

Efficacy of biopesticides for the management of rice yellow stem borer *scirpophaga incertulas* (Walker) in rice at prayagraj, U.P, India

ABSTRACT

The present experiment was conducted to highlight the Efficacy of biopesticides for the management of rice yellow stem borer [*scirpophaga incertulas* (Walker)] at prayagraj, U.P, India. The eight treatments comprised of different insecticides and biopesticides. *Metarhizium anisopliae* (T₁), *Bacillus thuringiensis* 1.15% (T₂), *Beauveria bassiana* 1.15% (T₃), *Verticillium lecanii* 1.15% (T₄), Neem oil 5% (T₅), Eucalyptus oil 5% (T₆), Imidacloprid 17.8%SL (T₇), one untreated Control (T₈) were evaluated against rice stem borer. The different insecticides and biopesticides treatments revealed that the minimum dead hearts, were recorded in synthetic insecticides, Imidacloprid 17.8%SL followed by *Beauveria bassiana* 1.15%, *Metarhizium anisopliae*. The minimum dead heart percentages Imidacloprid 17.8%SL were observed in as compared to the natural dead heart of per cent being noticed in untreated control. The percent of the dead heart infestation among the treatments are notices as *Metarhizium anisopliae* (T₁) *Bacillus thuringiensis* 1.15%WP (T₂), *Beauveria bassiana* 1.15%WP (T₃), *Verticillium lecanii* 1.15%WP (T₄), Neem oil 5% (T₅), Eucalyptus oil 5% (T₆), Imidacloprid 17.8%SL(T₇), The yield and cost benefit ratio of the data revealed that the highest yield was recorded in the Imidacloprid 17.8%SL @46.66q/ha with highest Benefit-cost ratio of 1:3.47 followed by *Bacillus thuringiensis* 1.15% @ 38.33 q/ha with benefit cost ratio of 1:2:77 *Beauveria bassiana* 1.15% @ 43.33q/ha with benefit cost ratio of 1:3:27, *Verticillium lecanii* 1.15% @ 36.66q/ha with benefit cost ratio of 1:2:73, Neem oil 5% @ 33.33q/ha with benefit cost ratio of 1:2:46, Eucalyptus oil 5% @ 31.66 q/ha with benefit cost ratio of 1:2:35, *Metarhizium anisopliae* @41.66q/ha with benefit cost ratio of 1:3:13. The chemicals shows better results in combating to the pest infestation compare to biopesticides and botanicals.

KEY WORDS: Bio-pesticides, Chemicals, Cost benefit, Efficacy, Rice, stem borer (*scirpophagaincertulas*)

INTRODUCTION

“Rice (*Oryza sativa* L.) occupies the prominent place in Indian agriculture. It is the most important staple food crop of the developing world for more than 3 billion people. The production and productivity of rice is low in Chhattisgarh and India as compared to world production. Chhattisgarh popularly known as “Rice Bowl of India” occupies an area around 3756.80 thousand hectares with the production of 5.22 million tones and productivity of 2050 kg per hectares” (Krishi Dairy, 2016). “Amongst various constraints for low productivity of rice the insect pests and diseases are very important”. (Krishi Dairy, 2016)

“The hot and humid environment in which rice is grown is very conducive for proliferation of insects and diseases. The rice plant is attacked by more than 128 species of insects, 20 of them can cause serious economic loss” (Kalode, 2005). “YSB causes 1% to 19% yield loss in early planted and 38% to 80% in late transplanted rice crops”. (Kalode, 2005)

“Various control strategies have been adopted to check insect pest of rice, use of synthetic insecticides is a common method of pest control. But The indiscriminate uses of insecticides have resulted in a number of undesirable side effects such as the development of resistant strain of insects, environmental pollution and health hazards to farmers” (Hasan *et al.*,2002)

