Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 305-310
Received: 01-07-2019
Accepted: 05-08-2019

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Ecofriendly insecticides for the management of rice earheadbug (*Leptocorisa acuta* Thunberg) under eastern Uttar Pradesh conditions

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DOI: https://doi.org/10.22271/phyto.2019.v8.i5f.14642

Abstract
A study was conducted on the evaluation of efficacy of some ecofriendly insecticides for the management of rice earheadbug (*Leptocorisa acuta* Thunberg) under rice ecosystem of Eastern Uttar Pradesh for the two consecutive years (2014 and 2015) at farmer field of district Deoria. This evaluation was observed most effective ecofriendly insecticides concerned to lowest infestation, lowest P:D ratio, and highest yield. 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. The surveillance was conducted as per methodology of agroecosystem analysis (AESA) (Pontius *et al*., 2002) modified as accessibility. The rice earheadbug is a sporadic insect pest of rice and accounted for 10-50% yield loss. It was observed most serious insect pest and confined infestation over 15% during the study. The insecticide treatments comprise 9 insecticides (Cartap Hcl, 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). There were 6 insecticides (Cartap Hcl, Indoxacarb, Imidacloprid, Chlorpyriphos, Thiamethoxam, and Chlorantraniliprole) inference non-significant for lowest infestation; 1 insecticide (Imidacloprid) inference non-significant for lowest P:D ratio; 2 insecticides (Cartap Hcl and Imidacloprid) inference non-significant for highest yield. There was only 1 insecticide (Imidacloprid) inference most effective ecofriendly insecticide. The Imidacloprid was observed only one the most effective ecofriendly insecticide as a chemical insecticide, because the rice earheadbug infestation was started abundantly after 40 days of transplanting, where bioagents population could not get opportunity to check the rice earheadbug population.

Keywords: Efficacy, ecofriendly insecticides, rice earheadbug (*Leptocorisa acuta* Thunberg), rice ecosystem, Eastern Uttar Pradesh, India

Introduction
Rice is a staple food for 70% population over the world and 65% population of the India. It is grown in almost all the states of India and shares 21% of the world rice production. Uttar Pradesh shares 15% of the India rice production and occupies second position after West Bengal (17%) and first position in rice crop area. Despite this above proud credential, Uttar Pradesh is not appearing leading position. The main cause of low productivity is traditional and ill cultivation practices by losses 65% of yield of the highest productivity and shares 25% losses caused by insect pests itself. About 800 insect pest species associated with rice crop over world. Among them 250 insect pest species associated with rice crop in India and 20 of them are pests of major economic significance. The insect pests of rice infest all parts of the plant at all growth stages and transmit few viral diseases of rice. Historically, insect pest outbreaks have been causing extensive losses in rice crop production ranging from 60 to 95% over world. India have been estimated rice crop losses by insect pests ranging from 21 to 51%. (Pathak and Khan, 1994; Oerke, 2006; Dhaliwal *et al*., 2015; Sharma *et al*., 2017; Heinrichs and Muniappan, 2017; Pathak *et al*., 2018; DAC&FW, 2018; FAOSTAT, 2019) [14, 12, 7, 22, 10, 13, 4, 9].

Uttar Pradesh is the fourth largest and first most populous state of the India. It has 11.56 million hectares of cultivated area, constituting 70% of the total geographical area of state. The rice production of Uttar Pradesh is mostly concentrated to the Eastern Uttar Pradesh region. But the Uttar Pradesh is under lag phase of adaptation of modern technologies of rice crop production, especially to insect pest management. Which contributes valuable share in India rice production.

Though, Farmers are practicing all possible available methods and techniques for rice insect pest management based on traditional knowledge, layman and salesman advice, while all the management practices are concentrated to the farmers' perception about finishing approach of insect pests ignoring the significant role of bioagents in suppression of infestation rice insect pests. No doubt, Insecticides are the most powerful tool available for use in pest management and continue to be the foreseeable future. Insecticides are most common pesticides used widely in crop production. The role of pesticides in crop production to augment output has been well perceived and these have been considered essential inputs in crop production. There have been bunch of insecticides including conventional and novel chemical insecticides, and biological insecticides trending commonly in scientific community to evaluate their efficacy regarding ecofriendly approach, while combination application of biological insecticides have been limited evaluation towards biorational approach of pest management. Therefore, this research work selected those novel insecticides and their combinations to evaluate their efficacy regarding the ecofriendly approach, which has been commonly trending among the scientific community and as well as market availability among Eastern Uttar Pradesh conditions.

