.00	5.55	6.13	5.90	5.73	6.13	5.97
		(2.48)	(2.46)	(2.46)	(2.52)	(2.34)	(2.45)	(2.57)	(2.52)	(2.49)	(2.55)	(2.53)
SE (m)		0.19	0.07	0.07	0.08	0.06		0.09	0.06	0.06	0.06	
CD at 5%		NS	0.22	0.22	0.23	0.20		0.27	0.21	0.19	0.19	

( ) Figures in parentheses are square root transformed values

Table 3. Average number of Brown plant hopper population /hill after first and second spray during *kharif* 2012-13

Treatments	Dose ml/ha	Pre treatment	Post treatments									
			First Spray					Second Spray				
			1 days	3 days	7 days	14 days		1 days	3 days	7 days	14 days	
CPL2005	1000	6.17	3.63	3.07	2.90	2.73	3.08	2.63	2.53	2.37	2.13	2.42
		(2.58)	(2.00)	(1.88)	(1.84)	(1.79)	(1.88)	(1.76)	(1.74)	(1.69)	(1.62)	(1.70)
CPL2005	1500	6.13	3.03	2.67	2.43	2.30	2.61	1.93	1.80	1.70	1.50	1.73
		(2.57)	(1.87)	(1.78)	(1.71)	(1.67)	(1.76)	(1.55)	(1.51)	(1.48)	(1.41)	(1.49)
CPL2005	2000	5.80	2.70	2.27	2.03	2.00	2.25	1.60	1.37	1.23	1.17	1.34
		(2.50)	(1.87)	(1.66)	(1.59)	(1.58)	(1.68)	(1.44)	(1.36)	(1.31)	(1.29)	(1.35)
CPL2005	3000	5.90	2.13	2.00	1.80	1.63	1.89	1.03	0.83	0.80	0.70	0.84
		(2.52)	(1.78)	(1.58)	(1.51)	(1.45)	(1.58)	(1.23)	(1.15)	(1.14)	(1.09)	(1.15)
Buprofezin 25%SC	800	6.17	3.63	3.20	3.03	2.97	3.21	2.83	2.67	2.43	2.13	2.52
		(2.58)	(2.03)	(1.92)	(1.87)	(1.86)	(1.92)	(1.82)	(1.78)	(1.71)	(1.62)	(1.73)
Fenobucarb 50% EC	1500	6.37	3.90	3.70	3.63	3.13	3.59	3.03	2.93	2.73	2.73	2.86
		(2.62)	(2.09)	(2.04)	(2.03)	(1.90)	(2.02)	(1.87)	(1.85)	(1.79)	(1.79)	(1.83)
Control	-	6.60	6.67	6.70	6.87	6.00	6.56	6.13	6.10	6.13	6.23	6.15
		(2.66)	(2.67)	(2.68)	(2.71)	(2.54)	(2.65)	(2.57)	(2.56)	(2.57)	(2.59)	(2.57)
SE (m)		0.18	0.07	0.08	0.07	0.08		0.06	0.06	0.07	0.08	
CD at 5%		NS	0.22	0.24	0.21	0.24		0.19	0.18	0.22	0.25	

( ) Figures in parentheses are square root transformed values

Table 4. Average number of green leaf hopper population/ hill after first and second spray during *kharif* 2011-12

