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Pest-defender abundance under Evaluation of Ecofriendly Insecticides against Major Insect Pests of Rice in Eastern Uttar Pradesh Conditions

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present study was analyzed the abundance of pest: defender ratio (P:D) over check plot under evaluation of ecofriendly insecticides against the major insect pests of rice in eastern Uttar Pradesh conditions for two consecutive years (2014 and 2015) at farmer field of district Deoria under the supervision of Department of Entomology, B.R.D.P.G. College, Deoria, Uttar Pradesh, India. There were 10 treatments (09 insecticides + 01 check) evaluated under randomized block design (RBD) by transplanting method of rice cultivation on localized popular rice cultivar Samba Mahsuri (BPT-5204). The insecticide treatments comprise 9 insecticides (CartapHcl, 50 SP, Indoxacarb 14.5 SC, Imidacloprid 17.8 SL, Chlorpyriphos 20 EC, Thiamethoxam 25 WG, Chlorantraniliprole 18.5 SC, Azadirachtin (Neem Oil) 0.03 EC, *Bacillus thuringiensis kurstaki* (Btk) 3.5 WP, and combination of Neem Oil 0.03 EC + Btk 3.5 WP).This evaluation was observed most effective ecofriendly insecticides concerned to lowest pest: defender ratio (P:D), lowest abundance of pest: defender

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ratio (P:D) over check plot, and highest yield. The inferences of pest: defender abundance ratio (P:D) over check plot and yield of rice crop were based on non-significant ecofriendly insecticides for the lowest pest: defender ratio (P:D). There were 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for the lowest abundance of pest: defender ratio (P:D) over check plot. The mean ranking and inference of abundance of pest: defender ratio (P:D) over check was similar to the inference of non-significant ecofriendly insecticides for lowest pest: defender ratio (P:D) as, Neem Oil + Btk and Imidacloprid respectively.

Keywords: Abundance of pest-defender; ecofriendly insecticides; major insect pests of rice; Eastern Uttar Pradesh; India.

1. INTRODUCTION

Rice (*Oryza sativa* Linn.) is one of the most staple foods of the world as well as India [1-5]. The rice production provides livelihood and food security to the about half of the world population and more than half of the India population. It is mostly produced and consumed in Asian countries. The rice fragrance makes meal delicious to the entire world [6-8]. India shares, 22.46 % (109.7 mt) of the world rice production (488.31 mt) and occupies second position after China, 28.18% (137.64 mt) [6-8]. The Uttar Pradesh state shares, 12.53 % (13.75 mt) of the national rice production of India occupies second position followed by West Bengal state (17%) and first position in rice production area [6-8]. Being occupying first position in rice crop area, the Uttar Pradesh state is not standing on highest rice production in India. The major concern of this lower production of rice is non-modern approach of production and crop stress. The insect pests are major biotic stresses of rice. The rice crop losses caused by insect pests have been sharing about 60 to 95 % over the world and about 21 to 51 % in the India respectively [1-5]. There are about 800 insect pest species infesting rice crop over the world and about 250 insect pest species infesting rice crop in India [1,4,5]. The population of insect pests naturally suppressed by natural enemies. The natural enemies are bioagents, kill or prey insect pests as host for their nourishment and complete life cycle. Their buildup suppresses the insect pests population silently in the rice ecosystem. Being the most favorable environment congenial for rice production and proliferation for insect population, there are about 550 arthropod bioagent species suppressing rice insect pests population in India [1,4,6].

The regular efforts are necessary to develop effective strategy for insect pest management with particular agroecosystem under changing climatic conditions [1,4,6]. Being practicing modern approaches of rice production in India, most of the farmers are applying rice insect pest management practices as finishing approach of insect pests without considering the significant role of bioagents in suppression of insect pests infestations [4,5]. Being the most effective role of pesticides in the pest management, chemical insecticides are continuously applying pesticides for insect pest management in rice crop production [4,5]. The augmentation of crop production needs pesticides as essential inputs has been universally considered. The insecticides application always be perceived last resort for insect pest management [4,5]. The scientific community have been continuously evaluating the efficacy for various insecticides including conventional and novel chemical insecticides and biorational insecticides for ecofriendly pest management. The evaluation of efficacy of novel chemical and biorational insecticides have been reported scanty for ecofriendly pest management under eastern Uttar Pradesh conditions. To achieve the goal of ecofriendly insect pest management, it necessary to analyses the pest-defender abundance for evaluating the efficacy of ecofriendly insecticides against major insect pests of rice.

