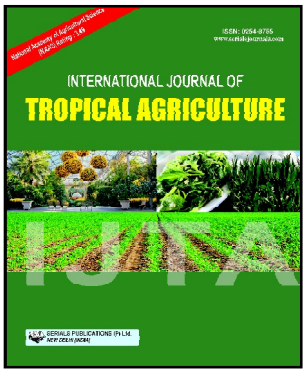

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Bio Efficacy of Fipronil 0.8 G Against Leaf Folder and Stem Borer of Rice and their Safety Against Natural Enemies

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Abstract: Field experiments were conducted at Sivapuri village in Chidambarm, Cuddalore district, Tamil Nadu, India to evaluate the bioefficacy of new formulation of fipronil 0.8 G against leaf folder and stem borer of paddy during January to April 2015 and October 2015 to January 2016 using the variety ADT 46. Fipronil 0.8 G was evaluated in comparison with Fipronil 0.3 G. Fipnronil 0.8 G was found effective in managing both leaf folder and stem borer and safer to natural enemy fauna in paddy eco system.

Key words: Bioefficacy, fipronil, paddy leaffolder, stem borer, safety, spider and mirid bug

INTRODUCTION

Rice is the staple crop over half the world's population and it provides 27 per cent of dietary energy in the developing world. In paddy 18 to 20 species are major pests in tropical Asia. The rice leaffolder *Cnaphalocrosis medinalis* Guenee was considered as minor or sporadic pest in many Asian countries (Dale, 1994). The pest of minor importance have increased abundance in late 1980's and have become major pest in many parts of world. Cumulative effect of loss in chlorophyll reduced photosynthetic availability and altered water relations caused by the leaffolder injury lead to greater yield loss in rice (Padmavathi *et al.*, 2013).Among the major pests, rice yellow stem borer *Scirpophaga incertulus* Walker assumed the number one pest status and attack the crop at all stages of its growth (Pasalu *et al.*, 2002). It causes dead hearts at active tillering stage and white ears at harvest stage, which leads to complete failure of the crop (Kartikeyan and Purusothaman, 2000).

Though the over dependence and excessive use of chemical pesticides and resurgence of pests, destruction of natural enemies and pollution in

environment chemical control still forms the first line of defence against various insect pests of rice (Pasalu *et al.*, 2002).Several of the newer insecticides are effective against pests of rice even at low dose of active ingredient and less disruptive to the environment. Hence, attempts where made to know the bio-efficacy of newer formulations of fipronil 0.8 G against paddy leaffolder and yellow stem borer and their safety to natural enemies fauna.

MATERIAL AND METHODS

Field experiments were conducted to evaluate the bioefficacy of fipronil 0.8 G against paddy leaffloder and stemborer. The first experiment was conducted during January to April 2015 and the second experiment was conducted during October 2015 to January 2016 using the variety ADT 46 (Table 1 and 2) in Sivapuri Village at Chidambaram, Cuddalore District, Tamil Nadu India.

The experiments were laid out in a randomized block design. The plot size was 50 m^2 with the spacing of 20 × 10 cm in both the seasons. Each treatment was replicated four times.

The insecticides used in the investigation and their doses are given below

T. No	*Proprietary product*	*Doseg a.i/ ha*	*Source*
T_1	Fipronil 0.8% G	40	Sulphur Mills India Pvt Ltd., Mumbai
T_2	Fipronil 0.8% G	50	Sulphur Mills India Pvt Ltd., Mumbai
T_3	Fipronil 0.8% G	75	Sulphur Mills India Pvt Ltd., Mumbai
T_4	Fipronil 0.3% G	50	Bayer crop science., Mumbai
T_5	Fipronil 0.3% G	75	Bayer crop science., Mumbai
T_6	Untreated control	-	-

Granular application was given at 21 and 45 days after transplanting by broadcasting method.

METHOD OF ASSESSMENT

Observations on the pest population/ damage were recorded in randomly selected 10 hills per plot before and 1, 3, 5, 7, 14, 21 and 28 days after each application

Safety of Fipronil 0.8G to natural fauna of rice eco-system particularly to spiders and mirid bug was evaluated.

C. medinalis

Vegetative stage: The damage was assessed by counting total number of leaves and number of damaged / scrapped leaves on ten randomly selected hills per plot and reported as per cent damaged leaves (Bambawale *et al.*, 2011).

Reproductive stage: The damage on boot leaf was assessed by counting twenty randomly selected boot leaves per plot and the extent of damage was given by per cent boot leaf damage (Bambawale *et al.*, 2011).

S. incertulas

The damage was assessed by counting total number of tillers and number of damaged tillers on ten randomly selected hills per plot and reported as per cent dead hearts in vegetative stage and per cent white ears in reproductive stage (Bambawale *et al.*, 2011).