“Pesticides have also entered into the food chain and have bioaccumulated in the higher tropic level. More recently, several human acute and chronic illnesses have been associated with pesticides exposure. Therefore, it has now become necessary to search for the alternative means of pest control, which can minimize the use of synthetic pesticides. Botanical pesticides are the important alternatives to minimize or replace the use of synthetic pesticides. Botanicals with different modes of action may minimize insecticide resistance and pest “resurgence problems while being safe and ecologically acceptable”. (Hasan *et al.*,2002)

Biopesticides are a good alternative to the synthetic pesticide. Neem is one of the most reliable botanical sources of biopesticides. Neem plant has been known for three decades for its potential against insect pests”. 103500

“Leaves and seed extract of Neem plant have been observed for their deleterious effects on insects. The principle component that has insecticidal activity in Neem extracts is a limonoid, Azadirachtin. Azadirachtin is non-toxic to mammals, rat, oral acute LD₅₀ is more than 5000 mg/kg. A 90 day oral feeding of rats with 10,000ppm of Azadirachtin did not show chronic toxicity” (Mehlhorn *et al.*, 2011). The purpose of this study was to find out the Efficacy of

MATERIALS AND METHODS

The Field experiment was conducted at the Central Research Farm of Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, U.P. during *kharif* season 2022. Trail was laid out in Randomised Block Design consisting of eight treatments including control. Each treatment was replicated thrice and C84 was sown and transplant date spacing of 30x35cm. Standard agronomic practices were followed to ensure a good crop stand. the treatments Imidacloprid 17.8%SL, *Beauveria bassiana* 1.15%, *Bacillus thuringiensis* 1.15%, Neem oil 5%, *Metarhizium anisopliae* 1.15%, *verticillium lecanii* 1.15% Eucalyptus oil 5% “The observations on account of Dead hearts and White heads were recorded on five randomly selected plants per treatment. First count was done one day before insecticide application and post treatment counts were made after 3,7,14 days. Two sprays was given with an interval of 15 days. In order to assess the per cent of Dead hearts and White heads on five randomly selected and tagged plants per net plot. Dead hearts and White ears due to rice yellow stem borer pest was recorded from each net plot and the population was worked out per plant”. (Madhu et. Al.,2020)

Observations.

The observations on the number of rice yellow stem borer pest were recorded from the ten randomly selected and tagged plants from each plot. The observations were recorded a day before followed by 3rd, 7th, 14th days after spraying. Dead hearts and White ears due to rice yellow stem borer pest were recorded from each net plot and the population was worked out per plant.

The per cent dead hearts and white ears calculated by using given formula.

$$\text{Percentage of dead hearts} = \frac{\text{Total no dead hearts}}{\text{Total no of tillers}} \times 100$$

$$\text{Percent of White ears} = \frac{\text{Total number of white ears}}{\text{Total number of tillers}} \times 100$$

RESULT AND DISCUSSION

All the insecticides were significantly superior over control in reducing the infestation percent of stem borer which were the mean of 3, 7, and 14 DAS after insecticidal application. Imidacloprid 17.8SL was found significantly superior (4.92), these findings are supported by the **Chatterjee et al. (2014)**, Followed by *Beauveria bassiana* 1.15WP (6.37) these findings are supported by (**singh et al.2021**) *Metarhizium anisopliae* (6.59) was found next best treatment similar results are recorded by **Chormule et al.(2014)**, *Bacillus thuringiensis* 1.15WP (6.80) was found next similar result recorded by (**Madhu et al.2019**) *Verticillium lecanii* (7.00), similar findings are also reported in Rice by (**Samanta et al.(2017)**, Neem oil 5% (7.80) was next best treatment these similar findings are with those of **Choudhary et al.(2017)**, Eucalyptus oil 5% (8.43) found to be least effective but comparatively superior over the untreated control recorded (23.51) these results were in supportive with **Longkumar et al.(2022)**.