Kulagod et al. [9] have been found that, the infestations of yellow stemborer (*Scirpophaga incertulus* Walker) and common rice leaffolder (*Cnaphalocrocis medinalis* Guenee) were lowered by biorationals as Azadirachtin and *Bacillus thuringiensis,* Berliner (Bt) formulations. Rath et al. [10] have been observed that, the infestations of yellow stemborer (*Scirpophaga incertulus* Walker) and rice earheadbug (*Leptocorisa acuta* Thunberg) were recorded lowest in Imidacloprid and highest grain yield was recorded in Thiamethoxam treated plots. Karthick et al. [11] have been studied that, the high population of coccinellids and spiders were favoured by indoxacarb treated plots. Sarao et al. [12] and Tigga et al. [13] have been studied that, the infestation of yellow stemborer (*Scirpophaga incertulus* Walker) and rice earheadbug (*Leptocorisa acuta* Thunberg) were lowered by Imidacloprid. Sharanappa et al. [14] have been reported that, the high population of coccinellids were favoured by Imidacloprid treated plots.

2. MATERIALS AND METHODS

The present study was analyzed the abundance of pest: defender ratio (P:D) over check plot under evaluation of ecofriendly insecticides against major insect pests of rice in eastern Uttar Pradesh conditions for the two consecutive years (2014 and 2015) at farmer field of under the supervision of Department of Entomology, B.R.D.P.G. College, Deoria, Uttar Pradesh, India. There were 10 treatments (09 insecticides + 01 check) evaluated under randomized block design (RBD) by transplanting method of rice cultivation on localized popular rice cultivar 'Samba Mahsuri (BPT-5204)'. The insecticide treatments comprise 9 insecticides (Cartap Hydrochloride (CartapHcl), 50 SP, Indoxacarb 14.5 SC, Imidacloprid 17.8 SL, Chlorpyriphos 20 EC, Thiamethoxam 25 WG, Chlorantraniliprole 18.5 SC, Azadirachtin (Neem Oil) 0.03 EC, *Bacillus thuringiensis kurstaki* (Btk) 3.5 WP, and combination of Neem Oil 0.03 EC + Btk 3.5 WP). This confined spot of study, represents the conductive environment for survival and proliferation of insect pests in rice ecosystem under eastern Uttar Pradesh conditions. The Spray formulations selected as recommended for lowland rice ecosystems to avoid leaching and toxicity to beneficial soil inhabitants of granular formulations despite effectivity. Application of insecticides spraying were taken for two times at 30 days and 45 days after transplanting (30 DAT and 45 DAT). Samples were taken 03 times at 03, 07 and 14 days after spraying per spray of insecticides and single sample before first spray of insecticides respectively. The duration of rice crops started from pre week of August to mid-week of November for about 110 days. There were 5 samples collected per plot at the size of 20 m^2. Each plot was selected 5 spots (4 in the corner and one in the center) at 01 hill/spot to observe infestation, and also at each plot, 05 net sweeps were made randomly at every 05 steps to observe abundance of insect pest species. The spraying of insecticides was made by manually operated knapsack sprayer with hollow cone nozzle @ 500 l/ha spray volume. The timing of sampling was 9.30 A.M. to 12.30 P.M. and timing of spraying was 2.30 P.M. to 4.30 P.M. respectively. Each observation was recorded abundance of major insect pests and their bioagents and yield of rice crop to evaluate efficacy of treated ecofriendly insecticides. This observation was analyzed the abundance of pest: defender ratio (P:D) over check plot of major insect pests of rice during evaluation most effective ecofriendly insecticides concerned to lowest pest: defender ratio (P:D) and highest yield respectively.

