The Andhra Agric. J 65 (1): 132-137, 2018

Evaluation of certain newer insecticides against Rice leaf folder, (*Cnaphalocrosis medinalis*) Guenee (Lepidoptera: Pyralidae)

K Appala Raju, P V Krishnayya, D V Sai Ram Kumar, B Krishnaveni and V Manoj Kumar
Department of Entomology, Agricultural College, Bapatla, Guntur Dt., 522 101. Andhra Pradesh.

ABSTRACT

A field trail was conducted at Agricultural College Farm, Bapatla during *kharif* 2015 to evaluate the efficacy of flubendiamide 480 SC, chlorpyriphos 20 EC, dinotefuran 20 SG, acephate 95 SC, *chlorantraniliprole* 18.5 SC, cyantraniliprole 10 OD, fipronil 5 SC, cartap hydrochloride 50 SP and untreated control against rice leaf folder in rice ecosystem. The pooled data on leaf folder inferred that flubendiamide 480 SC @ 0.2 ml l^{-1} recorded the lowest per cent leaf folder damage and the highest per cent reduction over untreated control against leaf folder damage after three sprays followed by cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6) and *chlorantraniliprole* 18.5 SC (T_5) @ 0.3 ml l^{-1}. All other insecticides are significantly superior over untreated control.

Key words: *chlorantraniliprole, cyantraniliprole, efficacy, flubendiamide, Rice leaf folder.*

Rice (*Oryza sativa* L.) belongs to the family of grasses (Poaceae), Which is one of the most important cereal crop worldwide. It is the staple food for more than two billion people in developing countries (FAO, 1995). In India, farmers grow many kinds of cereals in an area of 53.87 M ha with an annual production of 110.74 M t. Among them, the rice is grown in an area of 44.6 M ha with an annual production of 90 M t, which constitutes 52 per cent of total food grain production. In Andhra Pradesh, rice is grown in an area of 3.5 M ha with the production of 11.17 M t (Directorate of Economics & Statistics, 2013).

Insect pests are the major biotic constraints in enhancing rice productivity that cause 20-30 per cent losses every year, besides diseases and weeds. The warm and humid climate of tropics is quite congenial for the outbreak of insect pests. Nearly 300 species of insect pests are attacking the paddy crop at various stages. Among the insect pests, only 23 species are causing notable damage (Pasalu and Katti, 2006).

Generally lepidopteran insect pests cause significant damage to crop plant yields. The rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) (Lepidoptera: Pyralidae), is a predominant foliage feeder and one of the most destructive pests affecting in all the rice ecosystems of Asia**.** The yield loss is from 30 to 80 per cent due to leaf folder epidemic situation (Raveeshkumar, 2015).

Second instar leaf folder larvae glue to the growing paddy leaves longitudinally for shelter and feed voraciously on green foliage which results in papery dry leaves. Feeding on paddy leaves often results in stunting, curling or yellowing of plant green foliage. Severe infestations may annihilate the plant totally. Losses that incurred to the growing paddy crop are irrevocable (Yaspal Singh *et al.,* 2015).

While the use of insecticides remains an important component and used as a last resort of Integrated Pest Management (IPM), due to continuous usage, some of the conventional insecticides became ineffective, and hence efforts should be continued to generate information on the field efficacy of new generation low dose molecules with novel mode of action against the major insect pests of rice including rice leaf folder, *C. medinalis*.

Therefore the present investigation was carried out to evaluate new insecticides against rice leaf folder infesting rice.