Table 1.) “Effect of biopesticides for the management of rice yellow stem borer [*scirpophaga incertulas (walker)*] at prayagraj” infestation after first spray

TREATMENTS		MEAN % OF Dead hearts/5 plants				
		1DBS	3DAS	7DAS	14DAS	MEAN
T0	Control	16.17	16.95	19.15	23.35	19.81
T1	<i>Metarhizium anisopliae</i>	10.17	7.71	5.73	8.60	7.347
T2	<i>Bacillus thuringiensis</i> 1.15% wp	10.58	7.96	6.10	8.83	7.630

T3	<i>Beauveria bassiana</i> 1.15% wp	9.90	7.58	5.14	8.58	7.100
T4	<i>Verticillium lecanii</i> 1.15%wp	11.86	8.18	6.36	9.24	7.927
T5	Neem oil 5%	12.96	9.32	7.51	10.83	9.220
T6	Eucalyptus oil 5%	13.98	10.01	7.85	11.19	9.683
T7	Imidacloprid 17.8%SL	9.72	5.61	3.38	6.91	5.300
F-TEST		NS	S	S	S	S
C.V		--	3.58	1.97	3.04	1.01
CD (5%)		--	3.31	2.46	3.05	1.76

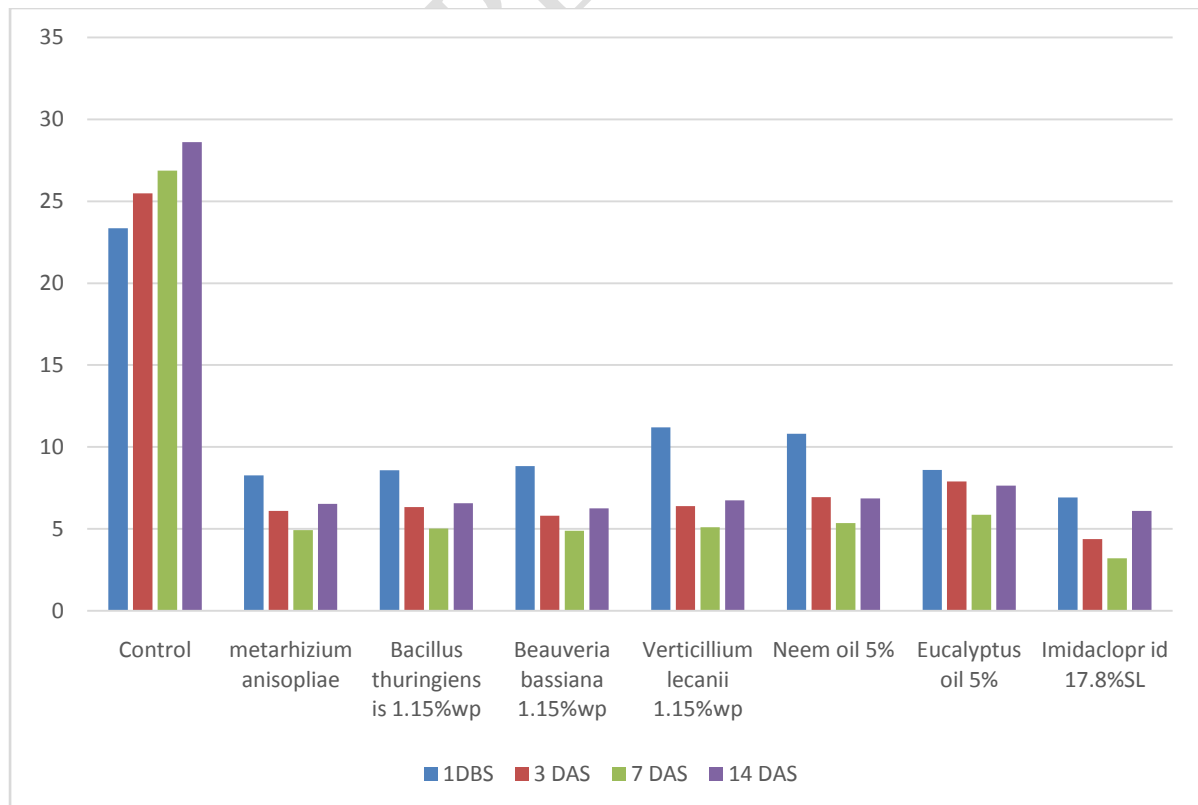


Fig 1. Effect of biopesticides for the management of rice yellow stem borer ((application of 1st spray)