The rice earheadbug (*Leptocorisa acuta* Thunberg) is a most serios insect pest of rice, which has been accounted for 10-50% yield loss. Rath *et al.* (2014) [19] have been reported that, plots treated with Imidacloprid recorded lowest infestation of rice earhead bug (*Leptocorisa acuta*) and highest grain yield followed by Thiamethoxam. Sarao *et al.* (2015) [20] and Tigga *et al.* (2018) [24] both have been found that, the damage rice earheadbug (*Leptocorisa acuta*) were recorded lowest in Imidacloprid. Sharanappa *et al.* (2019) [21] have been found that, the application of Imidacloprid observed favour the high population of coccinellids.

Materials and Methods

The evaluation was conducted on the efficacy of some ecofriendly insecticides against rice earheadbug (*Leptocorisa acuta* Thunberg) under rice ecosystem of Eastern Uttar Pradesh for the two consecutive years (2014 and 2015) at farmer field of district Deoria. This confined spot of study, represents the conductive environment for survival and proliferation of insect pests in rice ecosystem under Eastern Uttar Pradesh conditions. 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'. The insecticide treatments comprise 9 insecticides (Cartap Hcl, 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). 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 and their bioagents. The size of sweep net were 25 cm diameter and 70 cm handle and made up of nylon. 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 infestation of rice earheadbug, abundance of bioagents, and yield to evaluate efficacy of treated some ecofriendly insecticides. This observation was evaluated most effective ecofriendly insecticides concerned to lowest infestation, lowest P:D ratio, and highest yield. P:D ratio refers the ratio between the population of rice earheadbug and their bioagents.

Surveillance was conducted as per methodology of agroecosystem analysis (AESA) (Pontius *et al*., 2002) [15] modified as accessibility. Taxonomic identification was verified with texts of reference, *i.e*., Dale (1994) [5], Barrion and Litsinger (1994) [2], Pathak and Khan (1994) [14], David and Ananthakrishnan (2004) [6]; Rice knowledge management portal (RKMP); and Subject experts respectively. The statistical inferences were verified with texts of reference, *i.e*., Dhamu & Ramamoorthy (2007) [8], and Rangaswamy (2010) [17].

Results and Discussion

The evaluation of efficacy of some ecofriendly insecticides was observed on infestation and their bioagents of rice earheadbug (*Leptocorisa acuta* Thunberg) in rice crop for the two consecutive years 2014 and 2015 respectively. It was observed most serious insect pest and confined infestation over 15%. The rice earheadbug is a sporadic insect pest of rice and accounted for 10-50% yield loss. The symptoms of damage were observed as chaffy grains and dark spots on punctured grains in flowering stage. The damaging stages are nymph and adult, sucking cell sap from tender shoots and milky grains, leading to chaffy grains and emit offensive smell. The adults are slender, greenish brown with long antennae and legs. The eggs are laid in masses in single row, towards the midrib of leaves. The full-grown nymphs are yellowish green and inactive during hot sun by resting at the lower shady portion of the plants.

Of the total observed infestation and their bioagents of rice earheadbug (*Leptocorisa acuta* Thunberg) for pooled of both the years 2014 and 2015, there were 4 insecticides (Cartap Hcl, Indoxacarb, Imidacloprid, and Chlorpyriphos) inferenced non-significant for lowest infestation and 2 insecticides (Imidacloprid and Neem Oil + Btk) inferenced non-significant for lowest P:D ratio under first application (30 DAT); and 8 insecticides (Cartap Hcl, Indoxacarb, Imidacloprid, Chlorpyriphos, Thiamethoxam, Chlorantraniliprole, Neem Oil, and Neem Oil + Btk) inferenced non-significant for lowest infestation and 3 insecticides (Imidacloprid, Neem Oil, and Neem Oil + Btk) inferenced non-significant for lowest P:D ratio under second application (45 DAT) respectively. The mean of evaluation was observed as, 6 insecticides (Cartap Hcl, Indoxacarb, Imidacloprid, Chlorpyriphos, Thiamethoxam, and Chlorantraniliprole) inferenced non-significant for lowest infestation and 1 insecticide (Imidacloprid) inferenced non-significant for lowest P:D ratio under mean of first application and second application, and along with 2 insecticides (Cartap Hcl and Imidacloprid) were also inferenced non-significant for highest yield respectively.

