DOI: 10.54083/PHA/1.2.2023/37-41

Plant Health Arch., 2023, 1(2):37-41

Plant Health Archives

e-ISSN: 2583-9659

July-September, 2023

Article ID: PHA011 **Research Article**

Bioefficacy of Carbosulfan 6G against the Rice Stem borer, *Scirpophaga incertulas* (Walker) in Karaikal District, Union Territory of Puducherry

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Conflict of interests: The author has declared that no conflict of interest exists.

How to cite this article?

Kumar and Kandibane, 2023. Bioefficacy of Carbosulfan 6G against the Rice Stem borer, *Scirpophaga incertulas* (Walker) in Karaikal District, Union Territory of Puducherry. *Plant Health Archives* 1(3), 37-41.. DOI: 10.54083/PHA/1.2.2023/37-41

Abstract

Two field experiments were conducted during *kharif*, and *rabi* to evaluate the efficacy of carbosulfan 6G against the rice stem borer in the eastern farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI), Karaikal. During *kharif*, a least percent dead heart was recorded in the treatments *viz.*, Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} ranging from 1.45-1.88 and 3.22-3.88 percent dead heart at 14 and 21 days after the first application respectively. A lower percent white ear of 3.85 and 7.18 was recorded in Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} treatment which is on par with the treatments like Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} (4.67 and 7.36) and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} (4.79 and 8.12) at grain filling and at harvest stage respectively. During *rabi,* a least percent dead heart was recorded in the treatments *viz.*, Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} ranging from 2.16-2.67 and 4.20-4.72 percent dead heart at 14 and 21 days after the first application respectively while a least percent white ear of 2.89 and 5.74 was recorded in Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} treatment which is on par with the treatments like Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} (3.70 and 6.48) and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} (3.92 and 7.45) at grain filling and at harvest stage respectively. From the results of the field experiments, it was found that, the Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} as broadcast application in rice can be recommended for effective control of stem borer, *S. incertulas*.

Keywords: Carbosulfan, Efficacy, Rice, *Scirpophaga incertulas,* Stem borer

Introduction

Rice, scientifically known as *Oryza sativa* L., holds a prominent position as one of the world's most vital crops, serving as a fundamental dietary staple for nearly 50% of the world's population (Heinrichs *et al.*, 2017; Pathak, 1977). The rice crop faces a potential threat from over 100 different insect species, with approximately 20 of them capable of inflicting significant economic loss (Heinrichs *et al.*, 2017; Pathak, 1977). Among these pests, *Scirpophaga incertulas* stands out as the most formidable, posing a grave risk of causing substantial damage and yield loss to the rice crop during its later stages of growth (Yadav and Gupta, 2020; Yadav *et al.*, 2019). In India, *S. incertulas* has earned the dubious distinction of holding the top position as the most significant pest, as it can attack the rice crop at all stages of its growth (Pasulu *et al*., 2002; Yadav and Gupta, 2020). The presence of rice stem borers, which infest rice from seedling to maturity, poses a significant obstacle to rice production (Dale, 1994; Hugar *et al.*, 2010; Pathak, 1975). During the vegetative stage, the larvae of *Scirpophaga incertulas* result in dead hearts, while in the reproductive stage, they lead to the formation of white ear heads (Hugar *et al.*, 2010). The prime importance of applying insecticides arises when the

Article History

RECEIVED on 21st May 2023 RECEIVED in revised form 11th August 2023 ACCEPTED in final form 08th August 2023

pest population surpasses the economic threshold level. This approach aims to minimize the damage caused by the pest to a certain extent, which, in turn, can contribute to achieving a measurable yield (Yadav and Gupta, 2020). The utilization of insecticides has a favorable impact on rice yields (Abro *et al.*, 2013), and insecticides are frequently highly effective, rapid-acting, convenient and cost-effective, rendering them the most potent tools in pest management. The new insecticides should possess effectiveness in minimizing pest damage, cost-effectiveness, biodegradability and safety for natural enemies and other non-target organisms (Hugar *et al.*, 2010).