MATERIAL AND METHODS

Field experiment was conducted in Agricultural College Farm, Bapatla during *kharif* 2015 in Randomized Block Design (RBD) with nine

treatments including untreated control replicated thrice. The insecticide treatments includes flubendiamide 480 SC @ 0.2 ml l^{-1} (T_1), chlorpyriphos 20 EC (T_2) @ 2.5 ml l^{-1}, dinotefuran 20 SG @ 0.4 g l^{-1} (T_3), acephate 95 SC (T_4) @ 1.5 ml l^{-1}, chlorantraniliprole 18.5 SC (T_5) @ 0.3 ml l^{-1}, cyantraniliprole 10 OD (T_6) @ 1.2 ml l^{-1}, fipronil 5 SC @ 1.2 ml l^{-1} (T_7) and cartap hydrochloride 50 SP @ 2 g l^{-1} (T_8) along with untreated control (T_9).

The leaf folder susceptible variety BPT-5204 (Samba Mahsuri) was grown in plot of size 20 m^2 at spacing of 20x15 cm with recommended package of practices excluding plant protection. Sprayings were given by using a hand compression knapsack high volume sprayer during morning hours. The required spray fluid per each plot is one litre. The plot in each treatment was sprayed with respective insecticides ensuring uniform coverage of insecticide. The treatments were imposed as and when the pest reaches ETL. The data was recorded on the per cent leaf damage by leaf folder in 10 randomly selected hills from each plot were recorded at one day before the application of treatments and 2,7 and 15 DAS (Days After Spray). A total of three sprays are imposed at 30, 50 and 70 DAT (Days After Transplanting).

These percentages were transformed to the corresponding Arc sin values and subjected to ANOVA and those mean values are compared by using Least significant difference (LSD). The per cent reduction of leaf folder damage over control at each count also calculated by using Abott's formula as given by Fleming and Retnakaran (1985).

RESULTS AND DISCUSSION

There was no significant difference in per cent leaf folder damage among the treatments before the application of treatments. The data on the efficacy of the treatments after the three sprays were presented in table 1 & table 2.

The mean leaf folder per cent damage after the first spray (5.87 to 20.02%) was the lowest (5.87%) in flubendiamide 480 SC @ 0.2 ml l^{-1} (T_1) (70.05% reduction over control) followed by cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6) (7.05%) (66.09%), fipronil 5 SC @ 1.2 ml l^{-1} (T_7) (7.12%) (64.18%) and chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} (T_5) (7.27%) (65.17%). The next best treatments were cartap hydrochloride 50 SP @ 2 g l^{-1} (T_8) (7.58%) (61.81%), acephate 95 SC @ 1.5 ml l^{-1} (T_4) (9.38%) (49.14%) and chlorpyriphos 20 EC @ 2.5 ml l^{-1} (T_2) (10.19%) (48.81%). Among the insecticidal treatments dinotefuran 20 SG @ 0.4 g l^{-1} (T_3) recorded the highest (14.06%) mean leaf folder per cent damage and lowest (30.08%) mean per cent reduction over untreated control.

At the time of second spray (50 DAT) the per cent leaf folder damage varied between 10.66 to 24.66 (Pretreatment count) and there was a significant difference among insecticidal treatments.

The mean leaf folder per cent damage after the second spray (5.03 to 26.16%) was lowest (5.03%) in flubendiamide 480 SC @ 0.2 ml l^{-1} (T_1) (55.19% reduction over control) followed by chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} (T_5) (7.15%) (39.75%), cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6) (7.47%) (37.78%) and fipronil 5 SC @ 1.2 ml l^{-1} (T_7) (7.99%) (40.95%). The next best treatments were cartap hydrochloride 50 SP @ 2 g l^{-1} (T_8) (8.27%) (36.00%), acephate 95 SC @ 1.5 ml l^{-1} (T_4) (9.19%) (33.75%) and chlorpyriphos 20 EC @ 2.5 ml l^{-1} (T_2) (10.02%) (27.22%). Among the insecticidal treatments dinotefuran 20 SG @ 0.4 g l^{-1} (T_3) was recorded with the highest (15.81%) mean leaf folder per cent damage and the lowest (13.75%) mean per cent reduction over untreated control.

