



EFFICACY OF NEW CHEMICAL PII 122 4% G (THIOCYCLAM HYDROGEN OXALATE 4G) IN MANAGING RICE PESTS

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Abstract:

The major production constraint of rice in enhancing productivity is due to attack by pests. Rice stem borer and leaf folder are considered as economic pests and influence the yield if proper timely management practices are not adopted. In case of severe pest incidences the usage of insecticides is inevitable. A single insecticide application may control various pest species and usually forms a persistent residue that continues to kill insects for more days after application. Many farmers are adopting combination chemicals in order to manage the various pests attack at one instance. But, regular usage of chemicals with same mode of action and in compatible insecticidal combinations may lead to pest resistance, resurgence and residual effect. Granular formulations do not blow or drift and are considered relatively safe from the standpoint of accidental human exposure. Hence, alternate chemicals in form of granular formulations which can target major pests with no phytotoxicity on crops are required. Hence, studies on efficacy pertaining to PII 122 4% G at different concentrations along with check chemicals *viz.*, cartap hydrochloride 4 G, fipronil 0.3 G and untreated control were evaluate at Agricultural Research Station, Garikapadu during *rabi* 2017-18 to assess the efficacy of various test chemicals against stem borer and leaf folder infesting rice. The experimental trial was laid out with eight treatments that were replicated thrice and two spraying were imposed during the entire crop period at tillering at panicle initiation stage. The data on per cent leaf folder damaged leaves before and at 7, 14, 21 and 28 days after application and % Dead hearts before and at 10, 20, 30 and 40 days after application and % White ears before harvest were recorded. The data was pooled and were analysed using SPSS statistical package. The results revealed that, the treatment T₇ (university standard) and T₃ (PII 122 4% G @ 500g a.i./ha) was found effective in suppressing the leaf folder and stem borer in terms of dead hearts and white ears. T₅ was also found effective in suppressing the stemborer infestation and is found on par with the efficacy of test chemical T₇ and T₃. Hence, it can be concluded that PII 122 4% G @ 500g a.i./ha is effective against stem borer and leaf

folder with no phytotoxicity on rice crop.

Keywords: PII 122 4% G, rice pests, evaluation

INTRODUCTION

Rice is the major food crop in the world and contributes 52 per cent of the total food grain production and 55 per cent of total cereal production in our country (Kakde and Patel, 2014) ^[3]. In India, rice is grown in 43.86 million ha, the production level is 104.80 million tones and the productivity is about 2390 kg ha⁻¹. In Andhra Pradesh it is cultivated in an area of 38.09 lakh ha with a production of 127.24 lakh tons and 4234 kg ha⁻¹ productivity (www. India stat.com). Insect-pests are the major constraints in enhancing the rice productivity, besides diseases and weeds (Behura *et al.* 2011) ^[1]. Approximately 21 per cent of the global production losses of rice are attributed to the attack of insect pests (Yarasi *et al.*, 2008) ^[7]. Globally, stem borer alone causes yield losses of 10 million tones and accounts 50% of all insecticide's usage in the rice field (Deka and Barthakur, 2010) ^[2]. Among stem borers, the yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) (Lepidoptera: Pyralidae) is the dominant species in India and rice plants are most prone to stem borer infestation at the tillering and flowering stages. Stem borer inflicted 18 to 40% damage to the rice crop. The rice leaffolder, *Cnaphalocrocis medinalis* (Guenee) earlier considered as a minor pest has gained the status of major pest with the widespread of high-yielding rice varieties and the accompanying changes in cultural practices (Teng *et al.* 1993) ^[5]. It was most widely spread and damage caused from 18.30 to 58.40% depending upon the stage of the crop at the time of infestation (Ramasamy and Jaliecksono 1996) ^[4].

