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Evaluation of Different Insecticidal Schedules against Rice Yellow Stem Borer *Scirpophaga incertulas* (Walker)

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Abstract

A field experimental trial was conducted during two consecutive *rabi* season of 2018–19 and 2019–20 at Regional Agricultural Research Station, Jagtial, Hyderabad, Telangana, India to evaluate different insecticidal schedules against yellow stem borer in rice. The lowest dead hearts incidence was observed in 15–20 days after transplanting(DAT) chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+50–60 DAT cartap hydrochloride 50 SP @ 400 g acre^{-1} schedule (0.38%) followed by 15–20 DAT chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+50–60 DAT cabofuran 3G @ 10 kg acre^{-1} schedule (0.47%) and 15–20 DAT chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+50–60 DAT acephate 75% SP @300 g acre^{-1} schedule (0.56%) where chlorantraniliprole0.4 GR was applied at 15–20 DAT. White ears were lowest recorded in15–20 DAT chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+50–60 DAT cartap hydrochloride 50 SP @ 400 g acre^{-1}schedule (1.70%) followed by 15–20 DAT carbofuran 3G @ 10 kg acre^{-1}+50–60 DAT cartap hydrochloride 50 SP @ 400 g acre^{-1} (2.21%). Regarding the yield data and cost benefit ratio of the treatments, highest yield and cost benefit ratio was observed in 15–20 DAT chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+50–60 DAT cartap hydrochloride 50 SP @ 400 g acre^{-1} schedule (7213 kg ha^{-1} and 1:3.87) followed by 15–20 DAT cartap hydrochloride 50 SP @400g acre^{-1}+50–60 DAT chlorantraniliprole 18.5SC @ 60 ml acre^{-1} schedule (7063 kg ha^{-1} and 1:3.30), respectively.

Keywords: Stem borer, dead hearts, white ears, yield, insecticides

1. Introduction

Rice (*Oryza sativa* L.) is one of the most important staple food crops and its cultivation secures a livelihood for more than two billion people. India is the world's top rice producer, while China is the world's largest rice producer (Kakde and Patel, 2014). About 90% of the rice produced is consumed within the country. Rice grains are rich in (100 g^{-1} dry weight) nutrients like protein (8.12 g), fat (0.8 g), carbohydrates (91 g), minerals and vitamins. In modern agriculture, high yielding rice varieties are extensively grown with the use of fertilizers and manures. Such cultivation pattern of rice accidentally or inadvertently offers infestation of a large number of insect pests, which results in to severe loss in crop yields. Insects are major constraint to rice production. Most of the rice plant parts are vulnerable to insect feeding from the time of sowing till harvesting. Both the mature and immature stages of insects injure rice plants by chewing leaf and root tissues, boring and tunnelling into stems, or sucking fluid sap from stems and grains. As the insect pests cause damage to rice plants and are one of the reasons of total annual yield loss of rice, it is important. The rice crop can be attacked by more than 100 species of insects and 20 of them can cause serious economic loss (Heinrichs et al., 2017; Salim et al., 2001). The average yield loss in rice have been accounted for 30% stem borers, plant hoppers 20%, gall midge 15%, leaf folder 10% and other pests 25%, respectively. Yellow stem borer (YSB) *Scirpophaga incertulas* (Walker), (Lepidoptera: Pyralidae), a monophagous pest of paddy is considered as most important nuisance of rain fed, low land and flood prone rice ecosystemsin Indian subcontinent (Deka and Barthakur, 2010). The rice stem borer, which infest the rice from seedling to maturity, act as a major constraint for the rice production, their larvae bore in to stem, feed on the inner tissue and usually one larva occurs per tiller. The damage symptoms due to stem borer larvae on affected plants differ with the development period at which plant infestation is initiated. The feeding of larvae cause 'dead heart' symptoms at the vegetative stage and the rice plants may be capable of recompense the damage during the stage of maximum tillering. During reproductive stage, feeding of larvae particularly in panicle initiation and ear head emergence, cause 'white ear' symptoms (Jadhao and Khurad, 2012) and with heavy infestation resulting profound loss in yield (Huesing and English, 2004; Sarwar, 2012; Dutta and Roy, 2018; Muralidharan and Pasalu, 2006; Dhaliwal et al., 2013). The extent of yield losses in rice due to YSB has been estimated as 20–70 % (Sharma et al., 2018). For effective management of this insect pest is depend on proper timing of insecticide application (Anonymous, 2007) and use of insecticides has positive impact on rice yields (Iqbal et al., 2000; Wakilet al., 2001; Misra and Panda, 2004; Dhuyo and Soomro, 2007; Bhutto and Soomro, 2010; Chakraborty, 2012; Abro et al., 2013). Insecticides are often highly effective, fast-acting, convenient and economical, making them the most powerful tools in pest management.By the change in the resistance level of pest and discovery of new chemicals with insecticidal activities always conduct field trials to evaluate their efficacy and timely application of suitable insecticide for the management of stem borer gives better results. Keeping in view of the above, in the present study an attempt had been made to evaluate insecticidal schedule against yellow stem borer in rice.