Surveillance was conducted as per methodology of agroecosystem analysis (AESA) (Pontius et al. [15]) modified as accessibility. Taxonomic identification was verified with texts of reference, *i.e*., Dale [16], Barrion and Litsinger [17], Pathak and Khan [1], David and Ananthakrishnan [18]; Rice knowledge management portal (RKMP); and Subject experts respectively. The statistical inferences were verified with texts of reference, *i.e*., Dhamu & Ramamoorthy [19], and Rangaswamy [20]. The formula of abundance of P:D ratio over check was adopted as follows,

$$\text{Abundance of P:D ratio over check (\%)} = \frac{\text{Abundance of P:D ratio in treated plot x 100}}{\text{Abundance of P:D ratio in check plot}}$$

3. RESULTS AND DISCUSSION

The abundance of pest: defender ratio (P:D) over check plot was observed under evaluation of efficacy of some novel ecofriendly insecticides on infestation of major insect pests of rice for the two consecutive years 2014 and 2015 respectively. The infestations of major insect pests of rice were observed for most serious insect pests, which were 1.Yellow stemborer (*Scirpophaga incertulus* Walker), 2.Common rice leaffolder (*Cnaphalocrosis medinalis* Guenee), 3.Brown planthopper (*Nilaparvata lugens* Stal), 4.Rice hispa (*Dicladispa armigera* Oliver), and 5.Rice earheadbug (*Leptocorisa acuta* Thunberg). Of the total observed evaluation of ecofriendly insecticides against major insect pests of rice under abundance of pest: defender ratio over check (ABOC) for pooled of both the years 2014 and 2015, there were 1 insecticide (Neem Oil + Btk) inference non-significant for lowest abundance of pest: defender ratio over check (ABOC) under first application (30 DAT) and 2 insecticides (Neem Oil + Btk and Imidacloprid) under second application (45 DAT), based on evaluation of non-significant ecofriendly insecticides for lowest pest: defender ratio as, Neem Oil + Btk and Imidacloprid respectively. The mean of evaluation under abundance of pest: defender ratio over check (ABOC) was observed as, 2 insecticides ((Neem Oil + Btk and Imidacloprid)) inference non-significant for lowest abundance of pest: defender ratio over check (ABOC) under mean of first application and second application, based on mean evaluation of non-significant ecofriendly insecticides for lowest pest: defender ratio as, Neem Oil + Btk and Imidacloprid respectively. Of the total observed pest: defender ratio for major insect pests of rice for pooled of both the years 2014 and 2015, there were 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for lowest pest: defender ratio under first application (30 DAT) and second application (45 DAT) respectively. The mean of evaluation was observed as, 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for lowest pest: defender ratio under mean of major insect pests of rice and mean of first application and second application respectively (Table 1 and Fig. 1).

Of the most effective ecofriendly insecticides observed on abundance of pest: defender ratio over check for major insect pests of rice for pooled of both the years 2014 and 2015, there were 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for lowest abundance of pest: defender ratio over check (ABOC), lowest pest: defender ratio, and highest yield for mean of major insect pests of rice based on non-significant ecofriendly insecticides for lowest pest: defender ratio respectively (Table 1 and Fig. 1). The ranking of evaluation under abundance of pest: defender ratio over check was observed as, Btk > Neem Oil + Btk > Neem Oil > Imidacloprid > CartapHcl > Indoxacarb > Chlorantraniliprole > Thiamethoxam > Chlorpyriphos for lowest pest: defender ratio and abundance of pest: defender ratio over check: CartapHcl > Imidacloprid > Neem Oil + Btk > Chlorantraniliprole > Indoxacarb > Chlorpyriphos > Neem Oil > Thiamethoxam > Btk for highest yield; and Neem Oil + Btk > Imidacloprid > CartapHcl > Btk > Neem Oil > Indoxacarb > Chlorantraniliprole > Chlorpyriphos > Thiamethoxam for mean of pest: defender ratio (P:D), abundance of pest: defender ratio over check (ABOC), and yield respectively (Table 2). Similar findings were reported by Kulagod et al. [9], CRRI [21], Prakash et al. [22], Rath et al. [10], Karthick et al. [11], Sarao et al. [12], Tigga et al. [13], and Sharanappa et al. [14].