Materials and Methods

Two field experiments were conducted in the eastern farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI), Karaikal, during *kharif*, and *rabi* in a Randomized Block Design (RBD), followed by Dhivya and Kumar (2020) with seven treatments and were replicated thrice in an experimental area of 8 × 3.5 m^2 each with rice variety of ADT 39. The treatments included carbosulfan 6G (FMC-PY) @ 10, 12.5, 16.7, 20.8 kg ha^{-1}, carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1}, phorate 10G @ 10 kg ha^{-1} were evaluated along with the untreated control. The treatments were applied at 21 and 45 days after transplanting (DAT) in the two seasons.

The percent dead heart caused by stem borer, *S. incertulas* was recorded at two intervals *i.e.* at 14 and 21 days after first application of Carbosulfan 6G and after second application of Carbosulfan 6G percent white ears were recorded at grain filling stage and harvest stage on five randomly selected hills from each plot. The percent dead hearts and white ears were worked out using the formula,

$$\text{Percent dead hearts/ white ears} = \frac{\text{Total No. of tillers/ 5 hills - No. of affected tillers/ 5 hills}}{\text{Total No. of tillers/ 5 hills}} \times 100$$

The data recorded for stem borer damage were subjected to arcsine transformation. Grain yield of rice were recorded at the time of harvest and yield was computed to kg ha^{-1}.

Results and Discussion

The results of the field experiment during *Kharif* indicated that the least percent dead heart was recorded in the treatments *viz.*, Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} ranging from 1.45-1.88 and 3.22-3.88 percent dead heart at 14 and 21 days after the first application respectively. The observation on percent white ears recorded after second application at grain filling and harvest stage of crop indicated that, the treatments like, Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} recorded significantly least percent white ears compared to all other treatments. The least percent white ear of 3.85 and 7.18 was recorded in Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} treatment which is on par with the treatments like Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} (4.67 and 7.36) and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} (4.79 and 8.12) at grain filling and at harvest stage, respectively.

The percent control of stem borer damage followed same trend as that of percent dead heart and percent white ear observations. Where, Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} recorded highest percent control over check of 89.53 and 81.49 percent dead heart control at 14 and 21 days after first application respectively and 86.31 and 78.31 percent white ear control over check at grain filling and at harvest stage respectively. The above treatment remained on par with Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} treatments in controlling stem borer damage in rice and proved significantly superior to the standard Phorate 10G @ 10 kg ha^{-1} and lower dose treatments of Carbosulfan 6G *viz*., Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1} and Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1} (Table 1 & 2).

Table 1: Bioefficacy of carbosulfan 6G (FMC-PY) against stem borer (*Scirpophaga incertulas*) in Rice after first application during *kharif*

Treatments	Percent dead heart m^{-2}		Percent control over check	
	14 DAA	21 DAA	14 DAA	21 DAA
T_1: Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1}	**14.28 *(6.12)	17.85 (9.45)	55.81	55.81
T_2: Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1}	13.32 (5.34)	16.86 (8.46)	61.44	51.38
T_3: Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1}	7.65 (1.78)	11.13 (3.74)	87.15	78.51
T_4: Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1}	6.91 (1.45)	10.33 (3.22)	89.53	81.49
T_5: Carbosulfan 6G (Sheriff 6G) @ 16.7 kg ha^{-1}	7.86 (1.88)	11.34 (3.88)	86.43	77.70
T_6: Phorate 10G @ 10 kg ha^{-1}	13.48 (5.46)	17.25 (8.84)	60.58	49.20
T_7: Untreated control	21.83 (13.85)	24.63 (17.40)	-	-
S.Em.	0.39	0.48	-	-
CD at 5%	1.20	1.48	-	-

