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STUDIES ON THE EFFICACY OF CERTAIN NEW INSECTICIDES AGAINST YELLOW STEM BORER, SCIRPOPHAGA INCERTULAS (WALKER) ON SEMI DEEP WATER RICE

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Abstract
Field experiments have been conducted on a semi deep water rice variety, NDGR 201 during kharif seasons 2013-14 and 2014-15 to evaluate the efficacy of certain new insecticides against stem borer. Altogether, 11 treatments including 7 new insecticide formulations, viz. triazophos 40 EC @ 1250 ml ha^{-1}, sulfoxaflor 24 SC @ 375 ml ha^{-1}, acephate 75 SP @ 667 g ha^{-1}, acephate 95 SG @ 526 g ha^{-1}, buprofezin 25 SC @ 800 ml ha^{-1}, rynaxypyr 20 SC @ 150 ml ha^{-1}, dinotefuran 20 SG @ 200 g ha^{-1}; 2 combinations of insecticides, viz. flubendiamide (4%) + buprofezin (20%) 24 SC @ 875 ml ha^{-1}, imidacloprid (40%) + ethiprole (40%) 80 WG @ 125 g ha^{-1} besides check insecticide monocrotophos 36 SL @ 1390 ml ha^{-1} and untreated control. The stem borer infestation, i.e. white ears varied from 1.71 to 11.25% over the kharif seasons. The results on stem borer infestation and yield indicated that all the insecticidal treatments were significantly superior to untreated control. The results clearly indicated that sulfoxaflor 24 SP @ 375 g ha^{-1} followed by acephate 95 SG @ 592 g ha^{-1}, triazophos 40 SC @ 1250 ml ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} with 1.97, 2.74, 3.31 and 3.72% average YSB infestation; and 32.03, 31.42, 30.73 and 30.56 q ha^{-1} average grain yields, and 64.76, 61.63, 58.08 and 57.20% yield increase over untreated control, respectively, were effective against YSB on semi deep water rice. The insecticidal check monocrotophos 36 SL @ 1390 g ha^{-1} was superior with 5.13% average stem borer infestation and 24.53 q ha^{-1} average grain yield to untreated control with 10.05% average stem borer infestation and 19.44 q ha^{-1} average grain yield.

Key Words: Insecticide, Yellow Stem Borer, Scirpophaga Incertulas, Semi Deep Water Rice.

Introduction
The low production in deep water rice ecosystem is a recurring feature, which is adapted to *chaurs* and *tals* etc. in rainfed lowland ecosystem in different parts of eastern India. One of the major reasons for low production of deep water rice in Asia is insect pests and diseases. Among the insect pests, the yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) is the most important and devastating insect pest of deep water rice causing yield losses to the tune of 27-34% every year (Catling *et al.*, 1987; Prasad *et al.*, 1988). The economic threshold level for YSB have been determined to be in between 5 and 10% larval infestation levels (Prasad *et al.*, 1992). As there is no full proof method to get rid of YSB either through a resistant variety or through certain biological agents, the use of insecticides becomes unavoidable. For quick knock down effect, the application of judicious dose of insecticides is desired to save the crop from toll of insects. By the change in the resistance level of pest and discovery of new chemicals with insecticidal activities always provide room to conduct field trials to evaluate their efficacy. Keeping in view of the above, in the present study, an attempt has been made to evaluate the efficacy of certain new promising insecticides against YSB in semi deep water rice.

Materials and Methods
The field experiments have been conducted in randomized block design with four replications during *kharif* seasons 2013-14, 2014-15 and 2015-16. The plot size was (5x4) m^2 with 1.0 m replication border and 0.5 m treatment border between the plots. The experimental plots have been separated by raising bunds of about 0.6 m height all around each plot. The semi deep water rice variety used in the present study was *NDGR 201* of 155 days duration. Thirty five days old seedlings were transplanted at a spacing of 20x15 cm during last week of July. The crops were raised adopting a standard package of practices. The fertilizers were applied @ 80 :60 :40 kg N:P:K ha^{-1}. The basal application of N:P:K @ 40:60:40 kg ha^{-1} was done just before transplanting and top dressing of the rest 40 kg N ha^{-1} was made after hand weeding during 2nd week of August before flooding of the field.

