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Field evaluation of sulfoxaflor 3.75% + chlorpyriphos 37.5% SE mixtures with other insecticides, fungicides and urea against *Scirpophaga incertulas* (Walker) in rice

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Abstract
A field experiment was carried out to evaluate the sulfoxaflor 3.75 + chlorpyriphos 37.5 SE mixtures with other insecticides, fungicides and urea against *S. incertulas* against yellow stem borer [*Scirpophaga incertulas* (Walker)] in rice during 2012 and 2013 at Agricultural College and Research Institute, Madurai. All the twelve treatments were found significantly superior over control in reducing the infestation of yellow stem borer. Among the treatments, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i./ha in combination with quinalphos 25 EC 375 g (5.6% and 3.4% with reduction of 83.8 and 84.3%) combinations were superior and effective in reducing the per cent dead heart and white ear damage respectively, followed by sulfoxaflor 3.75 + chlorpyriphos 36.5 SE 619 g + thiamethoxam 25 g a.i./ha (5.2% and 3.2% with reduction of 85.5% and 85%) and sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + monocrotophos 36 WSL 360 g a.i./ha (5.3% and 3.1% with reduction of 84.4% and 85%) were effective in reducing the per cent dead heart and white ear damage respectively. A pre-mixture of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE is compatibility with quinalphos 25 EC, monocrotophos 36 WSL, thiamethoxam 25 WG, carbendazim 50 WP, tricyclazole 75 WP and urea. All the combinational treatments did not show any phytoxicity symptoms on rice plants.

Keywords: field evaluation, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE, other insecticides, fungicides, pesticide compatibility, yellow stem borer

Introduction
Rice (*Oryza sativa* L.) is one of the world's most important cereal crops, providing a staple food for nearly, half of the global population (Heinrichs *et al*., 2017) [1]. The rice crop can be attacked by more than 100 species of insects and 20 of them can cause serious economic loss. Total yield loss from insect pests in rice is estimated to be about 30-40% (Henrichs *et al*., 1979) [2]. Among them, the attack of yellow stem borer, [*Scirpophaga incertulas* (Walker)] is quite serious as it can cause 25-30 per cent damage to the crop manifests as “dead hearts” in vegetative stage and white ears with chaffy grains during flowering stage [3&4]. Larvae of yellow stem borers bore into the stems of rice plants after hatching from eggs. Feeding within the stem cuts off supplies of photosynthates and nutrients to the upper parts of the affected stem. Attack by yellow stem borers at the vegetative stage of plant growth produces symptoms called 'dead hearts' while attack at the reproductive stage (at the time of panicle development) produces 'white ear'. The larvae and pupae have overlapping populations in the field, and larvae mostly remain concealed inside the stem and are difficult to control by spraying insecticides. Proper timing of insecticide application is critical to yellow stem borer control (Phil Rice, 2007) [5].

Moreover, occurrence of pests and diseases together in rice, demands the necessity of insecticidal and fungicidal application at the same place and time in combination. Farmers can save time, labour and money if they can apply pesticides in combinations. However, it is essential for the farmer to know about the compatibility of chemicals so that there is no adverse effect of the pesticide mixtures in terms of their efficacy in reducing pest incidence in field. Compatibility of insecticides, *viz.*, imidacloprid and thiamethoxam; fungicides, *viz.*, propiconazole and validamycin alone and tank mixed in all possible combinations indicated that insecticidal and fungicidal treatments alone were effective against stem borer (Prasad *et al.*, 2009) [6].

Nalini *et al*. (2003) [7] observed lowest per cent of white ear damage was observed in combination of betacyfluthrin + chlorpyriphos (8.33 and 10.48% in rabi and summer respectively). Vinod Kumar *et al*. (2009) [8] reported that chlorpyriphos 16% + alphacypermethrin 1% at higher dosages of 1250 and 1000 ml/ha produced pronounced effect on leaf folder. Combination of acetamiprid + chlorpyriphos (40+2000) g did not showed any phytotoxic symptoms like wilting, necrosis, epinasty and hyponasty in any of the treatments (Bhamare *et al*., 2011) [9]. Flubendiamide 480 SC at 24 g a.i. ha^{-1} was physically compatible with chlorpyriphos, carbendazim, zinc sulphate and urea on rice [10]. Spirotetramat 150 OD at 60 and 75 g a.i. ha-1 was compatible with imidacloprid, monocrotophos, chlorpyriphos, carbendazim and urea (Vinoth Kumar, 2007) [11]. So, far work related to the effect of sulfoxalor 3.75 + chlorpyriphos 37.5 SE combination other insecticide, fungicide and urea against rice pests is almost nil. New molecules are now emerging as a viable component of IPM strategies in all crops in view of their good efficacy to insect-pest control and safety to non-target organisms. Therefore, the present investigation was undertaken to study evaluation of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE in combination with insecticides, fungicides and urea against yellow stem borer of rice.

