www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(9): 191-195

www.thepharmajournal.com
Received: 02-06-2023
Accepted: 08-08-2023

Hitendra Kumar
Department of Entomology
School of Agricultural Sciences
Shri Guru Ram Rai University
Dehradun, Uttarakhand, India

Sarvendra Singh
Department of Entomology
RMP PG College
Gurukul Narsan, Haridwar,
Uttarakhand, India

Ravindra Kumar
Department of Biotechnology
School of Basic and Applied
Sciences Shri Guru Ram Rai
University, Dehradun,
Uttarakhand, India

Corresponding Author:
Hitendra Kumar
Department of Entomology
School of Agricultural Sciences
Shri Guru Ram Rai University
Dehradun, Uttarakhand, India

Management of yellow stem borer, *Scirpophaga incertulas* (Walker) in rice by using different eco-friendly methods at Dehradun District of Uttarakhand

Hitendra Kumar, Sarvendra Singh and Ravindra Kumar

Abstract
The study was carried out at farmer's field in Doiwala area of district Dehradun, Uttarakhand during *kharif*-2021 and 2022 to assess the effectiveness of different eco-friendly methods of pest management against *Scirpophaga incertulas* (Walker) in rice**.** Pheromone traps and lures of two different brands were used in this study. The traps were installed at a spacing of 25 m X 20 m on two meter high wooden sticks. Weekly counts were made on the *S. incertulas* male moths held in the polythene sleeves of traps. To measure the damage of *S. incertulas*, total number of tillers and number of dead hearts in vegetative stage and number of panicle bearing tillers and white ear head during reproductive stage were also counted on randomly selected hills in each treatment. The average number of insects trapped was relatively high in treatment I, where only pheromone traps were installed and no chemical was applied, as compared to treatment II and III. Without pheromone mass trapping or insecticide spraying, treatment IV shown a noticeably greater infestation during the fourth week of September. Results revealed that level of attack was less in second and third week of August during 2022 in treatment II and III. The benefit cost ratio of treatment II installed with pheromone traps @ 20/ha along with application of Azadirachtin 5.00% was cost effective for management of *S. incertulas* in rice at Doiwala area of Dehradun during both year of study.

Keywords: Rice, *Scirpophaga incertulas*, pheromone traps, azadirachtin

Introduction
Rice, the key and indispensable food crop of world is attacked by a number of insect pests during its different growth stages. In India, around 100 insect species take their nutrition from rice and nearly 18 of these are deliberated to be the major pests of rice causing significant yield loss (Jena *et al*., 2018; Katti, 2021) [5, 7].

In the majority of the world's rice agro-ecosystem, the Yellow Stem Borer, *Scirpophaga incertulas* (Walker), is a significant pest. In several Asian nations, it is especially harmful due to prevalence of favourable abiotic and abiotic factors for its incidence and multiplication in rice (Kakde and Patel, 2018; Sudharani *et al*. 2021) [6, 13]. Many Indian states, including Andhra Pradesh, Tamil Nadu, Karnataka, Kerla, Maharasthra, Orissa, Uttar Pradesh, Uttarakhand, Punjab, Haryana, Himachal Pradesh, Bihar, West Bengal, and Assam, experience serious damage to their rice crops due to *S. incertulas* (Senapati and Panda, 1999) [11].

Incidence of *S. incertulas* on rice is a significant limitation that led to 3–95% yield losses in India due to low yield output in nearly all rice ecosystems (Krishnaiah and Verma, 2015; Singh and Triveni, 2019) [9, 12].

In fact, rice consumes the maximum insecticides after cotton because of the crucial function that these chemicals play in the management of this pest. However, because of their imprecise application, we rarely obtain favourable benefit-cost ratios (Abhinandan and Gupta, 2020; Kinjale *et al*., 2021; Bhagat *et al*. 2022) [1, 8, 2].

The integration of alternative non-chemical methods with need based and green label chemical control is becoming more popular and is an effort to make it more affordable and environmentally safe. Recent studies suggest that pheromone-mediated mass trapping is particularly successful for the control of *S. incertulas* and, when combined with use of plant origin bio-insecticides such as neem, has the ability to keep the pest population below the level that causes economic damage. (Varma *et al*., 2000; Patel and Desai, 2004; Chatterjee and Mondal, 2014; Chatterjee *et al*. 2017) [14, 10, 3, 4].