Table 2. “Effect of biopesticides for the management of rice yellow stem borer [*scirpophaga incertulas (walker)*] at prayagraj” infestation after second spray

TREATMENTS		MEAN % DEAD HEARTS AND WHITE HEADS				
		1DBS	3DAS	7DAS	14DAS	MEAN
T0	Control	23.35	25.48	26.88	29.27	27.210
T1	<i>Metarhiziu anisopliae</i>	8.60	6.09	4.92	6.53	5.847
T2	<i>Bacillus thuringiensis</i> 1.15% wp	8.83	6.34	5.02	6.56	5.973
T3	<i>Beauveria bassiana</i> 1.15% wp	8.58	5.80	4.89	6.26	5.650
T4	<i>Verticillium lecanii</i> 1.15%wp	9.24	6.39	5.11	6.75	6.083
T5	Neem oil 5%	10.83	6.94	5.35	6.86	6.383
T6	Eucalyptus oil 5%	11.19	7.89	6.04	7.65	7.193
T7	Imidacloprid 17.8%SL	6.91	4.37	3.20	6.10	4.557
F-TEST		NS	S	S	S	S
CV		--	1.71	1.22	1.67	0.51
CD (5%)		--	2.31	1.94	2.26	1.25

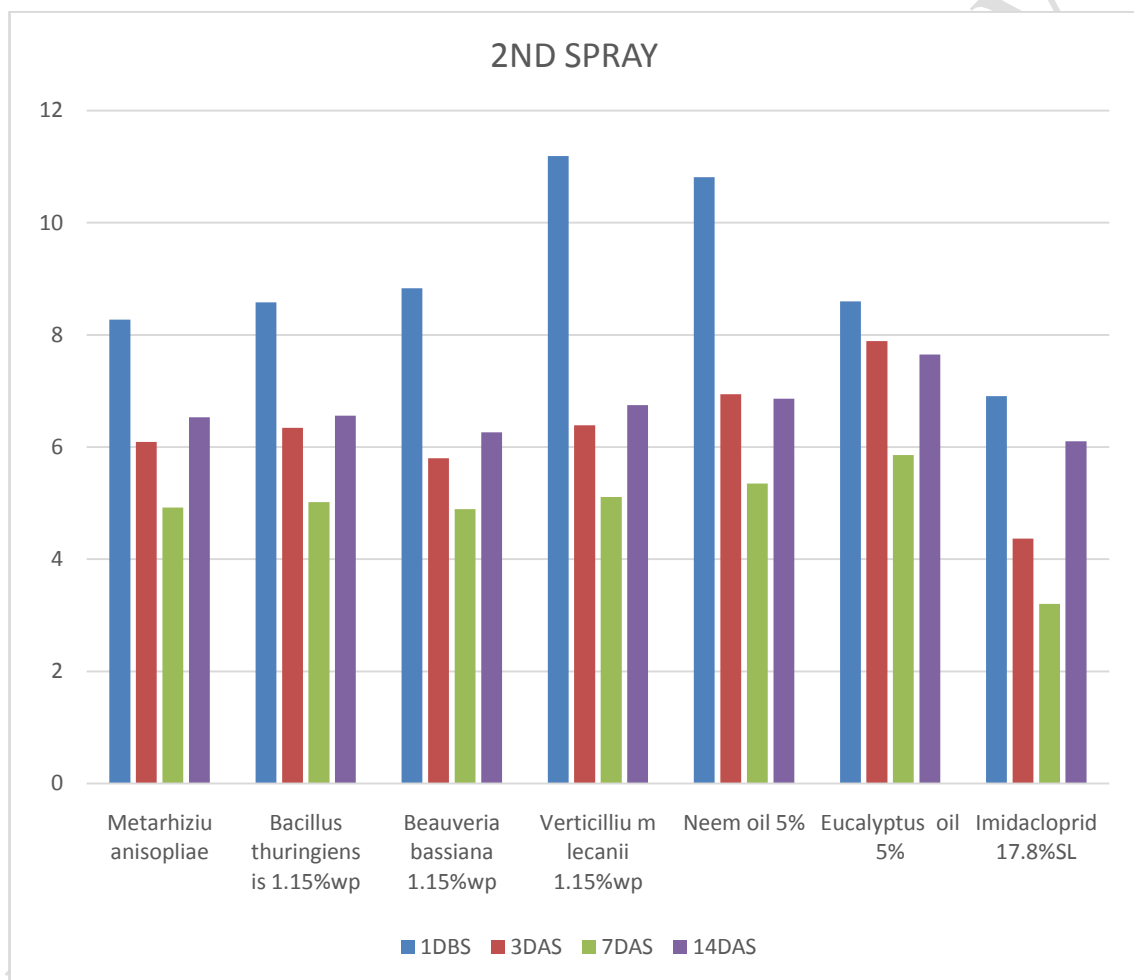


Fig 2. Effect of biopesticides for the management of rice yellow stem borer (application of 2nd spray)

CONCLUSION

Applications of the treatments for the management of rice yellow Stem Borer were initiated when the infestation crossed ETL (5 %) in the field. Subsequently applications were undertaken at an interval of 20 days. In all two applications were made during the

experimental period. The observations on stem were recorded after 3, 7 and 14 days of application. The results are summarized as follows.

Among all the treatments, most effective Number of dead heart percentage infestation of yellow stem borer, was recorded in imidacloprid 17.8%SL (4.92), followed by *Beauveria basiana* 1.15%wp (6.37), *Metarhizium anisopliae* (6.59), *Bacillus thuringiensis* 1.15%wp (6.80), *Verticillium lecanii* 1.15%wp (7.00), Neem oil 5% (7.80), Eucalyptus oil 5%(8.43), were significantly superior over untreated control (23.51).