Table 2*:* Bioefficacy of carbosulfan 6G (FMC-PY) against stem borer (*Scirpophaga incertulas*) in Rice after second application during kharif

Treatments	Percent white ear m^{-2}		Percent control over check	
	GFS	At harvest	GFS	At harvest
T_1: Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1}	19.98** (11.74)*	25.40 (18.50)	58.25	44.11
T_2: Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1}	18.73 (10.36)	23.40 (15.85)	63.16	52.11
T_3: Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1}	12.45 (4.67)	15.71 (7.36)	83.39	77.76
T_4: Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1}	11.30 (3.85)	15.52 (7.18)	86.31	78.31
T_5: Carbosulfan 6G (Sheriff 6G) @ 16.7 kg ha^{-1}	12.62 (4.79)	16.52 (8.12)	82.97	75.47
T_6: Phorate 10G @ 10 kg ha^{-1}	18.90 (10.54)	24.21 (16.89)	62.52	
T_7: Untreated control	32.00 (28.12)	35.09 (33.10)	-	-
S.Em.	0.57	0.71	-	-
CD at 5%	1.75	2.18	-	-

[**Arc sine transformed values; *Figures in the parentheses are original values; GFS: Grain filling stage]

The results of the field experiment during *rabi* indicated that the least percent dead heart was recorded in the treatments *viz*., Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} ranging from 2.16-2.67 and 4.20-4.72 percent dead heart at 14 and 21 days after the first application respectively. The observation on percent white ears recorded after second application at grain filling and harvest stage of crop indicated that, the treatments like, Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} recorded significantly least percent of white ears compared to all other treatments. The least percent white ear of 2.89 and 5.74 was recorded in Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} treatment which is on par with the treatments like Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} (3.70 and 6.48) and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} (3.92 and 7.45) at grain filling and at harvest stage, respectively.

The percent control of stem borer damage followed same trend as that of percent dead heart and percent white ear observations. Where, Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} recorded highest percent control over check of 87.04 and 78.07 percent dead heart control at 14 and 21 days after first application respectively and 87.5 and 78.34 percent white ear control over check at grain filling and at harvest stage respectively. The above treatment remained on par with Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} treatments in controlling stem borer damage in rice and proved significantly superior to the standard Phorate 10G @ 10 kg ha^{-1} and lower dose treatments of Carbosulfan 6G *viz*., Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1} and Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1} (Table 3 & 4).

The final grain yield recorded in rice indicated that, among all the treatments Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1} (5005 kg ha^{-1}, 5102 kg ha^{-1}) recorded highest yield followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} (4948 kg ha^{-1}, 5045 kg ha^{-1}) and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} (4804 kg ha^{-1}, 4990 kg ha^{-1}). The above three treatments remained on par among themselves and significantly superior to the standard Phorate 10G @ 10 kg ha^{-1} (4375 kg ha^{-1}, 4520 kg ha^{-1}) and other Carbosulfan 6G treatments like, Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1} (4350 kg ha^{-1}, 4482 kg ha^{-1}) and Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1} (4136 kg ha^{-1}, 4376 kg ha^{-1}). The least yield was recorded in untreated control treatment (3562 kg ha^{-1}, 4005 kg ha^{-1}) during *kharif* and *rabi* seasons respectively (Table 5).

Based on the results of two season experiments, it can be concluded that Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1}, Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} and Carbosulfan 6G (Sheriff) @ 16.7 kg ha^{-1} recorded significantly lower stem borer infestations in terms of dead heart and white ear and higher rice yield among all the treatments and remained on par with each other and statistically superior to the standards *viz*., Phorate 10G @ 10 kg ha^{-1}.