Materials and Methods

Two field experiments with 12 treatments and three replications in randomized block design (RBD) were laid out to study the compatibility of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + quinalphos 25 EC (619 g a.i./ha + 375 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + quinalphos 25 EC (309 g a.i./ha + 190 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + monocrotophos 36 WSL (619 g a.i./ha + 360 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + monocrotophos 36 WSL (309 g a.i./ha + 180 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + thiamethoxam 25 WG (619 g a.i./ha + 25 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + thiamethoxam 25 WG (309 g a.i./ha + 12.5 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + carbendazim 50 WP (619 g a.i./ha + 250 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + carbendazim 50 WP (309 g a.i./ha + 125 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + tricyclazole 75 WP (619 g a.i./ha + 125 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + tricyclazole 75 WP (309 g a.i./ha + 63 g a.i./ha); sulfoxaflor 3.75 + chlorpyriphos 37.5 SE + urea (619 g a.i./ha + 2%); and untreated control against *S. incertulas* on rice (cv. Seeraga samba) at A block of AC&RI, Madurai and in a farmer's holding at Kallandhiri village of Madurai district in two consecutive seasons of 2012 to 2013. The plot size was 5 x 5 m^2 / treatment which occupied 63 number of rice plants. Healthy crop stand was maintained throughout the experimental period by following TNAU recommended agronomic practices.

In all the experiments, there were three replications and three applications at 15-20 days interval based on the economic threshold level (ETL) of target pests from 30 days after transplantation. The spray fluid used was 500-700 l/ha based on the age of the crop. Insecticides were sprayed to run off point using a high volume hand operated knapsack sprayer with hydraulic cone nozzle. Care was also taken to avoid spray drifts to adjacent plots. Effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE on the damage of *S. incertulas* on rice were assessed as indicated below.

Assessment of per cent dead heart and white ear of *S. incertulas*

Per cent dead heart damage during vegetative stage and white ear damage, during grain formation and maturity stage due to *S. incertulas* was observed from randomly selected 10 hills per plot on pre-treatment, 7, 10 and 15 days after treatment (DAT) after 1st, 2nd and 3rd sprays. Per cent dead heart and white ear was calculated using formulae:

$$\text{Per cent dead heart} = \frac{\text{Number of tillers showing dead heart}}{\text{Total number of tillers per hill}} \times 100$$

$$\text{Per cent white ear} = \frac{\text{Number of tillers showing white ear}}{\text{Total number of ear heads per hill}} \times 100$$

Statistical Analysis

The data from various field experiments were scrutinized by RBD analysis of variance (ANOVA) after getting transformed into √x+0.5 and arcsine percentage values where appropriate (Gomez and Gomez, 1984) [12]. Critical difference values were calculated at five per cent probability level and treatment mean values were compared using Duncan's Multiple Range Test (DMRT) (Duncan, 1951) [13].

Results and Discussion

i. Effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE mixtures on stem borer, *S incertulas* (Season I – 2012)

The effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE mixtures on dead heart damage before imposing treatments ranged from 23.3 and 25.4 per cent (Table 1). After the first application of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE combinations, there was significant reduction on per cent dead heart when compared to untreated check. At 7 DAT, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha in combination with thiamethoxam 25 WG 25 g a.i/ha, quinalphos 25 EC 375 g a.i/ha, monocrotophos 36 WSL 360 g a.i/ha, tricyclazole 75 WP 375 g a.i/ha, urea (2%) and carbendazim 50 WP 250 g a.i/ha treated plots recorded the dead heart of 8.2, 8.5, 8.7, 10.5, 10.7 and 11.5 per cent respectively, as against untreated control (29.5%). The same trend of damage reduction was followed at 10 and 15 DAT after first spray.

