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Evaluation of pre-mixture of flubendiamide and buprofezin for management of major insect-pests of rice

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ABSTRACT

Experiment was conducted for two seasons at the Central Research Farm, Gayeshpur, BCKV, Nadia, West Bengal to manage the rice leaf folder (Cnaphalocrosis medinalis Guenee*), stem borer (Scirpophaga incertulas* Walker*) and brown plant hopper (Nilaparvata lugens* Stål*) in rice (cv. Satabdi) by using pre-mixture of two new molecules, flubendiamide 4% + buprofezin 20% SC. Result of the experiments revealed that the combined product was highly effective against the mentioned pests and found superior and harvested highest grain yield 43.13q and 41.79q per hectare during kharif and rabi seasons, respectively.*

Key words: *Brown plant hopper, flubendiamide + buprofezin, leaf folder, stem borer*

Rice (*Oryza sativa* L.) is the staple food for more than half of the world population. According to the United States, Department of Agriculture (USDA) the world rice production is 465.03mtin 2011-12, where, India ranked second (104.32mt) in rice production after China (USDA 2012). India contributes 45% total food grain and continues to play a vital role in national food security. A number of insect pests are reported to ravage rice fields in tropics. Total global potential loss in rice due to pests is about 37% (Oerke 2006). Among the insect pests of rice, yellow stem borer, leaf folder and brown planthopper are the most important. About 3-95% losses caused by stem borer (Ghose *et al*. 1960), 50% by leaf folder (Balasubramaniam *et al*. 1973) and 10-70% by brown plant hoppers (BPH) infestation (Kulshreshtha *et al*. 1974). Control strategies for rice pests are extensively dependent on the use of synthetic chemical insecticides. However, recognition of detrimental effect of insecticide such as resistance to insecticide, secondary pest outbreak, non-target effects, environmental pollution etc. have prompted the development of alternative control strategies and use of environmentally safer chemicals. Therefore, the experiment was conducted to evaluate the combined effect of flubendiamide 4% + buprofezin 20% SC for management of major insect-pests of rice.

MATERIAL AND METHODS

The field experiments were conducted at Centran Research Farm, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal during *kharif*, 2012 and *rabi*, 2013 to evaluate the bio-efficacy of a pre mixture insecticide, flubendiamide 4% + buprofezin 20% SC against rice leaf folder (*Cnaphalocrosis medinalis* Guenee), stem borer (*Scirpophaga incertulas* Walker) and brown planthopper (*Nilaparvata lugens* Stal). The experiments were carried out in Randomized Complete Block Design (block size 5m x 5m) consisting of ten treatments with four replicates. In the experiment, 30 days old seedlings (cv. *Satabdi*) were transplanted and the different treatments were applied first at tillering stage and second at panicle initiation stage. The observations on dead heart/white ear head, folded leaves and number

of brown plant hopper were recorded from randomly selected 10 hills in each plot. Observations of dead heart were taken before spraying, 10 days and 20 days after first spraying whereas for white ear head only after 20 days of second spraying. The percentage of infestation was calculated by using the following formula:

$$\% \text{ of dead heart} = \frac{\text{No. of dead hearts}}{\text{No. of total tillers}} \text{x100}$$

$$\% \text{ of white ear} = \frac{\text{No. of white ears}}{\text{No. of total productive tillers}} \text{x100}$$

(Heinrichs *et al*. 1985)

Observations on leaf folder were taken before spraying, 7 days and 15 days after each spray. The percentage of infestation was calculated by using the following formula:

$$\% \text{ leaf folder} = \frac{\text{No. of folded leaf per hill}}{\text{No. of tillers per hill}} \text{x100}$$

The population of brown plant hoppers (BPH) were counted on the date of spraying and subsequently after 10, 15 and 20 days after second spraying. The grain yield was recorded in each plot was subsequently converted to per hectare basis as quintal per hectare (q/ha). Yield and yield attributing characters were recorded following standard procedures (Kumar *et al.* 2017).