However, due to the wide variation in pest problem, safe and ecofriendly pest management methods are required to develop for different agro ecosystems. In the present study, we tried to assess the effectiveness of pheromone mediated mass trapping along with use of safer insecticides for management of yellow stem borer in rice during *kharif* -2021 and 2022 at Doiwala, Dehradun.

Materials and Methods

The study was carried out at farmers' field in Doiwala area of district Dehradun, Uttarakhand during *kharif*-2021 and *kharif*-2022. The experimental consisted of four treatments *viz*., Treatment-I (Pheromone Traps only), Treatment-II (Pheromone traps + Azadirachtin 5.00%), Treatment-III (clipping of rice seedling tips + pheromone traps + need based application of Chlorantraniliprole 18.50% SC) and Treatment-IV (Farmers' Practice). Experimental area of respective treatment was divided into four plots, thus each consisting of four replications.

The pheromone traps of two different brands were used in this study. For the purpose of secrecy of pheromone manufacturing company, we have designated the products as YSBPE-1 & YSBPE-2. The pheromone traps were installed at a spacing of 25 m X 20 m on a two meter high wooden sticks. We installed twenty traps per ha in all the treatments. Three milligram pheromone lures of both YSBPE-1 & YSBPE-2 were fixed in the traps alternatively at 25 DAT during *kharif* -2021 and 26 DAT during *kharif* -2022. The lures were replaced in each treatment after every 21 days interval. The trap height was maintained at 1/4 meter above crop canopy through out the study duration.

Weekly counts were made on *S. incertulas* male moths caught in the polythene sleeves of traps. To measure the damage of *S. incertulas*, total number of tillers and number of dead hearts during vegetative stage and number of panicle bearing tillers and white ear head during reproductive stage were counted on 100 randomly selected hills in each replication. Data on grain yield was recorded at the time of harvesting from 10 × 10 sq.ft. Area in each replication of all the treatments.

Results and Discussion

Table 1 provides information on the average number of male *S. incertulas* moths captured in various treatments during *kharif* -2021. These findings indicate that the insect persisted in all the treatments throughout the rice crop season. Observations taken on trap catch signposts that population of *S. incertulas* was high in all the treatments at 7 and 14 days after installation of traps. The average number of trapped insects was relatively high in treatment I, where only pheromone traps were installed and no chemical was applied, as compared to treatment II and III. While in treatment I this peak was reported at 28 and 56 days after installation but in treatment II and III more adults were confined at 28 and 49 days following installation.

Results of the effectiveness of various pheromone lures shows that, in all treatments with pheromone traps fitted, the average number of moths captured by YSBPE-1 lures was higher than that by YSBPE-2 lures. Percent dead hearts/white heads caused by *S. incertulas* during *kharif* -2021 is given in Table 2. This revealed that level of pest attack was less in second and third week of August in treatment II and III. Less infestation was seen in treatment IV (farmers practice) in the fourth week of August, and it was absent from all subsequent treatments by the first week of September. Without pheromone mass trapping or insecticide spraying, treatment IV had a noticeably greater infestation during the fourth week of September. In treatment III, where chlorantraniliprole 18.50% SC was sprayed both in the nursery and the main field in addition to pheromone mass trapping and trimming of seedling tip, the mean infestation was considerably reduced. Data on yield of various treatments did not differ significantly, even though it ranges from 1588.15 to 2123.68kg/ha and was relatively superior in treatment II than other treatment.

According to Table 3, which details the benefit cost ratio (BCR) calculated for 2021, treatment I and II had BCR of 1.28:1 and 1.53:1, respectively, whereas treatment III and IV (farmers practice) produced benefits of 1.14:1 and 1.35:1 for each unit cost.

The average number of moth caught in different treatments during *kharif* -2022 is presented in Table 4. These results specify that during this year also *S. incertulas* persisted during the entire season of rice crop. The population level of insect in this year was nearly identical to that in 2021. The majority of *S. incertulas* adults were captured in all of the pheromone traps during the first week of September. In treatment I, which used only pheromone traps and no insecticide, the greatest number of moths were captured during this year. In all three other treatments, YSBPE-1 lures attracted a greater number of *S. incertulas* moths than YSBPE-2 lures.

Percent dead hearts/white heads caused by *S. incertulas* during *kharif*-2021 is given in Table 5. The average incidence of *S. incertulas* was much lower in the first week of September than it was in the fourth week, with peak in the latter part of the month. The mean infestation was found to be pointedly small in treatment III, applied with chlorantraniliprole 18.50% SC both in rice nursery and main field along with pheromone mass trapping and clipping of rice seedling tips.