(Table & Figure 1). Of the total observed evaluation of ecofriendly insecticides under suppression over check for pooled of both the years 2014 and 2015, there were 4 insecticides (Cartap Hcl, Indoxacarb, Imidacloprid, Chlorpyriphos and Thiamethoxam) and 2 insecticides (Imidacloprid and Chlorpyriphos) inferenced non-significant for highest suppression over check at intervals of 3, 7, and 14 days after application under first application (30 DAT) and second application (45 DAT) respectively, based on evaluation of non-significant ecofriendly insecticides for lowest infestation as, Cartap Hcl, Indoxacarb, Imidacloprid, and Chlorpyriphos for first application; and Cartap Hcl, Indoxacarb, Imidacloprid, Chlorpyriphos, Thiamethoxam, Chlorantraniliprole, Neem Oil, and Neem Oil + Btk for second application, The mean of evaluation under suppression over check was observed as, 2 insecticide (Imidacloprid and Chlorpyriphos) inference non-significant for highest suppression over check under mean of first application and second application, based on mean evaluation of non-significant ecofriendly insecticides for lowest infestation as, Cartap Hcl, Indoxacarb, Imidacloprid, Chlorpyriphos, Thiamethoxam, Chlorantraniliprole respectively. (Table & Figure 2). The ranking of evaluation was observed as, Chlorpyriphos > Imidacloprid > Cartap Hcl > Indoxacarb > Thiamethoxam > Chlorantraniliprole > Neem Oil + Btk > Neem Oil > Btk for lowest infestation; Btk > Neem Oil + Btk > Neem Oil > Imidacloprid > Cartap Hcl > Indoxacarb > Chlorantraniliprole > Thiamethoxam > Chlorpyriphos for lowest P:D ratio; Cartap Hcl > Imidacloprid > Neem Oil + Btk > Chlorantraniliprole > Indoxacarb > Chlorpyriphos > Neem Oil > Thiamethoxam > Btk for highest yield; and Imidacloprid > Cartap Hcl > Neem Oil + Btk > Indoxacarb > Chlorpyriphos > Chlorantraniliprole > Neem Oil > Btk > Thiamethoxam for mean of infestation, P:D ratio, and yield respectively. (Table 3). Of the most effective ecofriendly insecticides observed on infestation and their bioagents of rice earheadbug for pooled of both the years 2014 and 2015, there were 6 insecticides (Chlorpyriphos, Imidacloprid, Cartap Hcl, Indoxacarb, Thiamethoxam, and Chlorantraniliprole) inference non-significant for lowest infestation; 1 insecticide (Imidacloprid) inference non-significant for lowest P:D ratio; 2 insecticides (Cartap Hcl and Imidacloprid) inference non-significant for highest yield; and only 1 insecticide (Imidacloprid) inference most effective ecofriendly insecticides for the management of rice earheadbug respectively. (Table 3). Similar results were also reported by CRRI (2014) [3], Rath *et al.* (2014) [19], Sarao *et al.* (2015) [20], Tigga *et al.* (2018) [24], and Sharanappa *et al.* (2019) [21].

Present research work was adopted the lowest P:D ratio, respective to non-significant lowest infestation as scale to confined efficacy of insecticides as ecofriendly. Therefore, only 1 insecticide (Imidacloprid) was confined most effective ecofriendly insecticide as inference non-significantly for lowest P:D ratio for the management of rice earheadbug. Though, Chlorpyriphos was being most effective insecticides for rice earheadbug among 6 insecticides (Chlorpyriphos, Imidacloprid, Cartap Hcl, Indoxacarb, Thiamethoxam, and Chlorantraniliprole) as inference non-significantly for lowest infestation, but interestingly this observation was changed in P:D ratio as it did not inference non-significantly for lowest P:D ratio with only 1 insecticide (Imidacloprid). The Imidacloprid was observed only one most effective ecofriendly insecticide as a chemical insecticide, because the rice earheadbug infestation was started abundantly, where bioagents population could not get opportunity to check the rice earheadbug population before first 40 days after transplanting when bioagents were strengthening their build up. Similar recommendation has also been reported by Norton *et al.* (2010) [11], Prakash *et al.* (2014) [16], Baehaki *et al.* (2017) [1], Heinrichs and Muniappan (2017) [10], and Rao (2019) [18].