Treatments Details:

Treatments	Dosage (Formulation/ha)
T_1-Flubendiamide 4% +buprofezin 20% SC	750ml
T_2 - Flubendiamide 4% + buprofezin 20% SC	875ml
T_3 - Flubendiamide 20 % WG	125g
T_4 - Flubendiamide 20 % WG	150g
T_5 - Flubendiamide 20 % WG	175g
T_6 - Buprofezin 25 % SC	600ml
T_7 - Buprofezin 25 % SC	700ml
T_8-Buprofezin 25 % SC	800ml
T_9- Buprofezin 5%+ deltamethrin 0.625% EC	1500ml
T_{10}- Control	-

RESULTS AND DISCUSSION

Leaf folder

Performance of the insecticide during *kharif*, 2012 against leaf folders has been presented in Table 1 and Table 2. The treatment T_2 *i.e.*, flubendiamide 4% + buprofezin 20% SC @ 875ml/ha, was found best at each time of observations and recorded 2.27%, 2.13% leaf infestation after 7 days of 1st and 2nd spray, respectively and 2.37%, 2.01% after 15 days of 1st and 2nd spray, respectively. This was followed by the treatments, T_5- flubendiamide 20 % WG @ 35g a.i./ha and T_4- flubendiamide 20 % WG @ 30g a.i./ha. During the second season (*rabi*-2013) the pest appeared late but assumed a substantial size during the second spray. However, observations revealed that after 15 days of 1st and 2nd spraying only 0.24%, 0.26% leaf damage were recorded in treatment T_2- flubendiamide 4% + buprofezin 20% SC @ 875ml/ha followed by the T_5- flubendiamide 20 % WG @ 35g a.i./ha and T_4, flubendiamide 20 % WG @ 30g a.i./ha, respectively (Table 1). Present findings are in agreement with the findings of Kartikeyan *et al*. (2012) who reported that the lowest percent of leaf folder was recorded in combined product of flubendiamide 4% + buprofezin 20% SC @ 875 ml/ha. While the superiority of flubendiamide against leaf folder on rice was reported by Bhanu and Reddy (2008), Kulagod *et al*. (2011), Girish *et al*. (2012).

Rice stem borer

During *kharif* 2012, population of the rice stem borers were initially low but afterwards it ravaged the crop in numbers and reaching ETL very soon with a steady increase in population as evidenced by the data in the untreated plots (Table 3). Similar to leaf folder the treatment T_2- flubendiamide 4% + buprofezin 20% SC @ 875ml/ha again found to be the best in reducing the insect population after 20 days of spraying in both first and second sprays (0.47% and 0.86%). However, during *rabi*, 2013 (Table 3) it clearly showed that this pest was quite abundant in the summer paddy where per cent white ear head in untreated plots reached to 30.32%. The treatment T_2 sustained only 2.06% white ear head and emerged as the best performer in reduction of rice stem borer population significantly. The results are in agreement with the findings of Kartikeyan *et al*. (2012), Rath (2011) and Anonymous

Table 1. Effect of different combinations and pre-mixture of flubendiamide and buprofezinagainst leaf folder (*Cnaphalocrosis medinalis* Guenee) population in rice