Mean data indicated that dead heart ranged from 5.2 to 18.2 per cent due to all treatments. Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i./ha in combination with quinalphos 375 g a.i/ha, thiamethoxam 25 g a.i/ha, monocrotophos 360 g a.i/ha, urea 2%, tricyclazole 375 g a.i/ha and carbendazim 250 g a.i/ha were superior in reducing the per cent dead heart to 5.2, 5.4, 5.5, 6.9, 7.4 and 8.0 and registered 84.3, 83.4, 83.7, 79.2, 77.7, and 75.9 per cent reduction, respectively over untreated check. The next best treatments were sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + thiamethoxam 12.5 g a.i/ha (12.0% dead heart and 63.8% reduction), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + quinalphos 190 g a.i/ha (13.0% dead heart and 60.8% reduction), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + monocrotophos 180 g a.i/ha (13.9% dead heart and 58.1% reduction) followed by sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + carbendazim 125 g a.i/ha (15.3% dead heart and 53.9% reduction), and sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + tricyclazole 190 g a.i./ha (18.2% dead heart and 45.2% reduction). Highest per cent dead heart of 33.2 per cent was observed in untreated plot.

The effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE mixtures on the per cent white ear before imposing treatments ranged from 15.3 to 17.6 (Table 2). After the second application of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE combinations, there was significant reduction on per cent white ear when compared to untreated check. At 7 DAT, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha in combination with thiamethoxam 25 WG 25 g a.i/ha, monocrotophos 36 WSL 360 g a.i/ha, quinalphos 25 EC 375 g a.i/ha, tricyclazole 75 WP 375 g a.i/ha, urea (2%) and carbendazim 50 WP 250 g a.i/ha treated plots recorded white ear of 6.7, 7.1, 7.3, 7.6, 8.4 and 9.5 per cent respectively, The same trend of damage reduction was followed at 10 and 15 DAT after second spray and third spray.

Mean data indicated that white ear damage ranged from 3.2 to 11.2 per cent due to all treatments. Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i./ha in combination with monocrotophos 36 WSL 360 g a.i/ha, thiamethoxam 25 WG 25 g a.i/ha, quinalphos 25 EC 375 g, urea (2%), tricyclazole 75 WP 375 g a.i/ha and carbendazim 50 WP 250 g a.i/ha were superior in reducing the white ear damage to 3.2, 3.4, 3.5, 3.9, 4.6 and 5.1 per cent and registered 84.6, 83.6, 83.2, 81.2, 77.9 and 75.5 per cent reduction, respectively over control. The next best treatments were sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + thiamethoxam 25 WP 12.5 g a.i/ha (7.9% dead heart and 62.0% reduction), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + quinalphos 25 EC 190 g a.i/ha (8.1% dead heart and 61.1% reduction), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + monocrotophos 36 WSL 180 g a.i/ha (8.4% dead heart and 59.6% reduction) followed by sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + carbendazim 50 WP 125 g a.i/ha (9.7% dead heart and 53.4% reduction), and sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + tricyclazole 75 WP 190 g a.i/ha (11.2% dead heart and 46.2% reduction). Highest dead heart damage of 29.5 per cent was observed in untreated plot.

ii. Effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE mixtures on *S. incertulas* (Season II – 2013)

The effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE on dead heart damage varied from 27.3 to 28.6 per cent before imposing first spray (Table 3). Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g a.i/ha in combination with thiamethoxam 12.5 g, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + quinalphos 25 EC 190 g a.i/ha, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + carbendazim 250 g a.i/ha and sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + tricyclazole 190 g a.i/ha were next effective treatments in minimizing dead heart damage throughout the post treatment observation after first spray and contributed 15.2, 11.0 and 9.2 per cent; 16.5, 12.9 and 8.8 per cent; 20.2, 15.3 and 12.4 per cent and 22.3, 18.6 and 14.5 per cent at 7,10 and 15 DAT respectively. Dead heart damage was maximum in the untreated plot (32.6, 35.3 and 39.7% at 7, 10 and 15 DAT respectively).