2. Materials and Methods

The experiment was carried out under field conditions at Regional Agricultural Research Station, Jagtialon paddy variety Jagtial rice 1 (JGL 24423) which is a popular variety in Northern Telangana Zone of Telangana state, India during rabi seasons (December-April) of 2018–19 and 2019–20. Experiment was laid in Randomized Block design with 10 treatments including untreated control and replicated thrice. Plot size of 25 m^2 was prepared and each plot each was separated by a 0.75 m for reducing drift of insecticidal spray. Twenty-five days old seedlings were transplanted at a spacing 15X15 cm during second week of January. The crop was raised by adopting a standard package of practices. The fertilizers @ 120:60:40 kg N:P:K per acre was applied. Insecticidal schedule was prepared with different insecticides. A total of two applications were given during crop period. Regarding yellow stem borer damage, dead hearts (DH) at vegetative stage and white ears (WE) were recorded randomly from 10 hills $plot^{-1}$ after ten days of insecticidal application. The% dead hearts and whit ears calculated by using following formula.

% Dead hearts=(Total number of dead hearts/Total number of tillers)×100

% White ears=(Total number of white ears/Total number of tillers)×100

The yield data was recorded from each plot separately. Cost benefit ratio was also assessed by dividing the net returns by the total additional cost due to insecticide application. The data on % damage was transformed to arc sine (Gomezand Gomez, 1984) using OPSTAT software.

3. Results and Discussion

Regarding the efficacy of insecticides at different insecticidal schedules against yellow stem borer reveal that,dead hearts incidence ranges from 3.12–5.00% before insecticidal application and the lowest dead hearts incidence was recorded in T_2 (15–20 DAT chlorantraniliprole 0.4 GR @4kg acre+50–60 DAT cartap hydrochloride 50 SP @400gacre) treatment (0.34%) followed by T_7 (15–20 DAT chlorantraniliprole 0.4 GR @4kg acre+ 50–60 DAT carbofuran 3G @10kg acre) treatment (0.47%) and T_9 (15–20 DAT chlorantraniliprole 0.4 GR @4kg acre+50 DAT acephate 75% SP @300g acre) treatment (0.56%) and these treatments on par with each other at 20 days after spraying. All the treatments were significantly superior over untreated control (10.48%) in reducing dead hearts incidence. These results were conformity with Karthikeyan et al. (2008) who acknowledged that the granular insecticides were highly effective in managing *S. incertulas* in rice. The efficacy of treatments against dead hearts as follows (Table 1).

$T_2>T_7>T_9>T_6>T_8>T_1>T_5>T_3>T_4>T_{10}$

Regarding the white ears, lowest was recorded in T_3 (15–20 DAT cartap hydrochloride 50 SP @ 400 g acre+50–60 DAT chlorantraniliprole 18.5SC @60ml acre) treatment (0.92%) followed by T_2 (15–20 DAT chlorantraniliprole 0.4 GR @4kg acre+50–60 DAT cartap hydrochloride 50 SP @400g acre) treatment (1.70%)and T_1 (15–20 DAT carbofuran 3G @10kg acre50-60 DAT cartap hydrochloride 50 SP @400g acre) treatment (2.21%). Efficacy of insecticidal schedule against white ears as follows.

$T_3>T_2>T_1>T_7>T_6>T_9>T_5>T_8>T_4>T_{10}$

The data on grain yield revealed that, all the insecticidal treatments were significantly superior to untreated control. The yield data (Table 2) indicated that, T_2(15–20 DAT chlorantraniliprole 0.4 GR @ 4 kg acre+50–60 DAT cartap hydrochloride 50 SP @400g acre) treatment recorded higher yield (7213 kg ha^{-1}) followed by T_3 (15–20 DAT cartap hydrochloride 50 SP @ 400 g acre 50–60 DAT chlorantraniliprole 18.5SC @ 60 ml acre) treatment (7063 kg ha^{-1}) and T_1 (1520 DAT carbofuran 3G @ 10 kg acre+50-60 DAT cartap hydrochloride 50 SP @ 400 g acre) treatment (6999 kg ha^{-1}). All the treatments were significantly superior over untreated control (5654 kg ha^{-1}). These results were supported by Bhutto and Soomro (2009) who reported that, granular insecticides increased the yield in paddy. Cost benefit ratio was calculated based on the yield data obtained during the seasons of rabi, 2018–19 and 2019–20. The highest costbenefit ratio was obtained in T_2 (1:3.87) followed by T_3 (1:3.30), T_1 (1:2.91), T_7 (1:2.34), T_6 (1:1.93), T_4 (1:1.92), T_5 (1:1.75), T_9 (1:1.71) and