Because of cultivating high yielding varieties year after year which are susceptible to pest attack insecticides remain as sole dependable weapon to the farmer in order to mitigate the insect population especially during epidemics. Among various insecticides, granular mode of insecticide has possession of significance since granular insecticide when is applied over the rice plant, little is deposited on the plant surface and most reaches the surface of the paddy soi 1 after falling into the irrigation water. Therefore, granular application to rice field means the application of insecticide into irrigation water or paddy soil. In recent years, the possibility of applying insecticide into soil or irrigation water of rice fields instead of spraying or dusting it over the rice plant, has been gaining importance because of their efficacy. Hence, a paid-up trial was conducted at Agricultural Research Station, Garikapadu during late *Rabi (Summer)*, 2018 to

evaluate the bioefficacy of PII 122 4% G (Thiocyclam Hydrogen Oxalate 4 G) in suppressing the economic pests of rice for effective Management of stem borer and Leaf folder.

2. Material and Methods

Experimental site

Field studies were carried out at Agricultural Research Station, Garikapadu, Krishna district, Andhra Pradesh during *Late Rabi (Summer)*, 2018 to evaluate the efficacy of PII 122 4% G (Thiocyclam Hydrogen Oxalate 4 G) at different concentrations in comparison to cartap hydroCride 4G, Fipronil 0.3 G and University standard (First spray: Acephate 75 SP @ 750 g a.i./ha; Second spray: Chlorantriliniprole 20 SP @30 g a.i./ha). The experiment was laid out in RBD design with a plot size of 5 x 5 m including eight treatments which were replicated thrice. 30 days old seedling were transplanted (line sowing) with a spacing of 15 x 15 cm. Judicious fertilizer, inter cultivation and other agronomic practices were employed as per recommendations. Rice variety BPT-5204 which is prone to all pest and disease attack was used for experimentation.

Imposition of treatments

To evaluate efficacy of PII 122 4% G, a total of eight treatments including three test chemical treatments cartap hydrochloride 4G, Fipronil 0.3 G and University standard as check and untreated control were imposed twice during the crop period (Table 1).

Table 1: Treatment (Test chemicals) details

Treat ment No		Treatment	Technical (g a.i./ha)	Formulation (Kg/ha)	Dilution (l/ha)
T1	:	PII 122 4% G	300	7.50	500
T2	:	PII 122 4% G	400	10.0	500
T3	:	PII 122 4% G	500	12.5	500
T4	:	PII 122 4% G	1000	25.0	500
T5	:	Cartap hydrochloride 4G	750	18.75	500
T6	:	Fipronil 0.3 G	75	25.0	500
T7	:	University standard: First spray: Acephate 75SP @ 750g a.i./ha Second spray: Chlorantriliniprole 20 SC @ 30g a.i./ha			500
T8	:	Untreated control	-	-	-

Meteorological data

The data on weather parameters *viz.*, maximum temperature, minimum temperature, average relative humidity and rainfall data was recorded from Meteorological unit installed at Agricultural Research Station, Garikapadu.

Data recording on pest incidence

The data on per cent Dead Hearts (DH) before and at 10, 20, 30 and 45 days after application and per cent White Ears (WE) before harvest for stem borer, and per cent number of damaged leaves per hill for leaf folder before and at 7, 14, 21 and 28 days after application of test chemicals from 20 pre tagged hills per replication were recorded as per the formulae here under.

DH per cent = $\frac{\text{Total number of dead hearts in 20 hills}}{\text{Total number of tillers in 20 hills}} \times 100$

WE per cent = $\frac{\text{Total number of white ears in 20 hills}}{\text{Total number of panicles bearing tillers in 20 hills}} \times 100$

Per cent damaged leaves = $\frac{\text{Total number of damaged leaves in 20 hills}}{\text{Total number of leaves in 20 hills}} \times 100$

The percent reduction of DH, WE and Leaf Folder damaged leaves (LFDL) over control upon imposition of various test chemicals was calculated.

Per cent reduction over control = $\frac{C-T}{C} \times 100$

Where C= pest incidence in control; T=pest incidence in treatment

Influence on Natural enemies

The effect of various treatments (test chemicals) on natural enemies (spiders and mirid bugs) after pre and post application during second spray was recorded from 20 hills at intervals before, 1,5,10 and 15 days after second spray was recorded.

Phytotoxicity

The crop response or injury for yellowing, stunting, necrosis, epinasty, hyponasty were recorded in all the treatments and phytotoxicity rating was recorded basing on phytotoxicity scale (Table 2).

Table 2: Phytotoxicity scale based on crop injury

Scale	Crop injury (%)
0	0
1	1-10

2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

Yield data

Plot-wise yields were also recorded after removing the two border rows and marked hills from each plot and expressed in Kg ha⁻¹.