There was no significant difference detected in yield of different treatments during *kharif* -2022; however, it was fairly high in treatment II in which Azadirachtin 5.00% was applied in addition to pheromone traps.

Table 6 indicated that again high benefit cost ratio (BCR) was found in treatment II (1.80:1) in which Azadirachtin 5.00% was applied in addition to pheromone traps, followed by treatment IV (1.40:1), where farmer used crop cultivation practices of his choice. Treatment III, treated with chlorantraniliprole 18.50% SC both in nursery and main field along with pheromone mass trapping and clipping of rice seedling tips and treatment I installed with pheromone traps only, gave the BCR of 1.12:1 and 1.19: 1, respectively.

Our findings indicate that treatment II installed with pheromone traps @ 20/ha along with application of Azadirachtin 5.00% only was cost effective for management of *S. incertulas* in rice at Doiwala area of Dehradun. Use of neem based insecticides such as Azadirachtin 5.00% is crucial in current scenario, when we are promoting use of organic or non-chemical methods for pest management. Insect Pheromones has also emerged as an important line of defense against some important pests of rice like *S. incertulas*, where they are being used for mass trapping and mating disruption purpose. If we avoid the use of synthetic organic insecticides in crops like rice, then we are protecting our agro-ecosystem from pollution and even saving the lives and health of farmers and consumers.

Table 1: Average male moths of *S. incertulas* trapped in YSBPE-1 & YSBPE-2 baited pheromone traps during *kharif* -2021 at Doiwala, Dehradun

Date	DAI	YSBPE-1	YSBPE-2	Average
Treatment-I				
14-8-21	7	8.40±4.38	8.50±4.84	8.45
21-8-21	14	7.42±6.70	8.43±5.65	7.93
28-8-21	21	0.60±0.00	1.67±0.58	1.14
04-9-21	28	3.90±2.18	4.30±3.16	4.10
11-9-21	35	1.00±0.00	1.50±0.70	1.25
18-9-21	42	1.00±0.00	1.50±0.70	1.25
25-9-21	49	3.88±2.90	1.00±0.00	2.44
2-10-21	56	4.00±3.37	4.14±2.12	4.07
Average	–	3.78	3.88	3.83
Treatment-II				
14-8-21	7	1.90±2.05	8.20±4.76	5.05
21-8-21	14	4.70±3.23	5.00±2.94	4.85
28-8-21	21	1.50±0.70	0.10±0.00	0.80
04-9-21	28	4.11±2.67	4.50±4.04	4.30
11-9-21	35	1.25±0.50	1.25±0.70	1.25
18-9-21	42	1.50±0.58	1.00±0.00	1.25
25-9-21	49	6.67±3.12	4.63±2.50	5.65
2-10-21	56	2.50±1.41	1.40±0.55	1.95
Average	–	3.02	3.26	3.14
Treatment-III				
14-8-21	7	1.12±6.58	7.00±4.06	4.06
21-8-21	14	2.56±1.13	5.88±3.83	4.22
28-8-21	21	1.00±0.00	3.00±1.41	2.00
04-9-21	28	3.62±1.77	3.14±2.34	3.38
11-9-21	35	1.20±0.45	2.00±1.22	1.60
18-9-21	42	1.00±0.00	1.25±0.50	1.13
25-9-21	49	4.25±1.58	6.56±3.28	5.40
2-10-21	56	2.67±1.15	3.86±1.95	2.27
Average	–	2.18	4.09	3.14

Table 2: Percent dead hearts/white heads caused by *S. incertulas* in rice crop during *kharif* -2021 at Doiwala, Dehradun

Treatment	Percent dead hearts/white heads								Mean	Yield (kg/ha)
	14-8-21	21-8-21	28-8-21	04-9-21	11-9-21	18-9-21	25-9-21	02-10-21		
I	1.30	4.72	0.00	0.00	1.97	2.38	3.80	6.29	2.56	1816.94
II	2.64	0.96	0.00	0.00	0.80	2.09	1.89	5.01	1.68	2123.68
III	0.90	2.38	0.00	0.00	0.39	0.93	2.95	3.42	1.37	1935.84
IV	2.94	1.34	0.26	0.00	1.52	3.41	5.70	5.41	2.57	1588.15
Mean	1.94	2.35	0.064	0.00	1.17	2.20	3.59	5.03		
		Treatment (A)		Interval (B)		A × B		Yield		
S.Em.±		0.23		0.33		0.65		285.83		
Cd at 5%		0.64		0.90		1.82		987.79		