At the time of third spray (50 DAT) the per cent leaf folder damage varied between 10.15 to 23.66 (Pretreatment count) and there was a significant difference among insecticidal treatments.

The mean leaf folder per cent damage after the third spray (3.90% to 25.60%) was the lowest (3.90%) in flubendiamide 480 SC @ 0.2 ml l^{-1} (T_1) (64.37% reduction over control) followed by chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} (T_5) (6.76%) (47.52%), cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6) (7.00%) (49.91%) and fipronil 5 SC @ 1.2 ml l^{-1} (T_7) (8.18%) (43.88%). The next best treatments were cartap hydrochloride 50 SP @ 2 g l^{-1} (T_8) with (8.74%) (37.03%), acephate 95 SC @ 1.5 ml l^{-1} (T_4) (9.27%) (36.59%) and chlorpyriphos 20 EC @ 2.5 ml l^{-1} (T_2) (10.05%) (31.66%). Among the insecticidal treatments dinotefuran 20 SG @ 0.4 g l^{-1} (T_3) was recorded with the highest (17.19%) mean leaf folder per cent damage and the lowest (8.41%) mean per cent reduction over untreated control.

The data pertaining to the overall mean per cent leaf folder damage and reduction over untreated control of the treatments after the imposition of three sprays revealed that the most effective and the best treatment was flubendiamide

Table 1: Per cent leaf folder damage of different insecticides after three sprays against rice leaf folder, *Cnaphalocrocis medinalis, kharif* 2015