Karthikeyan and Purushothaman (2000) reported that, carbosulfan 1000 g a.i. ha^{-1} against the stem borer, *S. incertulas* in rice showed a greater reduction of dead heart with a higher yield (3492 kg ha^{-1}) compared to the standard carbofuran and untreated check. The results of the field experiment carried out at College of Agriculture, Navile, Shimoga, University of Agricultural Sciences, Bangalore, during *kharif* 2006 showed superiority of fipronil 0.3G @ 7.5 g a.i. ha^{-1} followed by carbosulfan 6G @ 1000 g a.i. ha^{-1} against the rice yellow stem borer *S. incertulas*; similar experiment was conducted by Hugar *et al.* (2010). Yadav and Gupta (2020) conducted a field experiment at Crop Research Station, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh against yellow stem borer, *Scirpophaga incertulas* infesting rice during *kharif*. It was stated that the order of efficacy of tested insecticides after first dose of insecticides application was Fipronil 5% SC > Chlorantraniliprole 0.4G > Carbosulfan 6G > Carbofuran 3G > Cartap hydrochloride 50% SP > Imidacloprid 17.8% SL > Monocrotophos 36% SL; while, the order of

Table 3: Bioefficacy of carbosulfan 6G (FMC-PY) against stem borer (*Scirpophaga incertulas*) in Rice after first application during *rabi*

Treatments	Percent dead heart m^{-2}		Percent control over check	
	14 DAA	21 DAA	14 DAA	21 DAA
T_1: Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1}	**15.79 *(7.45)	18.27 (9.89)	55.31	48.36
T_2: Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1}	14.26 (6.10)	16.89 (8.48)	63.41	55.72
T_3: Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1}	9.04 (2.48)	12.22 (4.50)	85.12	76.50
T_4: Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1}	8.44 (2.16)	11.81 (4.20)	87.04	78.07
T_5: Carbosulfan 6G (Sheriff 6G) @ 16.7 kg ha^{-1}	9.39 (2.67)	12.52 (4.72)	83.98	75.35
T_6: Phorate 10G @ 10 kg ha^{-1}	15.24 (6.95)	17.51(9.10)	58.31	52.48
T_7: Untreated control	24.07 (16.67)	25.93 (19.15)	-	-
S.Em.	0.43	0.49	-	-
CD at 5%	1.33	1.52	-	-

Table 4*:* Bioefficacy of carbosulfan 6G (FMC-PY) against stem borer (*Scirpophaga incertulas*) in Rice after second application during *rabi*

Treatments	Percent white ear m^{-2}		Percent control over check	
	GFS	At harvest	GFS	At harvest
T_1: Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1}	18.85** (10.50)*	21.82 (13.89)	54.58	47.58
T_2: Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1}	18.25 (9.86)	20.65 (12.50)	57.35	52.83
T_3: Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1}	11.07 (3.70)	14.71 (6.48)	84.00	75.55
T_4: Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1}	9.78 (2.89)	13.85 (5.74)	87.50	78.34
T_5: Carbosulfan 6G (Sheriff 6G) @ 16.7 kg ha^{-1}	11.40 (3.92)	15.81 (7.45)	83.04	71.89
T_6: Phorate 10G @ 10 kg ha^{-1}	17.61 (9.20)	20.32 (12.12)	60.21	54.26
T_7: Untreated control	28.71 (23.12)	30.96 (26.50)	-	-
S.Em.	0.53	0.60	-	-
CD at 5%	1.62	1.85	-	-

[**Arc sine transformed values; *Figures in the parentheses are original values; GFS: Grain filling stage]

Table 5: Effect of carbosulfan 6G (FMC-PY) on yield and yield parameters of rice variety ADT 39