Though semi deep water rice is grown in a water depth of 30-50 cm at least for one month, the experimental field remains flooded with accumulated rain water from 3rd week of August to 3rd week of October with maximum water depth of 39 cm in 2nd week of September during the year 2013-14; and from 2nd week of August to 1st week of December with maximum water depth of 43 cm in last week of September during the year 2014-15.

The treatments included 7 new insecticide formulations, viz. triazophos 40 EC @ 1250 ml ha^{-1}, sulfoxaflor 24 SC @ 375 ml ha^{-1}, acephate 75 SP @ 667 g ha^{-1}, acephate 95 SG @ 526 g ha^{-1}, buprofezin 25 SC @ 800 ml ha^{-1}, rynaxypyr 20 SC @ 150 ml ha^{-1}, dinotefuran 20 SG @ 200 g ha^{-1}; 2 combinations of insecticides, viz. flubendiamide (4%) + buprofezin (20%) 24 SC @ 875 ml ha^{-1}, imidacloprid (40%) + ethiprole (40%) 80 WG @ 125 g ha^{-1} besides check insecticide monocrotophos 36 SL

@ 1390 ml ha^{-1} and untreated control. To record the infestation of YSB, each plot was divided into 3 equal units for observation before harvesting. An area of 0.25 m^2 was selected from each unit and total panicle bearing tillers and YSB infested tillers, i.e. white ears (WE) were counted. Thus, a total of 20-27 hills (56-112 tillers) were sampled in each plot and infestation of YSB as %WE have been worked out. Harvesting was done by the end of November. The yield data was recorded by excluding 2 border rows from all sides for each plot separately. The data have been statistically analyzed.

Results and Discussion

The results regarding YSB infestation and yield are summarized in table 1. The YSB infestation varied from 1.71 to 11.25 and 2.23 to 8.85% during *kharif* seasons 2013-14 and 2014-15, respectively. The results on YSB infestation revealed that all the insecticidal treatments were significantly superior to untreated control during the two *kharif* seasons. The results on stem borer infestation clearly indicated that the new insecticide sulfoxaflor 24 SP @ 375 g ha^{-1} was most effective with 1.71 and 2.23% YSB infestation during the year 2013-14 and 2014-15, respectively, and significantly different from other insecticides. It was followed by acephate 95 SG @ 592 g ha^{-1} and triazophos 40 SC @ 1250 ml ha^{-1} with 2.95 and 3.03% YSB infestation, respectively, during the year 2013-14. However during the year 2014-15, acephate 95 SG @ 592 g ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} were also effective with 2.53 and 3.49% YSB infestation, respectively, but significantly different from sulfoxaflor 24 SP @ 375 g ha^{-1}.These were comparable to check insecticide monocrotophos 36 SL @ 1390 ml ha^{-1} with 5.33 and 4.93% YSB infestation during the year 2013-14 and 2014-15, respectively, and significantly superior to untreated control with 11.25 and 8.85% YSB infestation, respectively. Thus on an average the pooled data indicated that the new insecticide sulfoxaflor 24 SP @ 375 g ha^{-1} was most effective with 1.97% average YSB infestation and followed by acephate 95 SG @ 592 g ha^{-1}, triazophos 40 SC @ 1250 ml ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} with 2.74, 3.31 and 3.72% average YSB infestation, respectively. Earlier, Nayak *et al*. (2000) have reported that endosulfan was most effective against YSB. Cypermethrin, a pyrethriod have also been found effective against rice stem borer (Purohit *et al*., 1987 and Kumar *et al*., 1988). However in the present study, the newer insecticides such as sulfoxaflor (sulfoximine group), acephate (phosphoramidothioate group), triazophos (triazole organophosphate group) and the dinotefuran (nitroguanidine group), respectively, were most effective against YSB on semi deep water rice. We have also reported earlier that flubendiamide 480 SC @ 24 g.a.i. ha^{-1}, indoxacarb 15 EC @ 30 g.a.i. ha^{-1}, lambda cyhalothrin 5 CS @ 12.5 g.a.i. ha^{-1} and the combination of acetamiprid 0.4% and chlorpyriphos 20% (20.4 EC) @ 510 g.a.i. ha^{-1} were effective against YSB on deep water rice variety (Prasad *et al*., 2010).