Treatment	I spray					II spray					III spray				
	PRE COUNT	2 DAS	7 DAS	15 DAS	Mean	PRE COUNT	2 DAS	7 DAS	15 DAS	Mean	PRE COUNT	2 DAS	7 DAS	15 DAS	Mean
T1 Flubendiamide 480 SC@ 0.2 ml l^{-1}	14.38 (21.46)	7.39 (15.38)^{a}	5.30 (12.88)^{a}	4.49 (11.91)^{a}	5.87 (13.71)^{a}	10.66 (18.67)^{a}	6.66 (14.60)^{a}	4.93 (12.24)^{a}	3.49 (10.55)^{a}	5.03 (12.58)^{a}	10.15 (17.97)^{a}	5.07 (12.74)^{a}	3.57 (10.58)^{a}	3.06 (9.79)^{a}	3.90 (11.11)^{a}
T2 Chlorpyriphos 20 EC @ 2.5 ml l^{-1}	14.47 (21.52)	11.42 (19.12)^{bc}	9.84 (17.75)^{bc}	8.67 (16.63)^{b}	10.19 (18.06)^{cd}	13.04 (20.43)^{a}	11.70 (19.35)^{b}	9.84 (17.75)^{b}	8.50 (16.46)^{d}	10.02 (17.87)^{d}	13.63 (20.89)^{bc}	11.84 (19.46)^{c}	9.32 (17.25)^{b}	8.99 (16.91)^{c}	10.05 (17.90)^{d}
T3 Dinotefuran 20 SG @ 0.4 g l^{-1}	1 4.72 (21.71)	13.12 (20.49)^{cd}	14.07 (21.19)^{cd}	15.5 (22.25)^{c}	14.06 (21.22)^{d}	17.35 (23.57)^{b}	17.55 (23.71)^{c}	17.89 (23.92)^{c}	18.30 (24.16)^{e}	15.81 (22.48)^{e}	17.35 (23.57)^{cd}	17.67 (23.87)^{d}	17.89 (23.91)^{c}	16.01 (22.59)^{b}	17.19 (23.46)^{e}
T4 Acephate 95 SC @ 1.5 ml l^{-1}	13.73 (20.96)	11.39 (19.09)^{bc}	8.36 (16.27)^{ab}	8.43 (16.34)^{b}	9.38 (17.33)^{cd}	13.16 (20.53)^{a}	11.50 (19.18)^{b}	8.09 (16.03)^{ab}	7.97 (15.89)^{cd}	9.19 (17.09)^{cd}	13.56 (20.83)^{bc}	11.7 (19.35)^{c}	8.20 (16.15)^{b}	7.91 (15.83)^{c}	9.27 (17.16)^{cd}
T5 Chlorantraniliprole 18.5 SC @0.3 ml l^{-1}	13.78 (21.00)	7.56 (15.56)^{a}	6.50 (14.01)^{a}	5.23 (12.78)^{a}	7.27 (15.25)^{b}	11.28 (21.00)^{a}	9.66 (17.59)^{b}	6.87 (14.54)^{ab}	4.91 (12.43)^{b}	7.15 (14.99)^{b}	11.91 (19.52)^{ab}	8.14 (16.14)^{ab}	6.87 (14.54)^{ab}	5.25 (12.83)^{ab}	6.76 (14.50)^{b}
T6 Cyantraniliprole 10 OD @1.2 ml l^{-1}	15.24 (22.09)	8.12 (16.12)^{ab}	6.86 (14.71)^{ab}	5.83 (13.52)^{ab}	7.05 (15.02)^{b}	11.40 (19.00)^{a}	9.83 (17.54)^{b}	7.00 (14.93)^{ab}	5.49 (13.18)^{bc}	7.47 (15.35)^{bc}	12.93 (20.34)^{ab}	8.21 (16.21)^{abc}	6.91 (14.75)^{ab}	5.87 (13.65)^{abc}	7.00 (14.93)^{b}
T7 Fipronil 5 SC @ 1.2 ml l^{-1}1	4.92 (21.85)	8.32 (16.31)^{ab}	7.05 (14.92)^{ab}	6.20 (14.00)^{ab}	7.12 (15.10)^{b}	12.85 (20.28)^{a}	10.44 (18.28)^{b}	7.46 (15.40)^{ab}	6.06 (13.81)^{bc}	7.99 (15.89)^{bc}	13.52 (20.80)^{c}	10.96 18.73)^{abc}	7.46 (15.40)^{ab}	6.12 (13.89)^{abc}	8.18 (16.06)^{bc}
T8 Cartap hydrochloride 50 SP @2 g l^{-1}	14.89 (21.83)	8.45 (16.45)^{ab}	7.75 (15.66)^{ab}	6.86 (14.71)^{ab}	7.58 (15.57)^{c}	12.26 (19.81)^{a}	10.64 (18.45)^{b}	7.75 (15.66)^{ab}	6.40 (14.19)^{bcd}	8.27 (16.18)^{bcd}	12.87 (20.30)^{ab}	11.03 (18.79)^{bc}	8.01 (15.93)^{ab}	7.19 (15.15)^{bc}	8.74 (16.66)^{bc}
T9 Control (Untreated)	14.39 (21.47)	16.87 (23.24)	19.27 (25.82)^{d}	24.31 (27.89)^{d}	20.02 (25.32)^{e}	24.66 (28.01)^{c}	25.00 (28.29)^{d}	27.00 (29.38)^{d}	26.46 (29.07)^{f}	26.16 (28.94)^{f}	23.66 (27.53)^{d}	25.00 (28.29)^{e}	26.67 (29.18)^{d}	25.13 (28.32)^{e}	25.60 (28.63)^{f}
CD (P=0.05)	NS	3.31	3.70	3.37	2.94	2.98	2.56	3.78	2.88	1.95	2.72	2.95	3.78	3.03	1.53
CV	_	10.50	12.60	11.70	9.36	7.56	7.53	12.00	10.00	12.21	7.40	8.88	12.11	12.00	11.75
SEm	_	1.11	1.23	1.12	0.93	0.91	0.85	1.26	0.96	0.61	0.90	0.99	1.26	1.11	0.49
SED	_	1.16	1.74	1.5	1.32	1.29	1.21	1.79	1.36	0.86	1.28	1.39	1.79	1.57	0.70