Treatments	Grain yield (kg ha^{-1})	
	Kharif	Rabi
T_1: Carbosulfan 6G (FMC-PY) @ 10 kg ha^{-1}	4136	4376
T_2: Carbosulfan 6G (FMC-PY) @ 12.5 kg ha^{-1}	4350	4482
T_3: Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1}	4948	5045
T_4: Carbosulfan 6G (FMC-PY) @ 20.8 kg ha^{-1}	5005	5102
T_5: Carbosulfan 6G (Sheriff 6G) @ 16.7 kg ha^{-1}	4804	4990
T_6: Phorate 10G @ 10 kg ha^{-1}	4375	4520
T_7: Untreated control	3562	4005
S.Em.	114.10	119.34
CD at 5%	351.59	367.74

efficacy of tested insecticides was recorded to be Fipronil 5% SC > Carbosulfan 6G ≥ Cartap hydrochloride 50% SP > Chlorantraniliprole 0.4G > Carbofuran 3G > Monocrotophos 36% SL > Imidacloprid 17.8% SL, respectively, after the second dose of insecticides application (Yadav and Gupta, 2020). The above findings are found to support the present findings.

Conclusion

It is concluded that Carbosulfan 6G (FMC-PY) @ 20.8 kg

ha^{-1} followed by Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} recorded significantly lower stem borer infestation; and hence, Carbosulfan 6G (FMC-PY) @ 16.7 kg ha^{-1} as broadcast application in rice can be recommended for effective control of stem borer, *S. incertulas*.

Acknowledgement

The author is grateful to acknowledge FMC Pvt. India Ltd., for providing financial support towards the conduct of the experiments.

References

Abro, G.H., Syed, T.S., Shah, A.H., Cui, J., Sattar, M., Awan, M.S., 2013. Efficacy and economics of different insecticides against stem borers, *Scirpophaga incertulas* (Walker) in rice crop. *Pakistan Journal of Zoology* 45(4), 929-933.

Dale, D., 1994. Insect pests of rice plants - their biology and ecology. In: *Biology and Management of Rice Insects*. (Ed.) Heinrichs, E.A. IRRI. Wiley Eastern Ltd. pp. 363-485.

Dhivya, G., Kumar, K., 2020. Efficacy of essential oils against the rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) in Karaikal district, U.T. of Puducherry. *International Journal of Chemical Studies* 8(6), 306-310. DOI: 10.22271/chemi.2020.v8.i6e.10784.

Heinrichs, E.A., Nwilene, F.E., Stout, M.J., Hadi, B.A.R., Frietas, T., 2017. *Rice Insect Pests and Their Management*. 1st Edition. Burleigh Dodds Science Publishing Ltd., Cambridge. p. 277.

Hugar, S.V., Hosamani, V., S., Pradeep, Hanumanthaswamy, B.C., 2010. Evaluation of new chemical molecules for the management of *Scirpophaga incertulas* Walker, in Aerobic rice. *International Journal of Plant Protection* 2(2), 205-208.

Karthikeyan, S., Purushothaman, S.M., 2000. Efficacy of carbosulfan against rice yellow stem borer, *Scirpophaga incertulas* Walker (Pyralidae: Lepidoptera). *Indian Journal of Plant Protection* 28(2), 212-214.

Pasulu, I.C., Krishnaiah, N.V., Kotti, G., Varma, N.R.G., 2002. IPM in Rice. *IPM Newsletter*, pp. 45-55.

Pathak, M.D., 1977. Defense of the rice crop against insect pests. *Annals of the New York Academy of Sciences* 287(1), 287-295. DOI: 10.1111/j.1749-6632.1977.tb34247.x.

Pathak, M.D., 1975. *Insect Pest of Rice*. Indian Rice Research Institute, Phillippines. p. 68.

Yadav, A., Gupta, P.K., 2020. Evaluation of new insecticide molecules against Rice Yellow Stem Borer *Scirpophaga incertulas* Walker (Pyralidae: Lepidoptera) under Faizabad condition. *International Journal of Current Microbiology and Applied Sciences* 9(4), 2772-2777. DOI: 10.20546/ijcmas.2020.904.327.

Yadav, A., Gupta, P.K., Kurulkar, U., 2019. Incidence of insect-pests on Rice in Faizabad. *International Journal of Current Microbiology and Applied Sciences* 8(06), 551-555. DOI: 10.20546/ijcmas.2019.806.064.