REFERENCE

- Chaudhari, R., Chandrakar, G., Bhardwaj, J. R., Khan, H. H. and Sahu, R. (2017).** Assessment of the efficacy of neem-based insecticides for the management of yellow stem borer, (*Scirpophaga incertulas*) Walk. in paddy field. *Journal of Pharmacognosy and Phytochemistry*, **6** (5): 1446- 1499.
- Dhivya, G. and Kumar, K. (2021).** Bio-efficacy of botanical against the stem borer *Scirpophaga incertulas* (Walker) in rice. *The Pharma Innovation Journal*, **10**(8):311-314.
- Ghongade, D. S. and Sangha, K. S. (2021).** Efficacy of biopesticide against of *Scirpophaga incertulas*. *Egyptian Journal of Biological Pest Control*, 31-19.
- Kachhawa, D. (2017).** Microorganism as a biopesticides. *Journal of Entomology and Zoology Studies*, **5**(3)468-473.
- Kalode, M. B. (2005).** Insect pest of rice and their management in rice in Indian Perspective Today and Tomorrow Printers and Publishers (India). **3**:819-854.
- Krishi Diary. (2016).** Indira Gandhi Krishi Vishwavidyalaya, Raipur, C.G. 5-6.
- Kumar, K., and Balasubramamiam, M. (2017).** Bioefficacy of neem formulations against the rice yellow stemborer. *Journal of Entomology and Zoology Studies*, **7** (3): 1145-1149.
- Longkumar, I. Y., Singh, K. I., and Singh, A. (2017).** Efficacy of eco-friendly insecticides

against yellow stem borer under *kharif* rice-crop-ecosystem of Manipur valley. *The Pharma Innovation Journal*, **6** (11) :19- 21.

Madhu, B., Warghat, A. N. and Tayde, A. R. (2019). Comparative effect of biopesticide and commercial products on rice yellow stem borer *Scirpophaga incertulas*. *Journal of Entomology and Zoology Studies*,**8** (1): 758-760.