The grain yield data also revealed that all the insecticidal treatments were significantly superior to untreated control and check insecticide monocrotophos 36 SL @ 1390 ml ha^{-1}. The yield data indicated that sulfoxaflor 24 SP @ 375 g ha^{-1} followed by acephate 95 SG @ 592 g ha^{-1}, triazophos 40 SC @ 1250 ml ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} with 32.93, 31.32, 31.25 and 30.03 q ha^{-1} grain yields during the year 2013-14, respectively, were not significantly different but significantly superior to check insecticide monocrotophos 36 SL @ 1390 ml ha^{-1} and untreated control with 24.33 and 18.71 q ha^{-1} yields, respectively. However during the year 2014-15, acephate 95 SG @ 592 g ha^{-1} followed by sulfoxaflor 24 SP @ 375 g ha^{-1}, triazophos 40 SC @ 1250 ml ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} with 32.93, 31.32, 31.25 and 30.03 q ha^{-1} grain yields, respectively, were significantly superior to check insecticide monocrotophos 36 SL @ 1390 ml ha^{-1} and untreated control with 24.73 and 20.17 q ha^{-1} grain yields, respectively. The average grain yield of two seasons indicated that sulfoxaflor 24 SP @ 375 g ha^{-1} followed by acephate 95 SG @ 592 g ha^{-1}, triazophos 40 SC @ 1250 ml ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} were most effective with 32.03, 31.42, 30.73 and 30.56 q ha^{-1} average grain yields, respectively, in comparison to check insecticide monocrotophos 36 SL @ 1390 g ha^{-1} and untreated control with 24.53 and 19.44 q ha^{-1} average grain yields, respectively.

The calculation of % increase over untreated and check insecticide monocrotophos 36 SL @ 1390 ml ha^{-1} on pooled yield data indicated that sulfoxaflor 24 SP @ 375 g ha^{-1} recorded maximum increase of 64.76 and 30.57%, respectively. However, acephate 95 SG @ 592 g ha^{-1}, triazophos 40 SC @ 1250 ml ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} have recorded 61.63 & 28.09, 58.08 & 25.28 and 57.20 & 24.58% increase over untreated and check insecticide monocrotophos 36 SL @ 1390 ml ha^{-1}, respectively.

Thus on the basis of present findings, it may be concluded that sulfoxaflor 24 SP @ 375 g ha^{-1} followed by acephate 95 SG @ 592 g ha^{-1}, triazophos 40 SC @ 1250 ml ha^{-1} and dinotefuran 20 SG @ 200 g ha^{-1} were effective in controlling YSB and increasing grain yields on semi deep water rice variety and may be recommended for field use.

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Table 1. Comparative efficacy of certain new insecticides on YSB infestation in semi deep water rice variety, *NDGR 201* during *kharif* 2013-14 and 2014-15.

Treatments			Stem borer infestation (%WE)			Yield (q/ ha)			% increase in yield over	
Insecticides	Formulation	Dose (g or ml/ha)	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	Untreated control	Check Insecticide Monocrotophos
1. Triazophos	40 SC	1250	3.03	3.59	3.31	31.25	30.21	30.73	58.08	25.28
2. Sulfoxaflor	24 SC	375	1.71	2.23	1.97	32.93	31.13	32.03	64.76	30.57
3. Acephate	75 SP	667	4.85	4.21	4.53	26.77	27.97	27.37	40.79	11.58
4. Acephate	95 SG	592	2.95	2.53	2.74	31.32	31.52	31.42	61.63	28.09
5. Buprofezin	25 SC	800	4.13	4.83	4.48	27.13	25.83	26.48	36.22	7.95
6. Rynaxypyr	20 SC	150	4.03	3.83	3.83	26.73	27.93	27.33	40.59	11.41
7. Dinotefuran	20 SG	200	3.95	3.49	3.72	30.03	31.09	30.56	57.20	24.58
8. Flubendiamide + buprofezin	24 SC	875	4.85	4.27	4.56	25.95	26.41	26.18	34.67	6.73
9. Imidacloprid + ethiprole	80 WG	125	4.25	5.19	4.72	26.22	25.56	25.89	33.18	5.54
10. Monocrotophos	36 SL	1390	5.33	4.93	5.13	24.33	24.73	24.53	26.18	-
11. Untreated control	Water	Nil	11.25	8.85	10.05	18.71	20.17	19.44	-	-
CD (5%)			1.48	1.52		2.50	2.49			
CV (%)			12.33	14.71		16.89	18.27			