Figures in parentheses are arc sin transformed values

NS- Non Significant

Values with similar alphabets in each column do not vary significantly at 5% level

Table 2: Per cent reduction of leaf folder damage over untreated control of after three sprays against rice leaf folder, *Cnaphalocrocis medinalis, kharif* 2015

Tr.		I spray				II spray				III spray			
No	Treat ments	2 DAS	7 DAS	15 DAS	Mean	2 DAS	7 DAS	15 DAS	Mean	2 DAS	7 DAS	15 DAS	Mean
T1	Flubendiamide 480 SC @ 0.2 ml l^{-1}	56.16 (48.54)	72.47 (58.35)	81.51 (64.53)	70.05 (57.14)^{a}	38.33 (38.25)	57.78 (49.48)	69.45 (56.45)	55.19 (48.05)^{a}	52.70 (46.55)	68.79 (56.04)	71.62 (57.81)	64.37 (53.46)^{a}
T2	Chlorpyriphos 20 EC @ 2.5 ml l^{-1}	32.68 (34.87)	49.21 (44.55)	64.53 (53.45)	48.81 (44.28)^{c}	11.42 (19.75)	31.01 (33.84)	39.23 (38.78)	27.22 (30.79)^{c}	17.77 (24.93)	39.31 (38.83)	37.91 (38.00)	31.66 (33.92)^{d}
T3	Dinotefuran 20 SG @ 0.4 g l^{-1}	23.97 (29.31)	28.62 (32.34)	37.66 (37.86)	30.08 (33.17)^{d}	7.33 (15.71)	5.91 (30.60)	14.00 (21.97)	13.75 (22.75)^{d}	3.61 (10.95)	8.51 (16.96)	13.11 (21.23)	8.41 (16.38)^{e}
T4	Acephate 95 SC @ 1.5 ml l^{-1}	29.23 (32.73)	54.53 (47.60)	63.65 (52.92)	49.14 (44.41)^{c}	13.82 (21.82)	43.87 (41.88)	43.56 (41.30)	33.75 (34.86)^{bc}	18.34 (25.36)	46.32 (42.89)	45.11 (42.19)	36.59 (36.81)^{cd}
T5	Chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1}	53.20 (46.83)	64.77 (53.59)	77.53 (61.70)	65.17 (54.04)^{ab}	15.47 (23.16)	44.35 (41.76)	59.44 (50.44)	39.75 (38.45)^{b}	35.28 (36.44)	48.80 (44.31)	58.48 (49.88)	47.52 (43.54)^{b}
T6	Cyantraniliprole 10 OD @ 1.2 ml l^{-1}	54.55 (47.61)	66.38 (54.56)	77.35 (61.58)	66.09 (54.58)^{ab}	14.94 (22.74)	43.24 (41.11)	55.14 (47.95)	37.78 (37.26)^{b}	39.86 (39.15)	52.58 (46.48)	57.29 (49.19)	49.91 (44.94)^{b}
T7	Fipronil 5 SC @ 1.2 ml l^{-1}	52.43 (46.39)	64.71 (55.55)	75.40 (60.27)	64.18 (53.40)^{b}	19.86 (26.46)	46.98 (43.27)	56.01 (48.45)	40.95 (39.39)^{b}	23.24 (28.82)	51.03 (45.59)	57.38 (49.24)	43.88 (41.21)^{bc}
T8	Cartap hydrochloride 50 SP @ 2 g l^{-1}	51.59 (45.91)	61.13 (51.43)	72.72 (58.51)	61.81 (51.95)^{b}	14.42 (22.32)	42.23 (40.53)	51.35 (45.77)	36.00 (36.20)^{bc}	18.89 (25.76)	44.80 (42.02)	47.41 (43.52)	37.03 (37.09)^{cd}
T9	Control (Untreated)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	(0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	CV(%)	—	—	—	5.73	—	—	—	13.30	—	—	—	9.36
	SEm	—	—	—	1.25	—	—	—	2.25	—	—	—	1.64
	SED	—	—	—	1.77	—	—	—	3.18	—	—	—	2.32
	CD (P=0.05)	—	—	—	3.70	—	—	—	6.42	—	—	—	4.63