Table 3: Benefit-Cost ratio among different treatments during *kharif* -2021 at Doiwala, Dehradun

Particulars	Cost in Rs.			
	Treatment I	Treatment II	Treatment III	Treatment IV
Field preparation	5625	5625	5625	5625
Fertilizer application	3062	3062	3062	3062
Weeding/herbicide	975	975	975	975
Insecticide application	–	–	2000	–
Fungicide application	725	725	725	725
Costs of pheromone mass trapping	2260	2260	2260	–
Crop cut operation	2500	2500	2500	2500
Total cost	15147	15947	17147	12787
Gross return	34522	40350	36781	30175
Net return	19375	24403	19634	17388
BCR	1.28:1	1.53:1	1.14:1	1.35:1

Table 4: Average male moths of *S. incertulas* trapped in YSBPE-1 & YSBPE-2 baited pheromone traps during *kharif* -2022 at Doiwala, Dehradun

Date	DAI	YSBPE-1	YSBPE-2	Average
Treatment I				
21-8-22	10	4.67±3.51	3.71±2.12	4.19
28-8-22	17	8.00±5.29	2.50±1.29	5.25
04-9-22	24	15.43±21.62	4.40±3.44	9.92
11-9-22	31	1.25±0.50	1.00±0.00	1.13
18-9-22	38	11.10±4.08	6.80±2.59	8.95
25-9-22	45	2.40±0.55	1.67±0.58	2.04
2-10-22	52	1.00±0.00	1.00±0.00	1.00
Average		6.26	3.01	4.64
Treatment II				
21-8-22	10	3.25±1.70	5.40±4.39	4.33
28-8-22	17	4.67±3.79	0.00±0.00	5.04
04-9-22	24	16.00±3.83	5.17±3.19	10.59
11-9-22	31	1.50±0.70	1.33±0.58	1.42
18-9-22	38	4.20±1.30	5.33±3.07	4.77
25-9-22	45	1.00±0.00	2.50±0.58	1.75
2-10-22	52	1.00±0.00	1.00±0.00	1.00
Average		4.52	2.96	3.74
Treatment III				
21-8-22	10	3.33±3.33	4.83±2.32	4.08
28-8-22	17	3.50±2.65	1.50±0.70	2.50
04-9-22	24	13.71±11.44	9.50±6.25	11.60
11-9-22	31	1.67±1.15	1.67±0.58	1.67
18-9-22	38	5.43±2.15	4.17±1.33	4.80
25-9-22	45	1.25±0.50	3.14±1.06	2.32
2-10-22	52	1.00±0.00	1.71±0.76	1.36
Average		4.27	3.79	4.03

Table 5: Percent dead hearts/white heads caused by *S. incertulas* in rice crop during *kharif* 2022 at Doiwala, Dehradun

Treatment	Percent dead hearts/white heads								Mean	Yield (kg/ha)
	21-8-22	28-8-22	04-9-22	11-9-22	18-9-22	25-9-22	2-10-22	09-10-06		
I	3.20	2.20	3.75	0.94	2.72	3.06	4.50	3.01	2.92	1776.00
II	2.28	1.36	3.46	0.86	2.86	2.50	3.63	2.26	2.40	2279.48
III	2.27	0.85	1.59	0.55	2.52	1.49	3.22	1.22	1.71	1937.94
IV	4.26	3.79	4.73	1.34	4.28	3.20	5.02	1.70	3.54	1649.74
Mean	3.00	2.05	3.38	0.92	3.09	2.56	4.09	2.04		
		Treatment (A)		Interval (B)		A × B		Yield		
S.Em.±		0.23		0.33		0.65		188.49		
Cd at 5%		0.64		0.90		1.82		651.40		

Table 6: Benefit–Cost ratio among different treatments during *kharif*-2022 at Doiwala, Dehradun

Particulars	Cost in Rs.			
	Treatment I	Treatment II	Treatment III	Treatment IV
Field preparation	5730	5730	5730	5730
Fertilizer application	3172	3172	3172	3172
Weeding/herbicide	1070	1070	1070	1070
Insecticide application	–	–	2000	–
Fungicide application	830	830	830	830
Costs of pheromone mass trapping	2370	2370	2370	–
Crop cut operation	2600	2600	2600	2600
Total cost	15772	15772	17772	13402
Gross return	34632	44450	37790	32170
Net return	18860	28503	20018	18768
BCR	1.19:1	1.80:1	1.12:1	1.40:1