Mean data indicated that dead heart ranged from 5.0 to 18.5 per cent due to all treatments. Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i./ha in combination with thiamethoxam 25 WG 25 g a.i/ha, monocrotophos 36 WSL 360 g a.i/ha, quinalphos 25 EC 375 g a.i/ha, urea 2%, tricyclazole 75 WP 375 g a.i/ha and carbendazim 50 WP 250 g a.i/ha were superior and on par in reducing the damage to 5.0, 5.2, 6.0, 7.2, 7.5 and 8.2 per cent and Highest per cent dead heart of 36.0 per cent was observed in untreated plot.

The effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE on white ear damage varied from 18.0 to 19.4 per cent before imposing first spray (Table 4). There was significant reduction on the white ear damage at 7, 10 and 15 DAT after second spray due to sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha in combination with thiamethoxam 25 WG 25 g a.i/ha (6.4, 3.2 and 1.5% respectively), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + monocrotophos 36 WSL 360 g a.i/ha (7.0, 3.5 and 0.9% respectively), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + quinalphos 25 EC 375 g (7.4, 3.5 and 1.3% respectively), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + carbendazim 50 WP 250 g a.i/ha (9.3, 5.8 and 2.1% respectively), sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + tricyclazole 75 WP 375 g a.i/ha (8.8, 5.7 and 2.6% respectively) and sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i/ha + urea (2%) (7.8, 4.5 and 2.6% respectively). Similar trend was followed on the third spray.

Mean data indicated that white ear ranged from 3.0 to 10.4 per cent due to all treatments. Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i./ha in combination with thiamethoxam 25 WG 25 g a.i/ha, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + monocrotophos 36 WSL 360 g a.i/ha, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + quinalphos 25 EC 375 g a.i/ha, urea 2%, sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + tricyclazole 75 WP 375 g a.i/ha and sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + carbendazim 50 WP 250 g a.i/ha were superior and on par in reducing the population to 3.0, 3.1, 3.4, 4.1, 4.7 and 4.7 per cent and registered 87.1, 86.7, 85.4, 82.4, 79.8 and 79.8 per cent reduction, respectively over control. Highest white ear damage of 23.3 per cent was observed in untreated plot.

The present results of two season were in accordance with the findings of Krishnaiah and Varma, (2008) [14] who indicated that the combination product viz., acephate 45% + cypermethrin 5% (500 g a.i./ha); beta cyfluthrin 1.25% + chlorpyriphos 25% at 393 g a.i./ha; BPMC 23% + chlorpyriphos 33% at 550 g a.i/ha and BPMC 30% + fipronil 1% (at 310 g a.i/ha) were effective against stem borer. Tiwari (2005) [15] reported that significant reduction in white heads was recorded in plots treated with chlorpyriphos 20 EC @ 500 g a.i./ga at 45, 60 and 75 DAT. Monocrotophos 36 SL @ 500g a.i/ha proved to be most effective insecticide against stem borer [16 & 17]. Singh *et al*. (2012) [18] revealed that monocrotophos 36 WSC was observed as the most effective chemical with minimum stem borer infestation (0.50% DH & 0.27% WEH) and maximum grain yield of 6.30 t/ha. Neelakanth *et al*, (2017) [19] found that lowest per cent of yellow stem borer damage recorded in tricyclazole + chlorpyriphos, azoxystrobin + chlorpyriphos combination and minimum per cent of leaf folder damage in carbendazim + flubendiamide and carbendazim + chlorpyriphos were found to be best. The flubendiamide + buprofezin 24 SC in combination with hexaconazole 5 SC and tricyclazole 75 WP recorded less DHs and WEs and produced highest yield of paddy (Seni *et al*., 2017) [20]. Karthikeyan (2015) [21] revealed that the combination of triazophos + tricylazole recorded lowest incidence of dead hearts and also recorded lowest incidence of white ear.