ASSESSMENT OF NATURAL ENEMIES

Population of natural enemies *viz.*, spider *Paradosa pseudoannulata* Boes and mirid bug *Cyrtorhinus lividepennis* Reuter was recorded in ten hills per plot

selected at random and mean population was worked out.

RESULTS AND DISCUSSION

Efficacy of fipronil 0.8 G against *C. medinalis*

The result on the effect of chemical treatment on rice leaffolder, *(Cnaphalocrocis medinalis*) (Table 1) revealed the efficacy of the different concentrations of fipronil 0.8% G, fipronil 0.3% and control.

The per cent leaf damage ranged between 10.49 and 14.44 before application. Twenty eighty days after application, fipronil 0.8% G at 75 g a.i ha^{-1} recorded the lowest per cent damage of 1.90 which wasfollowed by fipronil 0.8% at50 g a.i$\cdot ha^{-1}$ with the per cent damage of 2.89 and untreated check recorded16.16per cent during first season.

Similar trend was noticed during the second season where the per cent damage ranged between 25.80 and 42.90 before application. Twenty eight days after application fipronil 0.8% G at 75 g a.i ha^{-1} recorded the lowest per cent damage of 6.50 which wasfollowed by fipronil 0.8% at50 g a.i$\cdot ha^{-1}$ with the per cent damage of 9.24and untreated check recorded48.16per cent during second season.

Bhanu *et al.* (2015) found that fipronil 200 SC formulation was more effective against rice leaffolder at 50 g a.i ha^{-1}. The fipronil 0.3 G at 15 kg ha^{-1} on rice leaffolder was found to be more effective (Aulakh and Randhwa 2015).

The bioefficacy of fipronil 0.8 G leaffolder and stem borer was reflected in the increased yield of rice to the extent of 2.85 - 4.21 and 2.85 - 4.25 t ha^{-1} in first season and 2.42 - 4.05 and 2.99 – 4.33 t ha^{-1} in second season trials respectively. Increased in the yield as a consequence of effective control of pests had been observed on rice by (Chormule *et al.,* 2014); (Singh *et al.*, 2015); (Satyanarayana *et al.*, 2014).

The order of efficacy exhibited by insecticides against leaffolder after second application was fipronil 0.8% G (SIN1) 75 > 50g a.i ha^{-1}> fipronil 0.3% G 75 g a.i ha^{-1}> fipronil 0.8% G (SIN1) 40 g a.i ha 1 > fipronil 0.3% G 50 g a.i ha^{-1}.

Efficacy of fipronil 0.8% G against *S. incertulas*

The result on the effect of chemical treatment on rice yellow stem borer, *(Scirpophaga incertulas*) revealed the efficacy of the different concentrations of fipronil 0.8% G, fipronil 0.3% and control after application. The data on per cent damage revealed that all the insecticidal treatments recorded significantly lower per cent damage than untreated control all days.

Twenty one days after application, fipronil 0.8% G at 75 g a.i ha^{-1} recorded the lowest per cent dead heart of 3.02 per cent,which was on par with fipronil 0.8% at50 g a.i$\cdot ha^{-1}$ with the per cent dead heart of 3.31 per cent during 21 days and untreated check record 16.08 per cent respectively (Table 2).

Fipronil 0.8% G at 75 g a.i ha^{-1} highly effective in reducing theper cent damage of yellow stemborer, recording the per cent reduction over control of 83.10, which was comparable with fipronil 0.8% G 50 g a.i ha^{-1} with per cent reduction of 80.20 whichwas followed by fipronil 0 8% G at 40 g a.i ha^{-1} (76.55%). Same trend continued even after 21 days after application.

The standard checks fipronil 0.3% G 75 and 50 g a.i ha^{-1}recorded per cent reduction of 70.06 and 66.00 respectively (Table 2).

After second application, per cent damage was recorded during harvest stage. Fipronil 0.8% G at 75 g a.i ha^{-1} recorded lowest per cent damage of 2.49 which was on par with the results of fipronil 0.8% G 50g a.i ha^{-1} recorded per cent damage of 2.65, per cent control over check at harvest stage recorded 86.24 per cent and 84.39 per cent in fipronil 0.8% G at75 g a.i ha^{-1} and 50 g a.i ha^{-1} respectively (Table 2).

The standard checks fipronil 0.3% G 75 and 50 g a.i ha^{-1} recorded per cent reduction of 80.70 and 66.32 respectively (Table 2).

Singh *et al.* (2015) found that fipronil 5 SC was effective against rice yellow stem borer at 18.75 kg ha^{-1}. The efficacy of fipronil 0.6 GR at 60 g a.i ha^{-1} was found to be the most effective against yellow stem borer in rice (Satyanarayana *et al.*, 2014).