Treatments	Dose ml/	Pre treatment	Post treatments									
			First Spray					Second Spray				
			1 days	3 days	7 days	14 days	Mean	1days	3 days	7 days	14 days	
CPL2005	1000 ha	8.00 (2.91)	4.50 (2.23)	3.93 (2.10)	2.83 (1.82)	3.13 (1.90)	3.60 (2.01)	2.00 (1.58)	2.03 (1.59)	2.03 (1.59)	1.90 (1.53)	1.99 (1.57)
CPL2005	1500	7.70 (2.86)	4.03 (2.12)	3.67 (2.04)	2.50 (1.73)	2.43 (1.71)	3.16 (1.90)	1.63 (1.45)	1.37 (1.36)	1.60 (1.44)	1.60 (1.41)	1.55 (1.42)
CPL2005	2000	7.80 (2.88)	2.70 (2.78)	2.37 (1.69)	2.03 (1.59)	2.00 (1.58)	2.28 (1.91)	1.00 (1.22)	1.17 (1.29)	1.23 (1.31)	1.03 (1.31)	1.11 (1.28)
CPL2005	3000	8.90 (3.06)	2.43 (2.71)	2.03 (1.59)	1.03 (1.23)	1.23 (1.31)	1.68 (1.71)	1.00 (1.22)	1.03 (1.23)	1.10 (1.26)	0.90 (1.19)	1.01 (1.23)
(Buprofezin 25%SC)	800	8.10 (2.93)	3.33 (2.95)	2.70 (1.78)	2.67 (1.78)	2.73 (1.79)	2.86 (2.08)	1.80 (1.51)	1.90 (1.54)	1.80 (1.51)	1.70 (1.48)	1.80 (1.51)
Fenobucarb 50% EC	1500	7.90 (2.89)	5.50 (2.44)	4.00 (2.12)	3.13 (1.90)	3.60 (2.02)	4.06 (2.12)	2.33 (1.68)	1.90 (1.54)	1.90 (1.54)	1.80 (1.49)	1.98 (1.56)
Control	-	8.00 (2.91)	8.60 (3.01)	7.73 (2.86)	9.87 (3.22)	8.30 (2.96)	8.63 (3.01)	8.13 (2.93)	8.90 (3.06)	8.73 (3.03)	8.13 (2.90)	8.47 (2.98)
SE (m)		0.19	0.07	0.08	0.06	0.08		0.09	0.09	0.08	0.06	
CD at 5%		NS	0.21	0.23	0.19	0.26		0.27	0.29	0.24	0.18	

( ) Figures in parentheses are square root transformed values

RESULTS AND DISCUSSION

Average pest population per hill

It is evident from (Table – 2 & 3) observations on bio-efficacy of insecticide against brown plant hopper revealed that in pretreatment observations was ranged between 4.87 (2.31) to 5.70 (2.48) and 5.80 (2.50) to 6.60 (2.66) per hill during season 2011-12 and 2012-13 respectively. The number of insects per hill was almost uniform in all the treatments and statistically no significant difference was observed. After post treatment observations (3, 5, 7 and 10 days after

Table 5. Average number of green leaf hopper population per hill after first and second spray during *kharif* 2012-13

Treatments	Dose ml/ha	Pretreatment	Post treatments									
			First Spray					Second Spray				
			1 days	3 days	7 days	14 days		1 days	3 days	7 days	14 days	
CPL2005	1000	7.10 (2.75)	4.83 (2.30)	4.70 (2.28)	4.10 (2.14)	4.00 (2.12)	4.41 (2.21)	3.43 (1.98)	3.13 (1.90)	3.00 (1.87)	2.83 (1.82)	3.10 (1.89)
CPL2005	1500	6.77 (2.69)	4.13 (2.15)	4.47 (2.22)	3.70 (2.04)	3.40 (1.97)	3.93 (2.10)	3.10 (1.89)	2.87 (1.83)	2.83 (1.82)	2.63 (1.76)	2.86 (1.83)
CPL2005	2000	7.00 (2.73)	4.00 (2.12)	3.87 (2.09)	3.43 (1.98)	3.10 (1.89)	3.60 (2.02)	2.10 (1.61)	2.10 (1.61)	2.03 (1.59)	2.03 (1.59)	2.07 (1.60)
CPL2005	3000	6.73 (2.68)	3.80 (2.07)	3.33 (1.95)	3.00 (1.87)	2.73 (1.79)	3.22 (1.92)	2.03 (1.59)	1.73 (1.49)	1.60 (1.44)	1.50 (1.41)	1.72 (1.48)
Buprofezin 25%SC	800	7.00 (2.73)	4.97 (2.33)	4.70 (2.28)	4.67 (2.27)	4.13 (2.15)	4.62 (2.26)	4.00 (2.12)	3.93 (2.10)	3.60 (2.02)	3.70 (2.04)	3.81 (2.07)
Fenobucarb 50% EC	1500	7.10 (2.75)	5.13 (2.37)	5.00 (2.34)	5.10 (2.36)	4.67 (2.27)	4.98 (2.34)	4.53 (2.24)	4.67 (2.27)	4.60 (2.25)	4.50 (2.23)	4.58 (2.25)
Control	-	6.90 (2.72)	6.93 (2.72)	7.00 (2.73)	7.80 (2.88)	7.30 (2.79)	7.26 (2.78)	7.23 (2.78)	6.93 (2.72)	7.10 (2.75)	7.13 (2.76)	7.10 (2.75)
SE (m)		0.18	0.06	0.07	0.07	0.06		0.08	0.06	0.09	0.07	
CD at 5%		NS	0.19	0.21	0.22	0.18		0.24	0.18	0.27	0.21	