Data analysis

The recorded data was transformed with suitable transformation method before analysis (Gomez and Gomez, 2002) and subjected to analysis of variance. Significant differences in means were separated using Duncan's multiple range test (P= 0.05).

3. Results and discussions:

3.1. Meteorological data

During the year 2017-18, the average maximum (40.5^oC) and minimum temperature (18.0^oC) was recorded during May and February, 2018 respectively. The annual rainfall was 770 mm with 47 rainy days (Table 3).

Table 3: Meteorological Data-Agricultural Research Station, Garikapadu – 2017-18

Month and year	Temperature (°c)		Humidity (%)	Rainfall (mm)	Rainy days
	Max	Min			
June 2017	36.0	22.9	80.7	159.8	7
July 2017	33.9	22.0	79.0	214.6	12
August 2017	32.8	23.0	85.2	185.7	10
September 2017	33.2	24.7	84.9	58.8	9

October 2017	33.2	23.4	87.2	105.0	5
November 2017	32.3	21.2	85.9	-	-
December 2017	31.1	17.6	85.5	-	-
January 2018	31.0	18.1	79.0	-	-
February 2018	32.0	18.0	76.5	-	-
March 2018	35.0	21.5	98.2	10.0	1
April 2018	38.2	26.0	92.0	12.0	1
May 2018	40.5	27.3	75.1	24.0	2
Total				769.9	47

Efficacy of test chemicals on incidence of rice stem borer

The yellow stem borer incidence in terms of per cent dead hearts during the entire crop period ranged from 0 to 28.5 per cent. The first spray was initiated 35 days after transplantation where the crop is at active tillering stage and the per cent DH were found to be 11-13%. At 10 and 20 days after application (DAA) of test chemicals, the results revealed that, among all the T₇ (University standard) and T₃ (PII 122 4% G @ 500g a.i./ha) were found superior over other treatments with 6.5 &

6.8 and 3.0 & 3.2 per cent dead hearts respectively. Similar trend was also noticed at 30 and 40 days after application of treatments. T₇ and T₃ has recorded 1.3 & 0 and 1.5 & 0 % DH at 30 and 40 DAA.

During second spray (45 days after first spray) also among all the treatments, T₇ (University standard) and T₃ (PII 122 4% G @ 500g a.i./ha) has recorded significant superiorly over other treatments with 9.0 & 9.1, 6.8 & 6.5, 3.5 & 3.2, 1.0 & 1.2 and

1.6 & 1.5 per cent dead hearts at 10, 20, 30 and 40 DAA. The treatment T₅ (cartap hydrochloride 4G @ 750 g ai./ha) also found to be superior over other treatments and is on par with T₇ and T₃ with respect to per cent dead hearts both after first and second application of treatments (Table 4).

The per cent white ears before harvest was recorded and the results inferred that T₇ and T₃ were found better and on par to each other with 1.6 and 1.5 per cent as against control with 33.5 per cent white ears.

Table 4: Efficacy of various test chemicals on incidence of rice yellow stem borer pests during *Late Rabi (Summer), 2018*