The order of efficacy exhibited by insecticides against yellow stem borer after second application was fipronil 0.8% G 75 > 50 > 40 g a.i ha^{-1}> fipronil 0.3% G 75 > 50 g a.i ha^{-1}.

Toxicity of fopronil 0.8% G to natural enemies

The effect of fipronil 0.8 G (SIN1) and fipronil 0.6 G (SIZ1) on the natural enemies was confirmed by field experiments on spiders *Paradosa pseudoannulata* Boes and mirid bugs *Cyrtorhinus lividepennis* Reuter.

The effect of fipronil 0.8 G on the spiders population per ten hills was to an extent of 1.23-2.25 nos. in first season and 5.24-6.45 nos. in second season.

The population of spiders in standard check fipronil 0.3 G to an extent of 1.23-1.98 nos. and 3.24-3.96 nos. in first season and 5.24-6.20 nos. and 1.48-1.98 nos. in second season at higher dose 75 g a.i ha^{-1} respectively.

The fipronil 5 SC at 18.75 kg ha^{-1} was found to be comparatively safer to spiders (Singh *et al.*, 2015).

The effect of fipronil 0.8 G on reduction of mirid bugs population per ten hills was to an extent of 4.97-4.20 nos. in first season and 3.72-3.38 nos. in second season.

The population of mirid bugs in standard check fipronil 0.3 G to an extent of 4.24-3.96 and 3.76-3.72 nos. in first season and 2.72-2.46 and 2.68-3.45 nos. at higher dose 75 g a.i ha^{-1} respectively.

Application of fipronil 0.8 G did not affect the natural enemies significantly. The mean population of spiders (Table 3) were 1.98 to 2.25 nos. 10 $hill^{-1}$

Table 1
Effect of Fipronil 0.8 G Against Leaf Folder *C. Medinalis*

Treatments	*Per Cent Leaf Damage of C. Medinalis*				*Yield Kg Ha⁻¹*	
	Season I		*Season II*			
	PTC	*28 DAT*	*PTC*	*28 DAT*	*Season I*	*Season II*
T_1	11.02 (3.32)^b	5.80 (2.41)^d	25.80 (5.08)^a	10.17 (3.19)^c	3500^b	3400^b
T_2	12.46 (3.53)^d	2.89 (1.70)^b	34.45 (5.87)^b	9.24 (3.04)^b	4180^c	3980^a
T_3	10.49 (3.24)^a	1.90 (1.38)^a	37.45 (6.12)^c	6.50 (2.55)^a	4215^a	4050^a
T_4	10.95 (3.31)^b	5.90 (2.43)^d	40.44 (6.36)^d	19.89 (4.46)^e	3415^c	3125^c
T_5	11.97 (3.46)^c	3.57 (1.89)^c	40.96 (6.40)^d	12.39 (3.52)^d	3600^b	3350^b
T_6	14.44 (3.80)^e	16.16 (4.02)^e	42.90 (6.55)^e	48.16 (6.94)^f	2850^d	2420^d
	0.028	0.015	0.047	0.027	–	–
	0.061	0.032	0.104	0.058	–	–

* Mean of four replications; PTC- Pre Treatment Count; DAT- Days After Treatment
Values in parentheses are $\sqrt{x}$ + 0.5 transformed values
In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 2
Effect of Fipronil 0.8 G Against Stem Borer *S. Incertulas*

Treatments	*Per Cent Dead Heart 10 Hill*[1*]						*Per Cent White Ear 10 Hill*[1*]			
	Season I			*Season II*			*Season I*		*Season II*	
	PTC	*21 Dat*	*% Roc*	*PTC*	*21 Dat*	*% Roc*	*Harvest*	*% Roc*	*Harvest*	*% Roc*
T_1	2.99 (1.73)[a]	3.61 (1.90)[c]	76.55	10.17 (3.19)[b]	3.96 (1.99)[b]	77.08	3.57 (1.89)[c]	77.16	4.75 (2.18)[c]	74.39
T_2	3.24 (1.80)[e]	3.31 (1.82)[b]	80.20	10.89 (3.30)[c]	3.20 (1.79)[a]	82.71	2.65 (1.63)[b]	84.39	2.62 (1.62)[b]	86.82
T_3	3.45 (1.86)[f]	3.02 (1.74)[a]	83.10	8.94 (2.99)[a]	3.13 (1.77)[a]	79.37	2.49 (1.58)[a]	86.24	2.49 (1.58)[a]	84.72
T_4	3.42 (1.85)[f]	6.00 (2.45)[e]	66.00	9.85 (3.14)[b]	5.38 (2.32)[d]	67.84	5.90 (2.43)[e]	65.21	6.05 (2.46)[d]	66.32
T_5	3.16 (1.78)[c]	4.88 (2.21)[d]	70.06	16.72 (4.09)[d]	5.10 (2.26)[c]	82.09	4.79 (2.19)[d]	71.04	5.90 (2.43)[d]	80.70
T_6	3.06 (1.75)[bc]	16.08 (4.01)[f]	_	8.94 (2.99)[a]	15.28 (3.91)[e]	-	16.32 (4.04)[f]	_	16.40 (4.05)[e]	-
SEd	0.016	0.010	-	0.067	0.022	-	0.013	-	0.017	-
CD	0.036	0.023	-	0.144	0.047	-	0.029	-	0.037	-