( ) Figures in parentheses are square root transformed values

Table 6. Average number of spider population per hill after first, second and third spray during Kharif 2011-12.

Treatments	Dose ml/ha	Pretreatment	Post treatments									
			First Spray					Second Spray				
			1 days	3 days	7 days	14 days	Mean	1 days	3 days	7 days	14 days	Mean
CPL2005	1000	1.00 (1.22)	0.90 (1.18)	1.00 (1.22)	1.00 (1.21)	0.93 (1.19)	0.96 (1.20)	0.97 (1.21)	1.00 (1.22)	0.90 (1.18)	0.90 (1.18)	0.94 (1.20)
CPL2005	1500	1.03 (1.23)	0.93 (1.19)	1.03 (1.23)	0.93 (1.19)	0.90 (1.18)	0.95 (1.20)	0.93 (1.19)	1.03 (1.14)	0.80 (1.14)	1.00 (1.22)	0.94 (1.17)
CPL2005	2000	0.93 (1.19)	0.80 (1.14)	0.97 (1.21)	0.93 (1.19)	1.00 (1.22)	0.93 (1.19)	0.90 (1.18)	0.90 (1.18)	0.90 (1.18)	0.97 (1.21)	0.92 (1.19)
CPL2005	3000	0.97 (1.21)	0.77 (1.12)	0.90 (1.18)	1.00 (1.22)	1.03 (1.23)	0.93 (1.19)	0.90 (1.18)	1.00 (1.22)	0.70 (1.09)	0.80 (1.14)	0.85 (1.16)
Buprofezin 25%SC	800	0.80 (1.14)	0.60 (1.04)	0.90 (1.18)	1.03 (1.23)	0.90 (1.18)	0.86 (1.16)	0.87 (1.17)	1.03 (1.23)	0.93 (1.19)	0.83 (1.15)	0.92 (1.19)
Fenobucarb 50% EC	1500	0.90 (1.18)	0.63 (1.06)	0.80 (1.14)	1.03 (1.23)	0.80 (1.14)	0.82 (1.14)	0.80 (1.14)	1.00 (1.22)	0.80 (1.14)	0.93 (1.19)	0.88 (1.17)
Control	-	0.93 (1.19)	0.83 (1.15)	0.80 (1.14)	1.00 (1.22)	0.97 (1.21)	0.90 (1.18)	0.93 (1.19)	1.03 (1.23)	0.93 (1.19)	0.87 (1.17)	0.94 (1.20)
SE (m)		0.03	0.02	0.02	0.01	0.02		0.02	0.03	0.01	0.02	
CD at 5%		NS	NS	NS	NS	NS		NS	NS	NS	NS	

( ) Figures in parentheses are square root transformed values

1st and 2nd spray of 2011-12 and 12-13) all the tested doses of insecticides were found significantly superior over untreated control. During this period CPL 2005 @ 3000 ml/ha was found to be the best effective treatment and minimized the BPH population, whereas Fenobucarb 50% EC @ 1500 ml/ha was recorded the least effective treatment.

Table 7. Average number of spider population per hill after first and second spray during Kharif 2012-13.