Mehlhorn, H. K., Al-Rasheid, A.S. and Abdel-Ghaffar, F. (2011). The Neem Tree Story: Extracts that Really Work. *Parasitol Research Journal*, 1:77-108.

Rajendra, D.K., Shrivastava., Kumar, D., and Kumar S. (2016) Efficacy of different novel insecticides and bio-pesticides against stem borer *Scirpophaga incertulas* (Walker). *Research Journal of Chemical and Environmental Sciences*, **5** (3): 21-24.

Sarwar, M. (2012) Study on the non-aromatic rice (*Oryza sativa* L.) varieties resistance to rice stem borers (Lepidoptera: Pyralidae) and yield factors. *International Journal of Agronomy and Plant Production*, **3** (5): 159-163.

Samanta , A., and Sen, K. (2017) A potential biocontrol agent in insect pest management *Inno. Farm.*, **2**(2): 117-121.

Singh., A.(2018) Comparative Efficacy of botanicals against yellow Stem Borers (*Scirpophaga incertulas*, Walker) and Leaf Folder (*Cnaphalocrocis medinalis*, Guenée) of rice *Journal of Pharmacognosy and Phytochemistry* , 474-478

Rajpoot., S. K. S. Dixit., S. Prasad., V. Giri., S. P. Singh., R.A. Parkash., A. 2021 Evaluation of insecticides and biopesticides against *Scirpophaga incertulas* (Walker), leaf folder *Cnaphalocrocis medinalis*) and green leafhopper in basmati rice *.The Pharma Innovation Journal* ,**10**(12): 368-371 .

Chormule ., A, J(2014) Bioefficacy of new insecticide molecules against rice yellow stem borer, *Scirpophaga incertulas* (walker) . *an international quarterly journal of environmental science* 63-67:

Chatterjee., S., and Singh., B (2021) Relative efficacy of some biorational and microbial insecticides against yellow stem borer and whorl maggot of boro paddy. *Journal of Biopesticides*, **14**(2): 90-96.

Singh., P. Singh., R. , S. Dhaka., S. Kumar., D (2015) Bioefficacy of insecticides and bio-pesticides against yellow stem borer, *Scirpophaga incertulus* (walk.) and their effect on spiders in rice crop *.South asian journal of food technology*,**1**(2):179-183

- Seni ., A. (2019)** Impact of certain essential oils and insecticides against major insect pests and natural enemies in rice. *Journal of Cereal Research*, **11**(3): 252-256
- Kumbhar .,C.R. and . Singh., S.P.N (2020)** Efficacy of newer insecticides against rice borer complex under North Bihar condition.*Journal of Entomology and Zoology Studies*, **8**(4): 797-801.
- Yimjenjang., I . Longkumer and Misra., A. K (2020)**Efficacy of essential oils against rice insect pest in Pusa, Bihar .*Journal of Entomology and Zoology Studies* ,**8**(3): 1980-1983
- Singh., H. (2021)** Performance of various pesticides against Yellow stem borer, *Scirpophaga incertulas* (Walker) of Basmati rice and effect on yield in Northern India research article
- Sasmal., A. Pratap and Sarangi., A. K (2018)** Bio-efficacy evaluation of some insecticides (solo and pre mixed) against major insect pests of rice. *Journal of Crop and Weed*, **14**(1): 238-244
- Chormule., A. J (2014)** Bioefficacy of new insecticide molecules against rice yellow stem borer, *Scirpophaga incertulas* (walker), 0974 - 0376
- Atwal, A. S.(1976)**. Agricultural Pests of India and South East Asia. Kalyani Publishers, Ludhiana, India. pp. 153-160
- Catling., H. D., Islam, Z. and Pattrasudhi, R. (1987)** Assessing yield losses in deep water due to yellow stem borer, *Scirpophaga incettulas* in Bangladesh and Thailand. *Crop Protection Journal*. **6**: 20-27.
- Catling., H. D. and Islam, Z. (1981)**. Problem of yellow stem borer in Asam deep water rice. *Proc. International Rice Research Institute*. 451-458.
- Dhaliwal, G.S., Jindal, V. and Dhawan, A.K. (2010)**. Insect pest problems and crop losses: Changing trends. *Indian Journal of Ecology*. **37**:1-7.
- Gupta., S.P. and O'Toole, J.C. (1986)**. Upland Rice. A Global Perspective. *International RiceResearch Institute. Lospbanos, Laguna, Philippines*.360p.
- Hajeck., A. E. and Leger, R. J. S.(1994)**. Interactions between fungal pathogens and insect host
- Hoy., M. A. and Myths.(1999)**, Models and mitigation of resistance to pesticides. In: *Insecticide Resistance: From Mechanisms to Management* (Denholm, I., *J.A. Pickett and A.L. Devonshire*, (eds.), New York, CABI Publishing,111-119
- Hussain., D., Akram, M., Iqbal, Z., Ali, A. and Saleem, M. (2010)**. Effect of insecticides on *Trichogramma chilonis* Ishii. (Hymenoptera: Trichogrammatidae) immature and