Treatments	First spray					Second spray					%WE Before harvest
	%DH					%DH					
	Before	10D AA	20D AA	30D AA	45 DA A	Before	10D AA	20D AA	30D AA	45 DA A	
T ₁	12.8 (20.96)	9.5 (17.95)	8.0 (16.43)	5.3 (13.31)	4.5 (12.25)	13.5 (21.56)	9.5 (17.95)	8.2 (16.64)	6.8 (15.12)	5.5 (13.56)	3.8 (11.24)
T ₂	13.5 (21.56)	8.0 (16.43)	5.5 (13.56)	3.8 (11.24)	3.0 (9.97)	16.8 (24.20)	8.8 (17.26) ^a	8.0 (16.43)	6.0 (14.18)	3.8 (11.24)	2.8 (9.63)
T ₃	13.0 (21.13)	6.8 (15.12) ^a	3.2 (10.30) ^a	1.5 (7.03) ^a	0 (0.0) ^a	14.5 (22.38)	9.1 (17.56) ^a	6.5 (14.77) ^a	3.2 (10.30) ^a	1.2 (6.29) ^a	1.5 (7.03) ^a
T ₅	12.4 (20.62)	7.1 (15.45) ^a	4.0 (11.54)	2.5 (9.10)	1.0 (5.74)	13.0 (21.13)	12.5 (20.70)	7.2 (15.56) ^a	5.0 (12.92)	2.0 (8.13)	3.5 (10.78)
T ₆	11.0 (19.37)	10.5 (18.91)	9.5 (17.95)	6.8 (15.12)	8.5 (16.95)	14.2 (22.14)	13.0 (21.13)	11.5 (19.82)	8.8 (17.26)	3.5 (10.78)	8.5 (16.95)
T ₇	14.5 (22.38)	6.5 (14.77) ^a	3.0 (9.98) ^a	1.3 (6.55) ^a	0 (0.0) ^a	14.0 (21.97)	9.0 (17.46) ^a	6.8 (15.12) ^a	3.5 (10.78) ^a	1.0 (5.74) ^a	1.6 (7.27) ^a
T ₈	12.5 (20.70)	18.4 (25.40)	13.5 (21.56)	15.8 (23.42)	18.5 (25.47)	13.5 (21.56)	18.5 (25.47)	20.4 (26.85)	22.5 (28.32)	28.5 (32.27)	33.5 (35.37)
CD	NS	0.30	0.28	0.42	0.11	NS	0.19	0.54	0.33	0.52	0.21
CV		18.32	16.55	15.95	10.56		12.55	19.58	23.56	14.58	16.51

Efficacy of test chemicals on infestation by leaf folder The leaf folder infestation in terms of per cent damaged leaves was recorded and data after 7 days of first application inferred that, among all the test applications T₃, T₅, T₆ and T₇ has harboured less per cent damage with 5.5, 6.5, 6.5 and 6.2 per cent respectively. At 14, 21 and 28 days after imposition of first spray T₃ (PII 122 4% G @ 500g a.i./ha) and T₇ (University standard) has recorded less leaf folder damage leaves with 3.4 & 3.2, 2.0 & 2.0, 0.0 & 0.0 per cent respectively. After second application also similar trend was recorded where in T₇ (University standard) and T₃ (PII 122 4% G @ 500g a.i./ha) has recorded nil infestation at 21 days after application. At 7 and 14 DAA the lowest infestation was recorded in T₃ and T₇ with 4.8 & 4.8 and 2.1 & 2.0 as against T₈ (untreated control) with 15.5 and 18.5 per cent LFDL (Table 5).

Table 5: Efficacy of various test chemicals on per cent damage by leaf folder during *Late Rabi* (Summer), 2018

Treatments	First spray					Second spray				
	Before	7DA	14D	21DA	28	Before	7DA	14D	21D	28
	A	AA	A	DAA		A	AA	AA	DAA	
T1	11.5 (19.8 2)	8.5 (16.9 5)	7.5 (15.8 9)	5.2 (13.1 8)	4.8 (12.6 6)	12.8 (20.9 6)	6.5 (14.7 7)	5.8 (13.9 4)	4.8 (12.6 6)	3.8 (11.2 4)
T2	13.8 (21.8 1)	7.4 (15.7 9)	6.8 (15.1 2)	5.0 (12.9 2)	2.8 (9.63)	11.5 (19.8 2)	5.8 (13.9 4)	5.0 (12.9 2)	3.2 (10.3 0)	1.8 (7.71)
T3	12.8 (20.9 6)	5.5 (13.5 6) ^a	3.2 (10.3 0) ^a	2.0 (8.1 3) ^a	0.0 (0.0) ^a	12.0 (20.2 7)	4.8 (12.6 6) ^a	2.1 (8.33) ^a	1.0 (5.74)	0 (0.0)
T5	10.8 (19.1 9)	6.5 (14.7 7) ^a	4.8 (12.6 6)	3.8 (11.2 4)	2.8 (9.63)	13.5 (21.5 6)	6.8 (15.1 2)	5.0 (12.9 2)	3.0 (9.97)	1.5 (7.03)
T6	13.0 (21.1 3)	6.5 (14.7 7) ^a	5.3 (13.3 1)	2.4 (8.9 1) ^a	2.5 (9.10)	11.5 (19.8 2)	4.0 (11.5 4)	3.7 (11.0 9)	2.5 (9.10)	1.8 (7.71)
T7	11.2 (19.5 5)	6.2 (14.4 2) ^a	3.4 (10.6 3) ^a	2.0 (8.1 3)	0.0 (0.0) ^a	14.5 (22.3 8)	4.8 (12.6 6) ^a	2.0 (8.13) ^a	0.0 (0.0)	0 (0.0)
T8	15.5 23.18)	13.5 (21.5 6)	19.5 (26.2 1)	21.5 (27.6 2)	23.5 (29.0 0)	13.0 (21.1 3)	15.5 (23.1 8)	18.5 (25.4 7)	21.8 (27.8 3)	25.8 (30.5 3)
CD	NS	0.88	0.31	1.19	0.48	NS	1.19	0.21	2.38	5.48
CV		18.9	16.3	28.4	16.5		18.5	19.8	21.2	12.58