Table 1: Effect of sulfoxaflor 3.75+ chlorpyriphos 37.5 SE mixtures against *Scirpophaga incertulas* (Dead heart) on rice – I season (2012)

Treatments (a.i./ha)	Per cent dead heart on DAT				Mean	Per cent reduction over control
	Pre count	1st spray				
		7	10	15		
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + quinalphos 25 EC 375 g	24.4	8.5 ^{b}	4.6 ^{a}	2.4 ^{a}	5.2 ^{a}	84.3
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + quinalphos 25 EC 190 g	23.3	16.8 ^{f}	13.2 ^{f}	9.1 ^{e}	13.0 ^{abc}	60.8
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + monocrotophos 36 WSL 360 g	25.1	8.7 ^{b}	5.2 ^{b}	2.6 ^{a}	5.5 ^{ab}	83.4
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + monocrotophos 36 WSL 180 g	25.4	17.3 ^{g}	14.3 ^{g}	10.2 ^{f}	13.9 ^{abc}	58.1
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + thiamethoxam 25 WG 25 g	24.0	8.2 ^{a}	5.0 ^{ab}	3.3 ^{b}	5.4 ^{c}	83.7
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + thiamethoxam 25 WG 12.5 g	25.1	15.4 ^{e}	11.2 ^{e}	94 ^{e}	12.0 ^{abc}	63.8
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + carbendazim 50 WP 250 g	24.7	11.5 ^{d}	8.0 ^{d}	4.3 ^{d}	8.0 ^{abc}	75.9
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + carbendazim 50 WP 125 g	23.9	19.5 ^{h}	14.6 ^{g}	11.3 ^{g}	15.3 ^{bc}	53.9
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + tricyclazole 75 WP 375 g	24.1	10.5 ^{c}	7.4 ^{d}	4.3 ^{d}	7.4 ^{abc}	77.7
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + tricyclazole 75 WP 190 g	24.5	22.0 ^{i}	18.3 ^{h}	14.2 ^{h}	18.2 ^{c}	45.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 619 g + urea 2%	23.9	10.7 ^{c}	6.4 ^{c}	3.5 ^{c}	6.9 ^{ab}	79.2
Untreated control	24.4	29.5 ^{j}	33.5 ^{i}	36.6 ^{i}	33.2 ^{d}	-
CD (0.05)	-	0.30	0.67	0.45	9.50	-
SEd	-	0.14	0.32	0.22	4.58	-

Data are mean values of three replications
Values were transformed by square root transformation and the original values are given
Means with columns lacking common bold upper case superscript are significantly different (P<0.05)

Table 2: Effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE against *Scirpophaga incertulas* (White ear) on rice- I season (2012)

Treatments (a.i./ha)	Per cent white ear on DAT							Mean	Per cent reduction over control
	Pre count	2nd spray			3rd spray				
		7	10	15	7	10	15		
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + quinalphos 25 EC 375 g	16.1	7.3 ^{c}	3.4 ^{a}	1.2 ^{a}	3.9 ^{a}	3.1 ^{a}	2.1 ^{d}	3.5 ^{b}	83.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + quinalphos 25 EC 190 g	15.3	13.3 ^{h}	9.7 ^{b}	5.6 ^{d}	10.3 ^{g}	6.8 ^{d}	3.1 ^{ef}	8.1 ^{g}	61.1
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + monocrotophos 36 WSL 360 g	17.0	7.1 ^{b}	3.6 ^{a}	1.0 ^{a}	4.5 ^{b}	2.3 ^{a}	1.0 ^{a}	3.2 ^{a}	84.6
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + monocrotophos 36 WSL 180 g	16.4	13.3 ^{h}	10.3 ^{bc}	6.2 ^{e}	10.5 ^{gh}	7.0 ^{d}	3.3 ^{g}	8.4 ^{h}	59.6
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + thiamethoxam 25 WG 25 g	15.8	6.7 ^{a}	3.5 ^{a}	1.8 ^{b}	4.7 ^{b}	2.4 ^{a}	1.3 ^{bc}	3.4 ^{b}	83.6
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + thiamethoxam 25 WG 12.5 g	16.1	12.6 ^{g}	8.4 ^{b}	6.6 ^{c}	10.1 ^{g}	6.6 ^{d}	2.9 ^{fg}	7.9 ^{f}	62.0
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + carbendazim 50 WP 250 g	16.9	9.5 ^{f}	6.0 ^{b}	2.3 ^{c}	7.6 ^{e}	3.7 ^{c}	1.5 ^{c}	5.1 ^{e}	75.5
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + carbendazim 50 WP 125 g	17.3	15.8 ^{i}	10.9 ^{bc}	8.0 ^{f}	9.4 ^{f}	7.7 ^{e}	6.7 ^{h}	9.7 ^{i}	53.4
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + tricyclazole 75 WP 375 g	17.6	8.4 ^{e}	5.3 ^{a}	2.2 ^{c}	5.8 ^{c}	3.8 ^{c}	2.7 ^{e}	4.6 ^{d}	77.9
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + tricyclazole 75 WP 190 g	16.9	17.0 ^{j}	3.3 ^{c}	9.2 ^{g}	10.8 ^{h}	9.1 ^{f}	8.1 ^{i}	11.2 ^{j}	46.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 619 g + urea 2%	17.4	7.6 ^{d}	4.3 ^{a}	2.4 ^{c}	6.1 ^{d}	2.2 ^{a}	1.2 ^{ab}	3.9 ^{c}	81.2
Untreated control	16.4	21.4 ^{k}	24.6 ^{d}	27.6 ^{h}	14.4 ^{i}	16.3 ^{g}	20.5 ^{j}	20.8 ^{k}	-
CD (0.05)	-	0.29	2.77	0.58	0.38	0.08	0.13	0.21	-
SEd	-	0.14	1.33	0.28	0.19	0.04	0.06	0.10	-