Treatments	Per cent of leaf folder infestation											
	First Season (*kharif*, 2012)						Second Season (*rabi*, 2013)					
	First spray			Second spray			First spray			Second spray		
	1DBS	7DAS	15DAS	1DBS	7DAS	15DAS	1DBS	7DAS	15DAS	1DBS	7DAS	15DAS
T_1	7.00 (15.34)	5.99 (14.17)	6.08 (14.28)	6.79 (15.11)	3.33 (10.51)	3.17 (10.26)	0.00	0.00 (0.00)	0.47 (3.92)	1.39 (6.76)	0.66 (4.66)	0.50 (4.05)
T_2	7.09 (15.44)	2.27 (8.67)	2.37 (8.85)	5.09 (13.04)	2.13 (8.40)	2.01 (8.16)	0.00	0.00 (0.00)	0.24 (2.79)	0.68 (4.74)	0.48 (3.97)	0.26 (2.90)
T_3	6.89 (15.21)	6.37 (14.62)	6.41 (14.67)	6.98 (15.32)	3.67 (11.05)	3.47 (10.74)	0.00	0.00 (0.00)	0.59 (4.42)	1.91 (7.94)	1.21 (6.32)	0.63 (4.54)
T_4	7.11 (15.46)	4.89 (12.78)	4.04 (11.59)	6.44 (14.70)	2.85 (9.72)	2.64 (9.35)	0.00	0.00 (0.00)	0.55 (4.24)	1.43 (6.86)	0.95 (5.58)	0.59 (4.41)
T_5	6.77 (15.08)	2.91 (9.83)	3.24 (10.38)	5.65 (13.75)	2.45 (9.01)	2.26 (8.65)	0.00	0.00 (0.00)	0.30 (3.16)	0.94 (5.56)	0.59 (4.41)	0.33 (3.31)
T_6	7.19 (15.55)	9.04 (17.50)	10.34 (18.76)	9.50 (17.96)	7.92 (16.35)	6.18 (14.39)	0.00	0.32 (3.23)	1.71 (7.51)	2.52 (9.14)	1.80 (7.72)	1.05 (5.89)
T_7	6.92 (15.26)	9.18 (17.64)	9.84 (18.28)	9.13 (17.59)	7.56 (15.96)	6.20 (14.42)	0.00	0.00 (0.00)	1.13 (6.09)	2.64 (9.36)	1.61 (7.29)	0.79 (5.11)
T_8	6.18 (14.40)	8.41 (16.85)	10.04 (18.48)	9.01 (17.47)	7.49 (15.88)	6.16 (14.37)	0.00	0.51 (4.11)	1.26 (6.45)	2.29 (8.71)	1.85 (7.82)	0.80 (5.12)
T_9	6.84 (15.16)	6.59 (14.87)	6.44 (14.70)	7.56 (15.96)	3.68 (11.06)	3.42 (10.66)	0.00	0.26 (2.90)	0.48 (3.97)	1.51 (7.06)	1.06 (5.90)	0.70 (4.80)
T_{10}	6.87 (15.19)	10.65 (19.04)	12.56 (20.76)	9.70 (18.14)	8.28 (16.72)	6.75 (15.06)	0.00	0.50 (4.05)	1.87 (7.86)	3.00 (9.97)	2.05 (8.23)	1.11 (6.05)
SEm±	0.78	0.44	0.41	0.48	0.28	0.49	-	1.10	1.37	1.13	1.03	1.53
CD (0.05)	NS	1.31	1.22	1.43	0.83	1.45	-	NS	4.08	3.37	3.06	NS

DBS=Days before spraying, DAS= Days after spraying, **figures in the parentheses indicate the angular transformed [Sin $^{-1}$ $\sqrt{\{x/100\}}$] values

Table 2. Protection over control of leaf folder *Cnaphalocrosis medinalis* Guenee) after application of pre-mixture of flubendiamide and buprofezin in rice