Figures in parentheses are arc sin transformed values

Values with similar alphabets in each column do not vary significantly at 5% level

Table 3: Effect of insecticidal treatments on yield of rice and their Cost Benefit Ratio, *kharif* 2015

Tr. No.	Treatments	Yield/ Plot (kg)	Yield / ha (kg)	Yield increased over control	Gross Income (Rs)	Net income (Rs)	Total cost (Rs)	CB ratio
T1	Flubendamide 480 SC @ 0.2 ml l^{-1}	8.83^{a}	4415^{a}	56.63	59603	34943	24660	1.42
T2	Chlorpyriphos 20 EC @ 2.5 ml l^{-1}	7.06^{cd}	3530^{cd}	24.85	47655	23395	24260	0.91
T3	Dinotefuran 20 SG @ 0.4 g l^{-1}	6.03^{de}	3047de	8.49	41130	15970	25160	0.63
T4	Acephate 95 SC @ 1.5 ml l^{-1}	6.72^{cde}	3358^{cde}	20.07	45338	20978	24360	0.81
T5	*Chlorantraniliprole* 18.5 SC @ 0.3 ml l^{-1}	8.58^{ab}	4288^{ab}	52.96	57893	31853	26310	1.14
T6	Cynatraniliprole 10 OD @ 1.2 ml l^{-1}	8.43^{ab}	4217^{ab}	50.00	56925	29365	27560	1.01
T7	Fipronil 5 SC @1.2 ml l^{-1}	7.46^{bc}	3728^{bc}	32.66	50333	25773	24560	0.99
T8	Cartap hydrochloride 50 SP @ 2 g l^{-1}	7.51^{abc}	3753^{abc}	32.38	50670	26625	24045	1.05
T9	Control (Untreated)	5.63^{e}	2815^{e}	0	38003	14043	23960	0.54
	CV	10.70	10.60	_	_	_	_	21
	SEm	0.46	226.48	_	_	_	_	0.12
	SED	0.65	320.29	_	_	_	_	0.18
	CD (P=0.05)	1.37	678.99	_	_	_	_	0.37

Values with similar alphabets in each column do not vary significantly at 5% level

480 SC @ 0.2 ml l^{-1} (T_1) with 4.93 per cent leaf folder damage (63.20% reduction over control) and it was significantly superior to other treatments. The next best treatments were cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6) (7.17%) (51.26%) and chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} (T_5) (7.06%) (50.81%) which were on par with each other followed by fipronil 5 SC @ 1.2 ml l^{-1} (T_7) (7.76%) (44.95%), cartap hydrochloride 50 SP @ 2 g l^{-1} (T_8) (8.20%) (44.95%), acephate 95 SC (T_4) @ 1.5 ml l^{-1} (9.28%) (39.83%), chlorpyriphos 20 EC (T_2) @ 2.5 ml l^{-1} (10.09%) (35.90%) and finally dinotefuran 20 SG @ 0.4 g l^{-1} (T_3) (15.69%) (17.41%). However, all the treatments were significantly superior over control in reducing the leaf folder damage caused by *C. medinalis* on rice after the three rounds of sprays during *kharif* 2015.

The present observation of superiority of flubendiamide was in conformity with the findings of Misra (2008), who reported that 69.65 per cent reduction of population over control and lower leaf folder incidence (1.43 %) with flubendiamide @ 25g a.i/ha at 10 days after spray. Similarly Sekh *et al.* (2007) also recorded that the number of leaf folder damaged leaves were reduced with flubendiamide @ 24 and 30 g a.i/ha (1.66 and 0.7/ hill). Javaregowda and Krishna Naik (2005) stated that flubendiamide @ 25 and 50 g a.i/ha was effective against leaf folder with 0.61 and 0.44 leaf folder damaged leaves per hill at 7 days after spray, respectively.