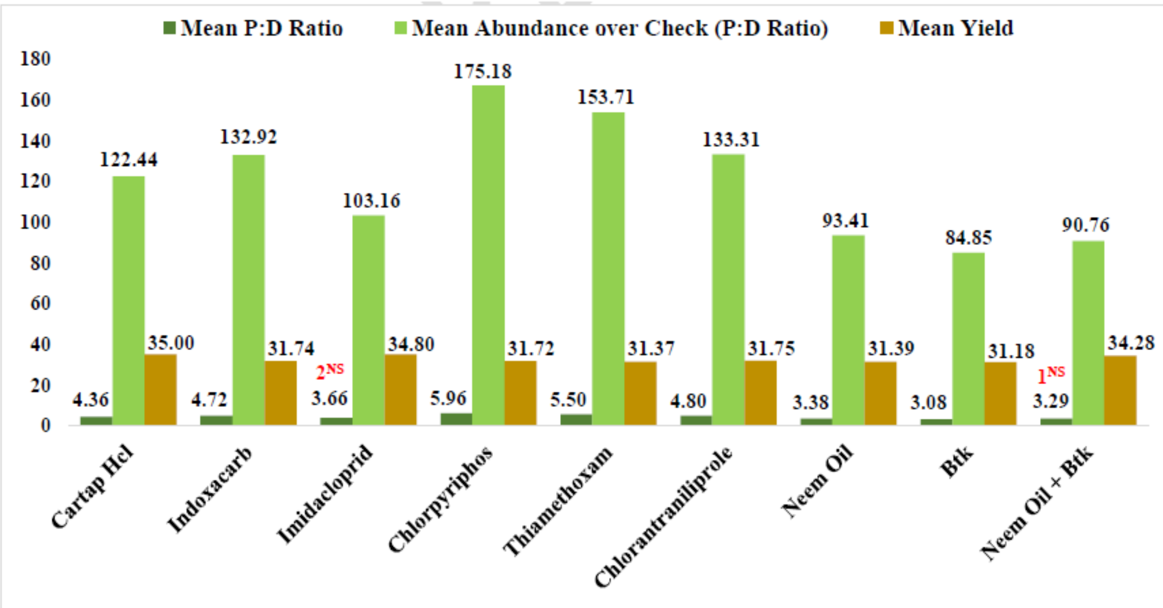

Fig. 1. Mean Evaluation of Ecofriendly Insecticides for Major Insect Pests (Pooled of 2014 & 15) (Pest: Defender Ratio (P:D) and % Abundance of P:D Ratio over Check (ABOC))

Table 1. Mean Evaluation of Ecofriendly Insecticides for Major Insect Pests (Pooled of 2014 &15)*
(Pest: Defender Ratio (P:D) and % Abundance of P:D Ratio over Check (ABOC))