Treatments	Per cent protection of leaf folder infestation over control							
	First Season (*kharif*, 2012)				Second Season (*rabi*, 2013)			
	First spray		Second spray		First spray		Second spray	
	7DAS	15DAS	7DAS	15DAS	7DAS	15DAS	7DAS	15DAS
T_1	43.76	51.59	59.78	53.04	100.00	74.87	67.80	54.95
T_2	78.69	81.13	74.28	70.22	100.00	87.17	76.59	76.58
T_3	40.19	48.96	55.68	48.59	100.00	68.45	40.98	43.24
T_4	54.08	67.83	65.58	60.89	100.00	70.59	53.66	46.85
T_5	72.68	74.20	70.41	66.52	100.00	83.96	71.22	70.27
T_6	15.12	17.68	4.35	8.44	36.00	8.56	12.20	5.41
T_7	13.80	21.66	8.70	8.15	100.00	39.57	21.46	28.83
T_8	21.03	20.06	9.54	8.74	-2.00	32.62	9.76	27.93
T_9	38.12	48.73	55.56	49.33	48.00	74.33	48.29	36.94
T_{10}	-	-	-	-	-	-	-	-

DBS=Days before spraying, DAS= Days after spraying

(2011) where they reported that the lowest percent of dead heart and white ear head was recorded in pre-mixture product of flubendiamide 4% + buprofezin 20%SC @ 875 ml/ha. Bhanu and Reddy (2008), Kulagod *et al*. (2011) observed significantly lower stem borer damage in flubendamide treatment over untreated check.

Brown plant hopper (BPH)

This insect appeared at late growth stage of rice. In our experiment too, it was observed in profuse number starting from the early panicle initiation stage and were

Table 3. Effect of different combinations and pre-mixture of flubendiamide and buprofezin against yellow stem borer (*Scirpophaga incertulas* Walker) population in rice

Treatments	First Season (*kharif*, 2012)				Second Season (*rabi*, 2013)			
	% DH before & after first spray			% WE after second spray	% DH before & after first spray			% WE after second spray
	1DBS	10DAS	20DAS	20DAS	1DBS	10DAS	20DAS	20DAS
T_1	0.00	0.00 (0.00)	0.56 (4.28)	1.07 (5.95)	0.00	0.00 (0.00)	0.56 (4.28)	4.46 (12.19)
T_2	0.00	0.00 (0.00)	0.47 (3.92)	0.86 (5.32)	0.00	0.00 (0.00)	0.47 (3.92)	2.06 (8.25)
T_3	0.00	0.24 (2.79)	0.67 (4.71)	3.22 (10.34)	0.00	0.24 (2.79)	0.67 (4.71)	5.82 (13.96)
T_4	0.00	0.00 (0.00)	0.51 (4.11)	1.47 (6.97)	0.00	0.00 (0.00)	0.51 (4.11)	3.67 (11.04)
T_5	0.00	0.00 (0.00)	0.46 (3.90)	0.93 (5.52)	0.00	0.00 (0.00)	0.46 (3.90)	2.78 (9.60)
T_6	0.00	0.00 (0.00)	0.94 (5.55)	8.12 (16.56)	0.00	0.00 (0.00)	0.94 (5.55)	27.37 (31.55)
T_7	0.00	0.29 (3.09)	1.06 (5.92)	8.05 (16.48)	0.00	0.29 (3.09)	1.06 (5.92)	26.59 (31.04)
T_8	0.00	0.00 (0.00)	1.73 (7.56)	7.41 (15.79)	0.00	0.00 (0.00)	1.73 (7.56)	26.06 (30.70)
T_9	0.00	0.25 (2.85)	0.83 (5.23)	3.28 (10.43)	0.00	0.25 (2.85)	0.83 (5.23)	5.97 (14.14)
T_{10}	0.00	0.48 (3.96)	2.55 (9.19)	9.23 (17.69)	0.00	0.48 (3.96)	2.55 (9.19)	30.32 (33.41)
SE(m±)	-	-	1.97	1.20	-	-	1.97	1.16
CD (0.05)	-	-	NS	3.57	-	-	NS	3.43

DBS=Days before spraying, DAS= Days after spraying, **figures in the parentheses indicate the angular transformed [Sin $^{-1}$ $\sqrt{\{x/100\}}$] values

Table 4. Per cent protection over control of yellow stem borer (*Scirpophaga incertulas* Walker) population after application of pre-mixture of flubendiamide and buprofezin in rice