Grain yield and Cost Benefit Ratio

Among the treatments flubendiamide 480 SC @ 0.2 ml l^{-1} (T_1) recorded the highest yield (4415 kg/ha) with an increase of 56.63% yield over control and dinotefuran 20 SG @ 0.4 g l^{-1} (T_3) recorded with the lowest yield (3047 kg/ha) with an increase of 8.49 per cent yield over control. Among the treatments chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} (T_5) (4288 kg/ha) and cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6) (4217 kg/ha) were on par with each other, whereas fipronil 5 SC @ 1.2 ml l^{-1} (T_7) with 3728 kg/ha (Table 3). Chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} (T_5), cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6), fipronil 5 SC @ 1.2 ml l^{-1} (T_7), cartap hydrochloride 50 SP @ 2 g l^{-1} (T_8), chlorpyriphos 20 EC @ 2.5 ml l^{-1} (T_2) and acephate 95 SC @ 1.5 ml l^{-1} (T_4) with 52.96, 50, 32.66, 32.38, 24.85 and 20.07 per cent increase in yield over control, respectively.

However, the highest Cost benefit Ratio (1.42) was recorded for flubendiamide 480 SC @ 0.2 ml l^{-1} (T_1) followed by chlorantraniliprole 18.5 SC @ 0.3 ml l^{-1} (T_5), cartap hydrochloride 50 SP @ 2 g l^{-1} (T_8) (1.05), cyantraniliprole 10 OD @ 1.2 ml l^{-1} (T_6) (1.01), fipronil 5 SC @ 1.2 ml l^{-1} (T_7) (0.99), chlorpyriphos 20 EC @ 2.5 ml l^{-1} (T_2) (0.91) and acephate 95 SC @ 1.5 ml l^{-1} (T_4) (0.81). CBR was lowest for untreated control (0.54) followed by dinotefuran 20 SG @ 0.4 g l^{-1} (T_3) (0.59).

LITERATURE CITED

Directorate of Economics and Statistics 2013 *Quarterly Statistical News Letter*. Government of Andhra Pradesh, Hyderabad. 16: 12-13.

Fleming R and Retnakaran A 1985 Evaluation of single treatment data using Abbot's formula with reference to insects. *Indian Journal of Economic Entomology.* 78: 1179-1181.

Food and Agriculture Organization of the United Nations 1995 *FAO Quarterly Bulletin of Statistics.* 8: 1-2.

Javearegowda an Krishna Naik L 2005 Bio efficacy of fluid end amide 20 WDG (RIL 038) against paddy pests and their natural enemies, Pestology. 29(11): 58-60.

Misra H P 2008 Management of the rice leaf folder, *Cnaphalocrocis medinalis* Guenee by newer insecticides. *Oryza*. 45 (3): 252-254.

Pasalu I C and Katti G 2006 Advances in eco-friendly approaches in rice IPM. *Journal of Rice Research.* 1 (1):83-90.

Raveeshkumar G 2015 Life cycle and abundance of rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) - A Review. *Journal of Natural Sciences Research*. 5 (15): 103-105.

Sekh K, Nair N, Gosh S K and Somchoudhury A K 2007 Evaluation of flubendiamide 480 SC (NN-0001) against stemborer and leaf folder of rice and effects on their natural enemies. *Pestology*. 31 (1): 32-34.

Yaspal S N, Sahu C M, Ghirtlahre S K, Painkra K L and Chandrakar G 2015 Studies on the seasonal incidence of leaf folder, *Cnaphalocrocis medinalis* Guenee in midland SRI and noram transplanted rice eco system. Insect journal of tropical agricultural. 33(2): 547-551.

(Received on 21.07.2016 and revised on 22.12.2016)