*values in parenthesis are arc sine transformations. DAA=Days after application T1: PII 122

4%G @ 300g ai/ha T7: University standard:

First spray: Acephate 75SP @ 750g a.i./ha

Second spray: Chlorantriliprole 20 SC @ 30 g a.i./ha T2: PII 122 4%G @ 400g ai/ha

T3: PII 122 4%G @ 500g ai/ha

T5: Cartap hydrochloride 4G @ 750g ai/ha T8: Untreated control T6: Fipronil 0.3 G @ 75 g ai/ha

Efficacy of test chemicals (pooled mean) in terms of per cent reduction over control

The pooled mean in terms of per cent reduction over control of stem borer inferred that, all the test chemicals were superior in suppressing the stem borer infestation both in terms of per cent dead hearts and white ears. The order of efficacy of various treatments at 40 days after application of test chemicals with respect to per cent dead hearts represents $T_7 (99.80) > T_3 (97.45) > T_5 (93.62) > T_2 (85.53) > T_1 (78.72) > T_6 (74.50)$. The order with respect to % WE before harvest represents $T_7 (94.30) \geq T_3 (94.30) > T_5 (83.67) > T_2 (85.53) > T_1 (76.33) > T_6 (64.90)$. With respect to leaf folder infestation all the treatments has recorded above 90 per cent reduction over control except $T_1 (82.56\%)$. The treatments T_7 and T_3 has exhibited cent per cent reduction over control at 28 DAA as there is nil incidence from 20 days after second spray (Table 6)

Table 6: Efficacy of various test chemicals on incidence of stem borer and leaf folder rice in terms of per cent reduction over control during *Late Rabi (Summer)*, 2018 (Pooled mean)

Treatments	Stem borer (%ROC)				LF(DL)	
	% DH 40 DAA	% R O C	%WE Before harvest	% R O C	28 DAA LF(DL)	%R O C
T1	5.0 (12.92)	78.72	5.8 (13.94)	76.33	4.3 (11.97)	82.56
T2	3.4 (10.63)	85.53	4.3 (11.97)	82.45	2.3 (8.72)	90.67
T3	0.6 (4.44)	97.45	1.4 (6.80)	94.30	0 (0.0)	100
T5	1.5 (7.03)	93.62	4.0 (11.54)	83.67	2.15 (8.43)	91.28
T6	6.0 (14.18)	74.50	8.6 (17.05)	64.90	2.15 (8.43)	91.28
T7	0.5 (4.05)	99.80	1.4 (6.80)	94.30	0 (0.0)	100
T8	23.5 (29.0)	-	24.5 (29.67)	-	24.65 (29.77)	-
CD	0.38		0.28		1.25	
CV	21.56		12.89		16.65	

*values in parenthesis are arc sine transformations. DAA=Days after application; % ROC:

per cent reduction over control. T1: PII 122 4%G @ 300g ai/ha T7: University standard:

First spray: Acephate 75SP @ 750g a.i./ha

Second spray: Chlorantriliprole 20 SC @ 30 g a.i./ha T2: PII 122 4%G @ 400g ai/ha

T3: PII 122 4%G @ 500g ai/ha

T5: Cartap hydrochloride 4G @ 750g ai/ha T8: Untreated control T6: Fipronil 0.3 G @ 75 g ai/ha

Influence of various treatments on natural enemies population

The population of predatory spiders and mirid bugs were recorded from each plot and the mean population inferred that there is no significant difference among various treatments and all are found on par to each. It was apparent from the results that, the application of PII 122 4% G treated plots did not cause any adverse effects to natural enemies (Table 7).