Treatments	Per cent protection of yellow stem borer population over control					
	First Season (*kharif*, 2012)			Second Season (*rabi*, 2013)		
	% of DH and WE* after first and second spray			% of DH and WE* after first and second spray		
	10DAS	15DAS	20DAS*	10DAS	15DAS	20DAS*
T_1	100.00	78.04	88.41	100.00	78.04	85.29
T_2	100.00	81.57	90.68	100.00	81.57	93.21
T_3	50.00	73.73	65.11	50.00	73.73	80.80
T_4	100.00	80.00	84.07	100.00	80.00	87.90
T_5	100.00	81.96	89.92	100.00	81.96	90.83
T_6	100.00	63.14	12.03	100.00	63.14	9.73
T_7	39.58	58.43	12.78	39.58	58.43	12.30
T_8	100.00	32.16	19.72	100.00	32.16	14.05
T_9	47.92	67.45	64.46	47.92	67.45	80.31
T_{10}	-	-	-	-	-	-

DBS=Days before spraying, DAS= Days after spraying

subjected to only second spray. Treatments with buprofezin as a component, solo or in combination, were found significantly superior to the rest. However, its pre-mixture with flubendamide in the treatment T_2, *i.e.*, flubendiamide 4% + buprofezin 20% SC @ 875ml/ha was recorded most efficacious than the other treatments in reducing the pest population over the control (Table 5). The results are at par with the findings of Kartikeyan *et al*. (2012) wherein the lowest BPH population were recoreded in flubendiamide 4% + buprofezin 20%SC @ 875 ml/ha while Hegde and Nidagundi (2009)

Table 5. Effect of combinations and pre-mixture of flubendiamide and buprofezinag ainst Brown plant hoppers (*Nilaparvata lugens* Stål) population in rice

Treatments	First Season (*kharif*, 2012)				Second Season (*rabi*, 2013)			
	Numbers of brown planthoppers / hill before and after second spray				Numbers of brown planthoppers / hill before and after second spray			
	0DBS	10DAS	15DAS	20DAS	0DBS	10DAS	15DAS	20DAS
T_1	12.33	5.87	6.27	7.40	7.33	3.93	4.13	5.20
	(3.58)	(2.52)	(2.60)	(2.81)	(2.80)	(2.11)	(2.15)	(2.39)
T_2	10.60	3.60	4.20	5.53	6.87	1.93	2.00	3.47
	(3.32)	(2.02)	(2.17)	(2.46)	(2.71)	(1.55)	(1.58)	(1.99)
T_3	15.80	23.40	21.20	14.40	10.00	14.27	14.27	8.67
	(4.04)	(4.88)	(4.66)	(3.86)	(3.24)	(3.84)	(3.84)	(3.02)
T_4	14.93	23.27	21.93	15.40	10.27	13.27	14.53	8.67
	(3.92)	(4.87)	(4.73)	(3.99)	(3.28)	(3.71)	(3.88)	(3.02)
T_5	15.13	22.87	20.07	14.47	9.67	13.40	13.73	8.40
	(3.95)	(4.83)	(4.53)	(3.86)	(3.19)	(3.73)	(3.77)	(2.98)
T_6	12.60	5.80	6.47	7.53	7.27	4.00	4.20	5.13
	(3.62)	(2.51)	(2.64)	(2.83)	(2.79)	(2.12)	(2.17)	(2.37)
T_7	12.13	5.07	5.60	6.73	7.40	3.27	3.47	4.47
	(3.55)	(2.36)	(2.47)	(2.69)	(2.81)	(1.94)	(1.99)	(2.23)
T_8	11.33	4.20	4.73	5.80	7.13	2.60	2.80	4.00
	(3.44)	(2.17)	(2.29)	(2.51)	(2.76)	(1.75)	(1.81)	(2.12)
T_9	12.40	5.47	6.20	7.27	7.33	4.07	4.20	5.00
	(3.59)	(2.44)	(2.59)	(2.78)	(2.80)	(2.13)	(2.17)	(2.34)
T_{10}	16.27	24.73	21.80	15.47	10.13	14.47	12.53	8.80
	(4.09)	(5.02)	(4.72)	(3.99)	(3.26)	(3.87)	(3.60)	(3.05)
SEm±	0.11	0.09	0.07	0.09	0.06	0.09	0.08	0.08
CD (0.05)	0.33	0.25	0.20	0.27	0.18	0.26	0.25	0.24