Conclusion

It can be concluded from our research findings that the average number of trapped insects was relatively high in treatment I, where only pheromone traps were installed and no chemical was applied, as compared to treatment II and III. The average number of moths captured by YSBPE-1 lures was higher than that by YSBPE-2 lures. The benefit cost ratio (BCR) calculated for 2021 and 2022 signifies that treatment II has BCR of 1.53:1 and 1.80:1, respectively. Our findings indicate that treatment II installed with pheromone traps @ 20/ha along with application of Azadirachtin 5.00% was cost effective for management of *S. incertulas* in rice at Doiwala area of Dehradun.

Acknowledgement

Author is very much thankful to the field and technical staff

of Department of Entomology, School of Agricultural Sciences, SGRR University, Dehradun for helping in all the experimental procedure and for successful preparation of manuscript.

References

1. Abhinandan Y, Gupta PK. Evaluation of new insecticide molecules against rice yellow stem borer *Scirpophaga incertulas* Walker (Pyralidae: Lepidoptera) under Faizabad Condition. International Journal of Current Microbiology & Applied Sciences. 2020;9(4):2772-2777.
2. Bhagat VK, Painkra KL, Painkra GP, Bhagat PK. Field efficacy of newer insecticides against yellow stem borer (*Scirpophaga incertulas* Walker) on rice. The Pharma Innovation. 2022;11(8):1368-1373.
3. Chatterjee S, Mondal P. Management of rice yellow stem borer, *Scirpophaga incertulas* Walker using some biorational insecticides. J Biopest. 2014;7:143-147.
4. Chatterjee S, Dana I, Gangopadhyay C, Mondal P. Journal of Crop and Weed. Monitoring of yellow stem borer, *Scirpophaga incertulas* (Walker) using pheromone trap and light trap along with determination of field incidence in kharif rice. Journal of Crop and Weed. 2017;13(3):156-159.
5. Jena M, Pandi GGP, Adak T, Rath PR, Gowda BG, Patil NB, *et al*. Paradigm shift of insect pests in rice ecosystem and their management strategy. *Oryza*. 2018;55:82-89.
6. Kakde AM, Patel KG. Seasonal incidence of rice yellow stem borer (*Scirpophaga incertulas* Wlk.) in relation to conventional and Sri Methods of planting and its correlation with weather parameters. Journal of Agriculture and Veterinary Science. 2014;7(6):2319-2372.
7. Katti G. Overview of entomology research under AICRIP –an experiential learning. Journal of Rice Research. 2021;14(2):69-77.
8. Kinjale RS, Jalgaonkar VN, Naik KV, Hatwar NK, Lad SS. Evaluation of the efficacy of some insecticides against rice yellow stem borer, *Scirpophaga incertulas* (Walker). Journal of Entomology and Zoology Studies. 2021;9(1):123-125.
9. Krishnaiah K, Varma NRG. Changing Insect Pest Scenario in the Rice Ecosystem – A National Perspective. Rice Knowledge Management Portal; c2015. p. 28.
10. Patel KG, Desai HR. Monitoring rice yellow stem borer, *Scirpophaga incertulas* (Walker), using sex pheromone/light traps. Insect Env. 2004;10:51-52.
11. Senapati B, Panda SK. Rice stem borers in insect pests of cereals and their management. In: Anand Prakash, Jagadiswari Rao, editors. AZRA, CRRI, Cuttack, Orissa; c1999. p. 3-18.
12. Singh DP, Triveni T. Assessment of extent of damage and yield loss caused by stem borer in rice. Journal of Pharmacognosy and Phytochemistry. 2019;8(2):2112-2115.
13. Sudharani D, Chiranjeevi CH, Madhumathi T, Krishnam Raju S, Nafeez Umar SK. Evaluation of various pest management modules against rice yellow stem borer, Scirphopaga incertulas (Walker) (Crambidae: Lepidoptera). Indian Journal of Agricultural Research. 2021;55(6):688-694.
14. Varma NRG, Krishnaiah K, Pasalu IC, Reddy DDR. Monitoring of rice yellow stem borer, *Scirpophaga incertulas* Walker using pheromone traps and thermal summations. Indian J Plant Prot. 2000;28:84-93.