PTC- Pre Treatment Count; DAT- Days After Treatment; GFS : Grain Filling Stage; % ROC – Per cent Reduction Over Control* Data are original values
Values in parentheses are $\sqrt{x}$+0.5 transformed values
In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 3
Effect of Fipronil 0.8 G Against Natural Enemies of Rice Ecosystem

Treatments	*Spiders / 10 Plants*				*Mirid Bugs / 10 Hill*			
	Season I		*Season II*		*Season I*		*Season II*	
	PTC	*10 DAT*	*PTC*	*10 DAT*	*PTC*	*21 DAT*	*PTC*	*21 DAT*
T_1	1.23 (1.11)[b]	2.25 (1.50)[a]	4.97 (2.23)[c]	5.95 (2.44)[c]	4.24 (2.06)[b]	3.88 (1.97)[d]	2.46 (1.57)[d]	2.89 (1.70)[d]
T_2	1.48 (1.22)[a]	1.98 (1.41)[b]	5.47 (2.34)[a]	6.20 (2.49)[b]	3.45 (1.86)[d]	3.72 (1.93)[e]	3.24 (1.80)[b]	3.06 (1.75)[c]
T_3	1.23 (1.11)[b]	2.25 (1.50)[a]	5.24 (2.29)[b]	6.45 (2.54)[a]	4.97 (2.23)[a]	4.20 (2.05)[b]	3.72 (1.93)[a]	3.38 (1.84)[b]
T_4	0.98 (0.99)[c]	1.98 (1.41)[b]	4.97 (2.23)[c]	6.45 (2.54)[a]	3.96 (1.99)[c]	3.96 (1.99)[c]	2.22 (1.49)[e]	2.68 (1.64)[e]
T_5	1.23 (1.11)[b]	1.98 (1.41)[b]	5.24 (2.29)[b]	6.20 (2.49)[b]	4.24 (2.06)[b]	3.96 (1.99)[c]	2.72 (1.65)[c]	2.46 (1.57)[f]
T_6	1.23 (1.11)[b]	1.98 (1.41)[b]	4.97 (2.23)[c]	6.45 (2.54)[a]	3.24 (1.80)[e]	4.49 (2.12)[a]	3.16 (1.78)[b]	4.08 (2.02)[a]
SEd	0.008	0.007	0.017	0.022	0.010	0.015	8.44	0.009
CD	0.018	0.016	0.038	0.048	0.022	0.032	0.018	0.020

PTC - Pre Treatment Count; DAT - Days After Treatment Mean of four replications
Values in parentheses are $\sqrt{x}$ + 0.5 transformed values
In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

after first application and mean population of mirid bugs (Table 3) were 3.04 to 3.96 nos. 10 hill^{-1} after second application in treated plots during first season.

The mean population of spiders (Table 3) were 1.96 to 2.48 nos. 10 hill^{-1} after first application and mean population of mirid bugs (Table 3) were 1.96 to 3.39 nos. 10 hill^{-1} after second application in treated plots during the second season.

Effect of fipronil 0.8% G yield of rice

The data on yield (Table 1) during first season revealed the effect of fipronil 0.8% G at 75g a.i ha^{-1} recorded the highest yield of 4215 kg ha^{-1}of rice, followed by fipronil0.8% G at 50 g a.i ha^{-1} (4180 kg ha^{-1}) both were on a par with each other and superior over fipronil 0.3% 75 g a.i ha^{-1} and 50 g a.i ha^{-1} (3600 kg ha^{-1} and 3415 kg ha^{-1}) whereas, control plot recorded the lowest yield of 2850 kg ha^{-1}.

The data on yield during the second season revealed the effect of fipronil 0.6% G (SIZ1) at 75g a.i ha^{-1} recorded the highest yield of 4335 kg ha^{-1}of rice, followed by Fipronil0.6% G (SIZ1) at 50 g a.i ha^{-1} (4270 kg ha^{-1}) both were on a par with each other and superior over fipronil 0.3% 75 g a.i ha^{-1} and 50 g a.i ha^{-1} (3830 kg ha^{-1} and 3780 kg ha^{-1}) whereas, control plot recorded the lowest yield of 2420 kg ha^{-1}.

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