DBS=Days before spraying, DAS= Days after spraying**figures in the parentheses indicate the root transformed $\left\{\sqrt{(x+0.5)}\right\}$ values

Table 6. Per cent protection over control of Brown plant hoppers (*Nilaparvata lugens* Stål)population after application of pre-mixture of flubendiamide and buprofezin in rice

Treatments	Per cent protection of Brown plant hoppers population over control					
	First Season (*kharif*, 2012) After second spray			Second Season (*rabi*, 2013) After second spray		
	10DAS	15DAS	20DAS	10DAS	15DAS	20DAS
T_1	76.26	71.24	52.17	72.84	67.04	40.91
T_2	85.44	80.73	64.25	86.66	84.04	60.57
T_3	5.38	2.75	6.92	1.38	-13.89	1.48
T_4	5.90	-0.60	0.45	8.29	-15.96	1.48
T_5	7.52	7.94	6.46	7.39	-9.58	4.55
T_6	76.55	70.32	51.33	72.36	66.48	41.70
T_7	79.50	74.31	56.50	77.40	72.31	49.20
T_8	83.02	78.30	62.51	82.03	77.65	54.55
T_9	77.88	71.56	53.01	71.87	66.48	43.18
T_{10}	-	-	-	-	-	-

reported buprofezin 25% SC significantly reduced the BPH population.

Yield and incremental cost benefit ratio

The incremental cost benefit ratio and yield of rice/ha as presented in Tables 7 and 8 for the seasons *kharif* - 2012 and *rabi* - 2013, respectively. It was found that in both the seasons, yield of rice was highest in treatment T_2 (43.13 and 41.79 q/ha, respectively) which corroborates the finding of Kartikeyan *el al*. 2012; Rath 2011; CRRI Annual Report (2010-11). The highest ICBR; 1: 6.48 and 1: 5.72 were recorded in the *kharif*

Table 7. Incremental cost benefit ratio [first season (*kharif*, 2012)]

Treatments	Cost of insecticide for two spray per hectare(Rs.)	Labour cost per hectare for two spray(Rs.)	Total cost per hectare (Rs.)	Total Yield per hectare (quintal)	Additional yield per hectare (quintal)	Additional gross income per hectare (Rs.)	Additional net income per hectare (Rs.)	Incremental cost benefit ratio
T_1	1500	1670	3170	32.25	8.81	11456.25	8286.25	1: 2.61
T_2	1750	1670	3420	43.13	19.69	25593.75	22173.75	1: 6.48
T_3	1625	1670	3295	28.13	4.69	6093.75	2798.75	1: 0.85
T_4	1950	1670	3620	30.62	7.19	9340.50	5720.50	1: 1.58
T_5	2275	1670	3945	31.82	8.38	10890.75	6945.75	1: 1.76
T_6	1344	1670	3014	24.38	0.94	1218.75	-1795.25	1: -0.60
T_7	1568	1670	3238	24.62	1.19	1540.50	-1697.50	1: -0.52
T_8	1792	1670	3462	24.88	1.44	1872.00	-1590.00	1: -0.46
T_9	1860	1670	3530	30.32	6.88	8940.75	5410.75	1: 1.53
T_{10}	-	-	-	23.44	-	-	-	-
SEm (±)	-	-	-	3.22	-	-	-	-
CD (0.05)	-	-	-	9.57	-	-	-	-