Treatments	A Day before Application (ADBAp)	First Application (Mean)		Second Application (Mean)		Total Mean P:D DAAp	Total Mean ABOC DAAp	Mean Yield (q/ha)
	P:D	P:D	ABOC	P:D	ABOC			
1.CartapHcl	**1.82**	**3.93** (2.10)	**131.88** (11.50)	**4.78** (2.30)	**113.01** (10.62)	**4.36** (2.20)	**122.44** (11.06)	**35.00**
2.Indoxacarb	**1.84**	**4.46** (2.22)	**149.43** (12.23)	**4.98** (2.34)	**116.41** (10.80)	**4.72** (2.28)	**132.92** (11.52)	**31.74**
3.Imidacloprid	**1.87**	**3.11** 2 NS (1.90)	**108.86** (10.45)	**4.22** 2 NS (2.17)	**97.47** 2 NS (9.89)	**3.66** 2 NS (2.03)	**103.16** 2 NS (10.17)	**34.80** 1 NS
4.Chlorpyriphos	**1.94**	**5.21** (2.39)	**175.18** (13.25)	**6.71** (2.68)	**159.00** (12.59)	**5.96** (2.54)	**167.09** (12.92)	**31.72**
5.Thiamethoxam	**1.92**	**4.84** (2.30)	**162.40** (12.76)	**6.16** (2.58)	**145.02** (12.04)	**5.50** (2.44)	**153.71** (12.40)	**31.37**
6.Chlorantraniliprole	**1.88**	**4.04** (2.12)	**135.22** (11.64)	**5.56** (2.46)	**131.40** (11.45)	**4.80** (2.29)	**133.31** (11.55)	**31.75**
7.Neem Oil	**1.87**	**2.82** (1.82)	**95.16** (9.78)	**3.94** (2.10)	**91.67** (9.59)	**3.38** (1.96)	**93.41** (9.69)	**31.39**
8.Btk	**1.88**	**2.48** (1.72)	**83.57** (9.17)	**3.68** (2.04)	**86.12** (9.29)	**3.08** (1.88)	**84.85** (9.23)	**31.18**
9.Neem Oil + Btk	**1.96**	**2.75** 1 NS (1.80)	**92.29** 1 NS (9.63)	**3.84** 1 NS (2.08)	**89.23** 1 NS (9.47)	**3.29** 1 NS (1.94)	**90.76** 1 NS (9.55)	**34.28** 2 NS
10.Untreated Check	**1.95**	**2.98** (1.86)	**–**	**4.37** (2.19)	**–**	**3.67** (2.03)	**–**	**31.02**
SE $_{(m)}$	**–**	**0.03**	**0.17**	**0.03**	**0.20**	**0.03**	**0.24**	**0.25**
CD $_{(5\%)}$	**–**	**0.10**	**0.49**	**0.10**	**0.57**	**0.10**	**0.70**	**0.72**
CV $_{(\%)}$	**–**	**2.84**	**2.63**	**2.58**	**3.18**	**2.16**	**3.06**	**1.33**

***** *Values in parentheses are square root transformation (√ (x + 0.5)) for uniform sample size (Steel and Torrie [23]);1,2,3 numerals are rank orders and NS stands for non-significant respectively; Comparison of all data respective to the non-significant lowest pest: defender ratio (P:D)*

Table 2. Rank Evaluation of Ecofriendly Insecticides for Major Insect Pests (Pooled of 2014 &15)*

Rank	P:D (Ratio) (Lowest)	ABOC (%) (Lowest)	Yield (q/ ha) (Highest)	Mean Rank
1	**Btk** **3.08** (1.88)	**Btk** **84.85** (9.23)	**CartapHcl** **35.00**	**Neem Oil + Btk** **2.33** 1 NS
2	**Neem Oil + Btk** **3.29** 1 NS (1.94)	**Neem Oil + Btk** **90.76** 1 NS (9.55)	**Imidacloprid** **34.80** 1 NS	**Imidacloprid** **3.33** 2 NS
3	**Neem Oil** **3.38** (1.96)	**Neem Oil** **93.41** (9.69)	**Neem Oil + Btk** **34.28** 2 NS	**CartapHcl** **3.67**
4	**Imidacloprid** **3.66** 2 NS (2.03)	**Imidacloprid** **103.16** 2 NS (10.17)	**Chlorantraniliprole** **31.75**	**Btk** **3.67**
5	**CartapHcl** **4.36** (2.20)	**CartapHcl** **122.44** (11.06)	**Indoxacarb** **31.74**	**Neem Oil** **4.33**
6	**Indoxacarb** **4.72** (2.28)	**Indoxacarb** **132.92** (11.52)	**Chlorpyriphos** **31.72**	**Indoxacarb** **5.67**
7	**Chlorantraniliprole** **4.80** (2.29)	**Chlorantraniliprole** **133.31** (11.55)	**Neem Oil** **31.39**	**Chlorantraniliprole** **6.00**
8	**Thiamethoxam** **5.50** (2.44)	**Thiamethoxam** **153.71** (12.40)	**Thiamethoxam** **31.37**	**Chlorpyriphos** **8.00**
9	**Chlorpyriphos** **5.96** (2.54)	**Chlorpyriphos** **167.09** (12.92)	**Btk** **31.18**	**Thiamethoxam** **8.00**
$SE_{(m)}$	**0.03**	**0.03**	**0.25**	–
$CD_{(5\%)}$	**0.10**	**0.10**	**0.72**	–
$CV_{(\%)}$	**2.16**	**2.16**	**1.33**	–