Treatments	Dose ml/ha	Pretreatment	Post treatments									
			First Spray					Second Spray				
			1 days	3 days	7 days	14 days	Mean	1 days	3 days	7 days	14 days	Mean
CPL2005	1000	0.33 (0.91)	0.63 (1.06)	0.90 (1.18)	0.70 (1.09)	0.83 (1.15)	0.77 (1.12)	0.70 (1.09)	0.90 (1.18)	0.90 (1.18)	0.93 (1.19)	0.86 (1.16)
CPL2005	1500	0.40 (0.94)	0.60 (1.04)	0.67 (1.08)	0.80 (1.14)	0.80 (1.14)	0.72 (1.10)	0.90 (1.18)	0.83 (1.19)	0.80 (1.14)	0.93 (1.19)	0.87 (1.18)
CPL2005	2000	0.50 (1.00)	0.70 (1.09)	0.70 (1.09)	0.87 (1.17)	0.93 (1.19)	0.80 (1.14)	0.70 (1.09)	0.90 (1.18)	0.90 (1.18)	0.80 (1.14)	0.83 (1.15)
CPL2005	3000	0.37 (0.93)	0.73 (1.10)	0.80 (1.14)	0.90 (1.18)	0.87 (1.17)	0.83 (1.15)	0.83 (1.15)	0.70 (1.09)	0.73 (1.10)	0.83 (1.15)	0.77 (1.12)
Buprofezin 25%SC	800	0.30 (0.89)	0.63 (1.06)	0.87 (1.17)	0.93 (1.19)	0.80 (1.14)	0.81 (1.14)	0.77 (1.09)	0.80 (1.14)	0.70 (1.09)	0.70 (1.09)	0.74 (1.10)
Fenobucarb 50% EC	1500	0.40 (0.94)	0.80 (1.14)	0.80 (1.14)	0.83 (1.15)	0.67 (1.08)	0.78 (1.13)	0.80 (1.14)	0.67 (1.08)	0.80 (1.14)	0.80 (1.14)	0.77 (1.13)
Control	-	0.47 (0.98)	0.83 (1.15)	0.70 (1.09)	0.80 (1.14)	0.93 (1.19)	0.82 (1.14)	0.90 (1.18)	0.77 (1.12)	0.83 (1.15)	0.83 (1.15)	0.83 (1.15)
SE (m)		0.02	0.01	0.03	0.03	0.02		0.01	0.02	0.02	0.03	
CD at 5%		NS	NS	NS	NS	NS		NS	NS	NS	NS	

( ) Figures in parentheses are square root transformed values.

Table 8. Yield of Rice in Kg/ha during Kharif 2011-12 and 2012-13.

Treatments	Dose ml/ha	Yield (Kg/ha)	
		2011-12	2012-13
CPL2005	1000	3142.00	2450.00
CPL2005	1500	3189.00	2560.00
CPL2005	2000	3410.00	2710.00
CPL2005	3000	3460.00	2723.00
Buprofezin 25%SC	800	2986.00	2328.00
Fenobucarb 50% EC	1500	3057.00	2272.00
Control	-	2613.00	1996.00
SE (m)	-	234	107
CD at 5%		762	318

RESULTS OF PHYTOTOXICITY

Table 9. Data on Epinasty, Hyponasty and Yellowing

Treatments	Dose ml/ha	observations											
		Epinasty				Hyponasty				Yellowing			
		1	3	7	14	1	3	7	14	1	3	7	14
CPL 2005	3000	0	0	0	0	0	0	0	0	0	0	0	0
CPL 2005	4000	0	0	0	0	0	0	0	0	0	0	0	0

Table 10. Data on stunting, wilting and Necrosis

Treatments	Dose ml/ha	observations											
		stunting				wilting				Necrosis			
		1	3	7	14	1	3	7	14	1	3	7	14
CPL 2005	3000	0	0	0	0	0	0	0	0	0	0	0	0
CPL 2005	4000	0	0	0	0	0	0	0	0	0	0	0	0

Perusal of the data (Table 4& 5) revealed that in pretreatment observations, the green leaf hopper population ranged between 7.70 (2.86) to 8.90 (2.06) per hill and 6.73 (2.68) to 7.10 (2.75) per hill, respectively during season 2011-12 and 2012-13. The number of insects per hill was almost uniform in all the treatments and statistically no significant difference was observed. After post treatment observations (3, 5, 7 and 10 days after 1st and 2nd spray of 2011-12 and 12-13) all the tested doses of insecticides were found significantly superior over untreated control. During this period CPL 2005 @ 3000 ml/ha was found to be the best effective treatment and minimized the GLH population, whereas Fenobucarb 50% EC @ 1500 ml/ha was recorded the least effective treatment.