Data are mean values of three replications
Values were transformed by square root transformation and the original values are given
Means with columns lacking common bold upper case superscript are significantly different (P<0.05)

Table 3: Effect of sulfoxaflor 3.75% + chlorpyriphos 37.5% SE mixtures against *Scirpophaga incertulas* (Dead heart) on rice – II season (2013)

Treatments (a.i./ha)	Per cent dead heart on DAT				Mean	Per cent reduction over control
	Pre count	1st spray				
		7	10	15		
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + quinalphos 25 EC 375 g	27.3	9.3 ^{c}	5.4 ^{c}	3.2 ^{c}	6.0 ^{c}	83.3
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 310 g + quinalphos 25 EC 190 g	27.4	16.5 ^{h}	12.9 ^{h}	8.8 ^{f}	12.7 ^{h}	64.7
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + monocrotophos 36 WSL 360 g	28.3	8.4 ^{b}	4.9 ^{b}	2.3 ^{a}	5.2 ^{b}	85.5
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 310 g + monocrotophos 36 WSL 180 g	28.4	16.9 ^{i}	13.9 ^{i}	9.8 ^{g}	13.5 ^{i}	62.5
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + thiamethoxam 25 WG 25 g	28.0	7.7 ^{a}	4.5 ^{a}	2.8 ^{b}	5.0 ^{a}	86.4
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 310 g + thiamethoxam 25 WG 12.5 g	2.9	15.2 ^{g}	11.0 ^{g}	9.2 ^{f}	11.8 ^{g}	67.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + carbendazim 50 WP 250 g	28.3	11.7 ^{f}	8.2 ^{f}	4.5 ^{e}	8.2 ^{f}	77.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 310 g + carbendazim 50 WP 125 g	28.6	20.2 ^{j}	15.3 ^{j}	12.4 ^{h}	16.0 ^{j}	55.6

Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + tricyclazole 75 WP 375 g	27.8	10.6 ^{d}	7.5 ^{e}	4.4 ^{e}	7.5 ^{e}	79.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 310 g + tricyclazole 75 WP 190 g	28.5	22.3 ^{k}	18.6 ^{k}	14.5 ^{i}	18.5 ^{k}	48.6
Sulfoxaflor 3.75 + chlorpyriphos 37.5 619 g + urea 2%	27.9	11.0 ^{e}	6.7 ^{d}	3.8 ^{d}	7.2 ^{b}	80.0
Untreated control	27.5	32.6 ^{l}	35.3 ^{e}	39.7 ^{j}	36.0 ^{l}	-
CD (0.05)	-	0.30	0.43	0.52	0.25	-
SEd	-	0.15	0.21	0.25	0.12	-

Data are mean values of three replications
Values were transformed by square root transformation and the original values are given
Means with columns lacking common bold upper case superscript are significantly different (P<0.05).