** Values in parentheses are square root transformation (√ (x + 0.5)) for uniform sample size (Steel and Torrie [23]); 1,2,3 numerals are rank orders and NS stands for non-significant respectively; Comparison of all data respective to the non-significant lowest pest: defender ratio (P:D)*

Present research work was adopted the non-significant pest: defender ratio for observation of lowest abundance of pest: defender ratio over check plot as scale to confined efficacy of insecticides as ecofriendly. There were 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for lowest pest: defender ratio, and highest yield respectively. The mean ranking and inference of abundance of pest: defender ratio over check were not similar. There were 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for abundance of pest: defender ratio over check based on non-significant ecofriendly insecticides for lowest pest: defender ratio. Though, both the insecticides were being most effective ecofriendly insecticides as, the Neem Oil + Btk are the biological insecticides (biorationals), while Imidacloprid is the chemical insecticide. Hence, Neem Oil + Btk as biorationals primarily would be the best choice before Imidacloprid for the ecofriendly management of major insect pests of rice. Meanwhile, the observation of the present investigations under untreated check revealed the abundance of P:D ratio was increased in 45 days after transplanting followed by 30 days after transplanting respectively (Table 1 and Fig. 1). It means, if the abundance of bioagents population would not be increased after first application of insecticides, the population of major insect pests of rice could not be decreased at lower level. So, the abundance of bioagents population have important role to suppress the population of insect pests of rice during 20-50 days after transplanting. The food chain of bioagents shortening have been continued for about 40 days after the first application of insecticides (30 days after transplanting) and tends to remove bioagents, making the rice more susceptible to secondary insect pests. Insecticides would then have to be sprayed again for the secondary insect pests become uneconomical. So primarily, the insecticide application has to avoid first 40 days after transplanting. If insecticide application is necessary, apply most effective ecofriendly insecticides at 40 days after transplanting as single application. Schoenly et al. [24], Heong et al. [25], Gallagher et al. [26], Norton et al. [27], Prakash et al. [22], Heinrichs and Muniappan [4] and Rao [28].

4. CONCLUSION

The abundance of pest: defender ratio for major insect pests of rice were observed for most serious insect pests, which were 1.Yellow stemborer (*Scirpophaga incertulus* Walker), 2.Common rice leaffolder (*Cnaphalocrosis medinalis* Guenee), 3.Brown planthopper (*Nilaparvata lugens* Stal), 4.Rice hispa (*Dicladispa armigera* Oliver), and 5.Rice earheadbug (*Leptocorisa acuta* Thunberg). The inferences of abundance of pest: defender ratio over check were based on non-significant ecofriendly insecticides for lowest pest: defender ratio. There were 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for lowest pest: defender ratio, and highest yield respectively. The mean ranking and inference of abundance of pest: defender ratio over check were not similar. There were 2 insecticides (Neem Oil + Btk and Imidacloprid) inference non-significant for abundance of pest: defender ratio over check based on non-significant ecofriendly insecticides for lowest pest: defender ratio. Though, both the insecticides were being most effective ecofriendly insecticides as, the Neem Oil + Btk are the biological insecticides (biorationals), while Imidacloprid is the chemical insecticide. Hence, Neem Oil + Btk as biorationals primarily would be the best choice before Imidacloprid for the ecofriendly management of major insect pests of rice. The present research works recommend to conserve strength of bioagents build up and the insecticide application has to avoid first 40 days after transplanting. If insecticide application is necessary, apply most effective eco-friendly insecticides at 40 days after transplanting as single application.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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