adult survival. *Journal of Agriculture Research*. 48:531-537

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

Khush., G. S.(1997). Origin, dispersal, cultivation and variation of rice. *Plant Molecular Biology*. 35:25–34.

Litsinger., J. A., Barrion, A.T. and Soekarna,D. (1987). Upland rice insect pests their ecology, importance and control. IRRI Research Paper Series Number 123. The International Rice Research Institute, Philippines, p. 41.

Mahar., M. N., Bratti, I. M. and Dhuyo, A.R.(1985). Stem borer infestation and yield loss relationship in rice and cost- benefit of control. Paper presented at 5th National Seminar on riceproduction. April 23-25

Moraes., J. C., Goussain, M.M., Carvalho ,G.A and Costa, R.R.(2005) Feeding non-preference of the corn leaf aphid *Rhopalosiphum maidis* (Fitch, 1856) (Hemiptera: Aphididae) to corn plants (*Zea mays* L.) treated with silicon. *Ciencia Agrotecnol*; 29:761-766.

Omprakash., S., Venkataiah, M. and Laxman, S. (2017) Comparative efficacy of some new insecticides against rice yellow stem borer, *Scirpophaga incertulas* Walker under field conditions. *Journal of Entomology and Zoology Studies* 5(5): 1126-1129.

Pasulu., I. C., Krishnaiah, N.V., Kotti, G. and Varma,N.R.G. (2002).IPM in rice mitr. pp. 45-55.

Pathak., M. D. and Khan,Z.R. (1994) *Insect pests of rice*. International Rice Research Institute, pp. 1-17. P.O box 933, 10999, Manila,Philippines.

Preetha., G., Manoharan, T., Stanley, J.and Kuttalam, S. (2010). Impact of chlornicotinyl insecticide, imidacloprid on egg, egg-larval and larval parasitoids under laboratory conditions. *Journal of Plant Protection and Research*.. 50:535-540.

Shafighi., Y., Ziaee, M. and Ghosta, Y.(2014). Diatomaceous earth used against insect pests, applied alone or in combination with *Metarhizium anisopliae* and *Beauveria bassiana*. *Journalof Plant Protection. Research*.. 54(1):62-66.

Song., M.Y.and Brown, J. J.(1998). Osmotic effects as a factor modifying insecticide

toxicity on *Aedes and Artemia*. *Ecotoxicology, Environment and Safety*.4:195-202.

Verma., D. K. and Shukla,K.(2011) Nutritional value of rice and their importance, *Indian Farmers' Digest*;**44-1**.

Madhu B, Warghat AN, Tayde AR. Comparative effect of bio pesticides and neem commercial products on rice yellow stem borer, *Scirpophaga incertulas* (Walker). *Journal of Entomology and Zoology Studies*. 2020;8(1):758-60.

UNDER PEER REVIEW