Table 7: Influence of various test chemicals on population of natural enemies in rice during *Late Rabi (Summer)*, 2018 (after second spray)

Treatments	Spiders (No./10hill)					Mirid bugs (No./10hill)				
	Before	1DA	5DA	10D	15D	Before	1DA	5DA	10D	15D
T ₁	8.8 (17.26)	7.8 (16.22)	8.8 (17.26)	5.3 (13.31)	8.3 (16.74)	10.6 (19.00)	8.4 (16.85)	2.5 (9.10)	2.0 (8.13)	9.5 (17.95)
T ₂	9.3 (17.76)	8.0 (16.43)	9.1 (17.56)	4.4 (12.11)	7.8 (16.22)	11.8 (20.09)	9.0 (17.46)	5.1 (13.05)	9.8 (18.24)	9.6 (18.05)
T ₃	9.8 (18.24)	8.8 (17.26)	7.8 (16.22)	5.2 (13.18)	6.8 (15.12)	11.5 (19.82)	9.4 (17.85)	4.8 (12.66)	8.8 (17.26)	8.9 (17.36)
T ₅	8.8 (17.26)	5.8 (13.94)	5.0 (12.92)	4.9 (12.79)	4.8 (12.66)	6.5 (14.77)	5.5 (13.56)	4.8 (12.66)	3.5 (10.78)	4.0 (11.54)
T ₆	9.5 (17.95)	6.3 (14.54)	7.5 (15.89)	6.8 (15.12)	9.5 (17.95)	10.8 (19.19)	9.0 (17.46)	3.5 (10.78)	6.8 (15.12)	4.5 (12.25)

T ₇	9.4 (17.85)	4.8 (12.66)	6.8 (15.12)	5.0 (12.92)	8.6 (17.05)	10.0 (18.43)	7.8 (16.22)	6.0 (14.18)	6.2 (14.42)	4.0 (11.54)
T ₈	9.4 (17.85)	6.0 (14.18)	8.3 (16.74)	6.2 (14.42)	8.5 (16.95)	11.8 (20.09)	9.3 (17.76)	6.2 (14.42)	5.9 (14.06)	8.8 (17.26)
T ₁	9.3 (17.76)	9.8 (18.24)	9.0 (17.46)	5.4 (13.44)	6.4 (14.65)	13.0 (21.13)	6.9 (15.23)	6.8 (15.12)	4.6 (12.38)	9.1 (17.56)
T ₂	9.0 (17.46)	9.0 (17.46)	12.5 (20.70)	6.8 (15.12)	11.8 (20.09)	12.5 (20.70)	11.8 (20.09)	11.0 (19.37)	9.8 (18.24)	9.8 (18.24)
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV										

≠values in parenthesis are square root transformations DAA=Days after application.

4. Phytotoxicity

The results showed that PII 122 4% G @ 500 and 1000 g a.i ha⁻¹ have not shown any phytotoxic symptoms like Leaf injury on tips and leaf surface, Wilting, Leaf vein clearing, Necrosis, Epinasty and Hyponasty in any of the doses and treatments tested in rice crop. PII 122 4% G was tested for phytotoxicity at all the doses and was also proven safe to rice crop during entire crop season (Table 8).

Table 8: Impact of PII 122 4 % G on Phytotoxicity effect on Rice crop during *Late Rabi* (Summer), 2017-18

Treatments	Dose (g ai/ha)	Score values on					
		1 DAA	3 DAA	5 DAA	7 DAA	10 DAA	15 DAA
T1: Untreated check	---						
T3: PII 122 4% G	500g						

infestation and is found on par with the efficacy of test chemical T₇ and T₃. Hence, it can be concluded that PII 122 4% G @ 500g a.i./ha is effective against stem borer and leaf folder with no phytotoxicity on rice crop.

7. References

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