Table 1: Efficacy of insecticidal schedules against yellow stem borer in rice during *rabi* 2018–19 and 2019–20

Treatments	Dead hearts (%)			White ears (%)
	Before spray	10 DAS	20 DAS	
T_1: 15–20 DAT Carbofuran 3G @ 10 kg acre^{-1}+ 50-60 DAT Cartap hydrochloride 50 SP @ 400 g acre^{-1}	4.19 (12.21)	2.37 (9.16)	1.36 (6.92)	2.21 (8.84)
T_2: 15–20 DAT Chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+ 50–60 DAT Cartap hydrochloride 50 SP @ 400 g acre^{-1}	3.19 (10.64)	1.20 (6.50)	0.38 (3.65)	1.70 (7.75)
T_3: 15–20 DAT Cartap hydrochloride 50 SP @ 400 g acre^{-1}+ 50–60 DAT Chlorantraniliprole 18.5SC @ 60 ml acre^{-1}	5.00 (13.36)	3.39 (10.97)	2.22 (8.86)	0.92 (5.67)
T_4: 15–20 DAT Profenophos 50 EC @ 400 ml acre^{-1}+ 50–60 DAT Thiaodicarb @ 200 g acre^{-1}	4.06 (12.02)	3.15 (10.57)	2.97(10.26)	8.32 (17.34)
T_5: 15–20 DAT Carbofuran 3G @ 10 kg acre^{-1}+50–60 DAT Emamectin benzoate 5SG @ 100 g acre^{-1}	4.64 (12.86)	2.62 (9.63)	1.61 (7.54)	6.72 (15.54)
T_6: 15–20 DAT Cartap hydrochloride @ 8 kg acre^{-1}+50–60 DAT Flubendiamide 480 SC @ 80 ml acre^{-1}	3.83 (11.67)	2.00 (8.42)	1.04 (6.05)	5.70 (14.28)
T_7: 15–20 DAT Chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+ 50–60 Cabofuran 3G @ 10 kg ha^{-1}	3.56 (11.25)	1.05 (6.08)	0.47 (4.08)	3.61 (11.32)
T_8: 15–20 DAT Carbofuran 3G @ 10 kg acre^{-1}+ 50–60 DAT Profenophos 50 EC @ 400 ml acre^{-1}	3.82 (11.66)	2.45 (9.31)	1.15 (6.36)	7.98 (16.97)
T_9: 15–20 DAT Chlorantraniliprole 0.4 GR @ 4 kg acre^{-1}+ 50–60 DAT Acephate 75% SP @ 300 g acre^{-1}	4.70 (12.94)	1.18 (6.45)	0.56 (4.43)	6.14 (14.83)
T_{10}: Untreated control	3.86 (11.72)	6.44 (15.20)	10.48 (19.54)	14.74 (23.35)
CD (p<0.05)	NS	0.96	0.84	0.68
SEm±	0.61	0.32	0.28	0.22
CV (%)	5.47	6.23	6.46	7.99

DAS: Days after spraying, NS: Non significant; Figures in parenthesis are arc sin transformed values

Table 2: Yield and cost benefit ratio of different insecticidal schedules in rice during *rabi* 2018–19 and 2019–20

Treatments	Yield (kg ha^{-1})	Cost of spray (insecticide+labour cost)	Additional yield over control (kg ha^{-1})	Profit of additional yield	Net profit (₹ ha^{-1})	C:B Ratio
T_1	6999	5500	13.46	21528	16028	1: 2.91
T_2	7213	5125	15.5	24944	19819	1: 3.87
T_3	7063	5245	14.10	22552	17307	1:3.30
T_4	6428	4250	7.75	12392	8142	1: 1.92
T_5	6527	5310	9.13	14608	9298	1: 1.75
T_6	6842	6480	11.88	19008	12528	1: 1.93
T_7	6931	6125	12.77	20432	14307	1: 2.34
T_8	6279	4800	6.26	10008	5208	1: 1.09
T_9	6502	5000	8.48	13568	8568	1:1.71
T_{10}	5654	-	-	-	-	-

1US$=₹ 76.7554

T_8 (1:1.09) (Table 2). The present findings were in agreement with reports of Sarao and Kaur (2013) and Fakruddin et al. (2017). However, new insecticide moleculesshowed higher efficacy in controlling yellow stem borer damage in rice due to their new broad spectrum and high insecticidal activity with novel mode of action.

4. Conclusion

Timely application of insecticides (15–20 DAT chlorantraniliprole 0.4 GR @ 4 kg acre+50–60 DAT cartap hydrochloride 50 SP @ 400 g acre schedule) was effective in controlling stem borer in rice.

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