Table 4: Effect of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE mixtures against *Scirpophaga incertulas* (White ear) on rice – II season (2013)

Treatments (a.i./ha)	Per cent white ear on DAT							Mean	Per cent reduction over control
	Pre count	2nd spray			3rd spray				
		7	10	15	7	10	15		
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + quinalphos 25 EC 375 g	18.3	7.4 ^{c}	3.5 ^{a}	1.3 ^{a}	3.7 ^{a}	2.8 ^{c}	1.8 ^{d}	3.4 ^{c}	85.4
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + quinalphos 25 EC 190 g	18.0	13.8 ^{g}	10.0 ^{e}	5.9 ^{e}	10.3 ^{g}	6.5 ^{e}	2.8 ^{f}	8.1 ^{g}	65.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + monocrotophos 36 WSL 360 g	19.1	7.0 ^{b}	3.5 ^{a}	0.9 ^{a}	4.4 ^{c}	2.2 ^{ab}	0.9 ^{ab}	3.1 ^{b}	86.7
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + monocrotophos 36 WSL 180 g	19.3	14.1 ^{h}	11.1 ^{f}	7.0 ^{f}	10.7 ^{h}	7.2 ^{f}	3.5 ^{g}	8.9 ^{g}	61.8
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + thiamethoxam 25 WG 25 g	19.4	6.4 ^{a}	3.2 ^{a}	1.5 ^{b}	3.9 ^{b}	1.9 ^{a}	1.3 ^{c}	3.0 ^{a}	87.1
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + thiamethoxam 25 WG 12.5 g	18.6	12.8 ^{f}	8.6 ^{d}	6.8 ^{f}	9.7 ^{g}	6.2 ^{e}	2.3 ^{e}	7.8 ^{f}	66.5
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + carbendazim 50 WP 250 g	18.5	9.3 ^{e}	5.8 ^{c}	12.1 ^{c}	7.1 ^{f}	3.2 ^{d}	1.0 ^{a}	4.7 ^{e}	79.8
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + carbendazim 50 WP 125 g	18.9	16.3 ^{i}	11.4 ^{f}	8.5 ^{g}	9.8 ^{g}	8.1 ^{g}	7.1 ^{h}	10.2 ^{i}	56.2
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + tricyclazole 75 WP 375 g	19.0	8.8 ^{e}	5.7 ^{c}	2.6 ^{d}	5.5 ^{d}	3.5 ^{d}	2.2 ^{e}	4.7 ^{e}	79.8
Sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 309 g + tricyclazole 75 WP 190 g	18.8	16.1 ^{i}	12.4 ^{g}	8.3 ^{g}	10.0 ^{g}	8.3 ^{g}	7.3 ^{h}	10.4 ^{i}	55.4
Sulfoxaflor 3.75 + chlorpyriphos 37.5 619 g + urea 2%	18.2	7.8 ^{d}	4.5 ^{b}	2.6 ^{d}	6.2 ^{e}	2.3 ^{b}	1.3 ^{bc}	4.1 ^{d}	82.4
Untreated control	19.3	24.9 ^{j}	27.4 ^{h}	31.2 ^{h}	16.5 ^{i}	18.6 ^{h}	21.4 ^{i}	23.3 ^{j}	
CD (0.05)		0.29	0.50	0.58	0.40	0.68	0.53	0.16	
SEd		0.14	0.24	0.28	0.20	0.33	0.25	0.08	

Data are mean values of three replications
Values were transformed by square root transformation and the original values are given
Means with columns lacking common bold upper case superscript are significantly different (P<0.05).

Conclusion

It was concluded that the minimum infestation of stem borer was noticed in application of sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g a.i./ha in combination with quinalphos 25 EC 375 g which was found to be most superior in terms of reduced the population and infestation with lowest dead heart and white ear incidence as compare to other combinatinal treatments. But it was at par with sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + thiamethoxam 25 g a.i./ha followed by sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + monocrotophos 36 WSL 360 g and sulfoxaflor 3.75 + chlorpyriphos 37.5 SE 619 g + tricyclazole 75 WP 375 g combinations were superior and effective in reducing the per cent dead heart and white ear damage respectively. The overall results revealed that tank mixing of premixture insecticides with other insecticides, fungicides and urea involved in the present studies did not show any antagonistic effect with each other against rice yellow stem borer. Hence, they are compatible with each other for spray application to control the yellow stem borer, *S. incertulas*.

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