T_1- Flubendiamide 4% + Buprofezin 20% SC @ 750ml/ha (Rs.1000/lit.) , T_2 - Flubendiamide 4% + Buprofezin 20% SC @ 875ml/ha (Rs.1000/lit.), T_3 - Flubendiamide 20 % WG @ 25g a.i./ha (Rs. 6500/kg), T_4 - Flubendiamide 20 % WG @ 30g a.i./ha (Rs. 6500/kg), T_5 - Flubendiamide 20 % WG @ 35g a.i./ha (Rs. 6500/kg), T_6 - Buprofezin 25 % SC @ 150 g a.i./ha (Rs. 1120/Litre), T_7 - Buprofezin 25 % SC @ 175 g a.i./ha (Rs. 1120/Litre), T_8-Buprofezin 25 % SC @ 200 g a.i./ha (Rs. 1120/Litre), T_9- Buprofezin 5%+ Deltamethrin 0.625% EC @1500ml/ha (Rs. 620/lit.), T_{10}- Control (Untreated check) Labour charge Rs. 167 per day per man, Price

Table 8. Incremental cost benefit ratio [second season (*rabi*, 2013)]

Treatments	Cost of insecticide for two spray per hectare(Rs.)	Labour cost per hectare for two spray(Rs.)	Total cost per hectare (Rs.)	Total Yield per hectare (quintal)	Additional yield per hectare (quintal)	Additional gross income per hectare (Rs.)	Additional net income per hectare (Rs.)	Incremental cost benefit ratio
T_1	1500	1670	3170	40.33	14.96	20937.00	17767.00	1: 5.60
T_2	1750	1670	3420	41.79	16.42	22984.50	19564.50	1: 5.72
T_3	1625	1670	3295	35.20	9.83	13755.00	10460.00	1: 3.17
T_4	1950	1670	3620	35.50	10.13	14175.00	10555.00	1: 2.92
T_5	2275	1670	3945	36.80	11.43	16002.00	12057.00	1: 3.06
T_6	1344	1670	3014	26.72	1.35	1890.00	-1124.00	1: -0.37
T_7	1568	1670	3238	27.70	2.33	3255.00	17.00	1: 0.01
T_8	1792	1670	3462	28.00	2.63	3675.00	213.00	1: 0.06
T_9	1860	1670	3530	30.40	5.03	7035.00	3505.00	1: 0.99
T_{10}	-	-	-	25.37	-	-	-	-
SEm (±)	-	-	-	2.80	-	-	-	-
CD (0.05)	-	-	-	8.31	-	-	-	-

T_1- Flubendiamide 4% + Buprofezin 20% SC @ 750ml/ha (Rs.1000/lit.) , T_2 - Flubendiamide 4% + Buprofezin 20% SC @ 875ml/ha (Rs.1000/lit.), T_3 - Flubendiamide 20 % WG @ 25g a.i./ha (Rs. 6500/kg), T_4 - Flubendiamide 20 % WG @ 30g a.i./ha (Rs. 6500/kg), T_5 - Flubendiamide 20 % WG @ 35g a.i./ha (Rs. 6500/kg), T_6 - Buprofezin 25 % SC @ 150 g a.i./ha (Rs. 1120/Litre), T_7 - Buprofezin 25 % SC @ 175 g a.i./ha (Rs. 1120/Litre), T_8-Buprofezin 25 % SC @ 200 g a.i./ha (Rs. 1120/Litre), T_9- Buprofezin 5%+ Deltamethrin 0.625% EC @1500ml/ha (Rs. 620/lit.), T_{10}- Control (Untreated check). Labour charge Rs. 167 per day per man, Price of paddy grain Rs. 1400/quintal.

- 2012 and *rabi*- 2013, respectively from the treatment T_2- flubendiamide 4% + buprofezin 20% SC @ 875ml/ha.

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