Yield of rice in Kg/ha during *kharif* 2011-12 and 2012-13

The significantly highest yield 3460 and 2723 kg/ha were recorded in CPL 2005 @ 3000 ml/ha and it was at par with CPL 2005 @ 2000 ml/ha. However, the lowest grain yield 2986 Kg/ha was observed in Buprofezin 25%SC @ 800ml/ha and 2272 kg/ha was recorded in Fenobucarb 50% EC @ 1500 ml/ha (Table -8).

Average number of spider population per hill:

Perusal of the data (Table 6 & 7) revealed that in pretreatment observations, the spider population ranged between 0.80 (1.14) to 1.03 (1.23) per hill and 0. 30 (0.93) to 0.50 (1.00) per hill, respectively during season 2011-12 and 2012-13. The number of spiders per hill was almost uniform in all the treatments and statistically no significant difference was observed. After post treatment observations (3, 5, 7 and 10 days after 1st and 2nd spray of 2011-12 and 12-13) all the tested doses of insecticides were found harmless.

Phytotoxicity:

Perusal of the data (Table 9 & 10) revealed that Phytotoxicity symptoms on epinasty, hyponasty, yellowing and stunting etc. were recorded in 0 – 10 scale at 1, 3, 7and 14 days after treatment, where 0 = No phytotoxicity and 100 = complete killed were also recoded. There were no phytotoxicity symptoms at any doses of CPL 2005 in Rice crop during 2011-12 and 2012-13.

Similar result was reported by Shashank, *et al.,* 2012 who conducted experiment during *Kharif* 2008-2009 to evaluate new insecticides against brown plant hopper

(BPH), *Nilaparvata lugens* (Stal); white backed plant hopper (WBPH), *Sogatella furcifera* (Horvath) and green leaf hopper (GLH), *Nephotettix virescens* (Distant). Ethiprole (0.05 kg a.i./ha) and buprofezin (0.20 kg a.i./ha) were found to be highly effective against BPH and WBPH. Buprofezin (0.20 kg a.i./ha) and Thiamethoxam (0.025 kg a.i./ha) were highly effective against GLH. These new insecticides also gave higher rice grain yields *viz.,* 5.16 t/ha, 5.13 t/ha and 4.98 t/ha, respectively. All the insecticides tested, proved to be superior over control.

LITERATURE CITED

Anonymous, 2009. Status paper on rice Chhattisgarh. *Dir. rice res.* Hyderabad. pp. 11-16.

Heong, K.L. 2009. Are plant hopper problems caused by a brackdown in ecosystem services? In: *Plant hoppers: New Threats to the Sustainability of Intensive Rice Production Systems in Asia*. K.L. Heong and B. Hardy (eds.).IRRI, ADB and ACIAR, Philippines, pp: 221-231.

Gomez, K. A. and Gomez, A. 1985. Statistical procedure for agriculture research. A wibey-Inter Sci.Publication John and sons, Newyork.

Dyck, V.A. and B. Thomus 1979. The Brown plant hopper problem. *In International Rice Research Institute*. pp. 3-17.

Gangrade, G.A., Kaushik, U.K., Patidar, G.L., Shukla, B.C., Shrivastava, S.K., Deshmukh, P.D. and Pophaly, D.J. 1978. Insect pest of summer paddy in M.P, India. *International. Rice Research. Newsl.* **3**(6): 16.

Watanabe, T. and Kitagawa, H. 2000. Photosynthesis and translocation of assimilates in rice plants following phloem feeding by the plant hopper, *Nilaparvata lugens* (Homoptera: Delphacidae). *Journal of Economic Entomology*. **93**: 1192-1198.

Shashank, P. R., Mallikarjuna J., Chalam, M. S. V. and Madhumathi, T. 2012.Efficacy of new insecticide molecules against leaf hoppers and Plant hoppers in rice (*Oryza sativa* l.) **5**:2, 397-400

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