Table 1: Mean Evaluation of Ecofriendly Insecticides for Rice Earhead bug (Pooled of 2014 & 15).* (% Infestation (Infestation) and Pest: Defender Ratio (P:D))

Treatments	First Application (ADBAp)		First Application (Mean)		Second Application (Mean)		Total Mean Infestation DAAp	Total Mean P:D DAAp	Mean Yield (q/ha)
	Infestation	P:D	Infestation	P:D	Infestation	P:D			
1.Cartap Hcl	–	1.82	0.83 $^{3\,NS}$ (1.15)	3.93 (2.10)	1.91 $^{3\,NS}$ (1.53)	4.78 (2.30)	1.37 $^{3\,NS}$ (1.34)	4.36 (2.20)	35.00 $^{1\,NS}$
2.Indoxacarb	–	1.84	0.86 $^{4\,NS}$ (1.17)	4.46 (2.22)	1.98 $^{4\,NS}$ (1.55)	4.98 (2.34)	1.42 $^{4\,NS}$ (1.36)	4.72 (2.28)	31.74
3.Imidacloprid	–	1.87	0.61 $^{2\,NS}$ (1.05)	3.11 $^{1\,NS}$ (1.90)	1.66 $^{2\,NS}$ (1.45)	4.22 (2.17)	1.14 $^{2\,NS}$ (1.25)	3.66 $^{1\,NS}$ (2.03)	34.80 $^{2\,NS}$
4.Chlorpyriphos	–	1.94	0.59 $^{1\,NS}$ (1.04)	5.21 (2.39)	1.60 $^{1\,NS}$ (1.43)	6.71 (2.68)	1.09 $^{1\,NS}$ (1.24)	5.96 (2.54)	31.72
5.Thiamethoxam	–	1.92	0.89 (1.18)	4.84 (2.30)	2.31 $^{5\,NS}$ (1.66)	6.16 (2.58)	1.60 $^{5\,NS}$ (1.42)	5.50 (2.44)	31.37
6.Chlorantraniliprole	–	1.88	0.96 (1.21)	4.04 (2.12)	2.47 $^{6\,NS}$ (1.71)	5.56 (2.46)	1.72 $^{6\,NS}$ (1.46)	4.80 (2.29)	31.75
7.Neem Oil	–	1.87	1.37 (1.37)	2.82 (1.82)	2.71 $^{8\,NS}$ (1.77)	3.94 $^{2\,NS}$ (2.10)	2.04 (1.57)	3.38 (1.96)	31.39
8.Btk	–	1.88	1.54 (1.43)	2.48 (1.72)	4.26 (2.17)	3.68 (2.04)	2.90 (1.80)	3.08 (1.88)	31.18
9.Neem Oil + Btk	–	1.96	1.33 (1.35)	2.75 (1.80)	2.66 $^{7\,NS}$ (1.76)	3.84 $^{1\,NS}$ (2.08)	2.00 (1.55)	3.29 (1.94)	34.28
10.Untreated Check	–	1.95	2.77 (1.81)	2.98 (1.86)	7.38 (2.78)	4.37 (2.19)	5.08 (2.30)	3.67 (2.03)	31.02
SE (m)	–		0.04	0.03	0.12	0.03	0.10	0.03	0.25
CD (5%)	–		0.13	0.10	0.34	0.10	0.29	0.10	0.72
CV (%)	–		5.89	2.84	11.33	2.58	9.09	2.16	1.33

* Values in parentheses are square root transformation (√ (x + 0.5)) for uniform sample size (Steel and Torrie, 1960); 1, 2, 3 numerals are rank orders and NS stands for non-significant respectively; Comparison of all data respective to the non-significant lowest insect pest infestation.

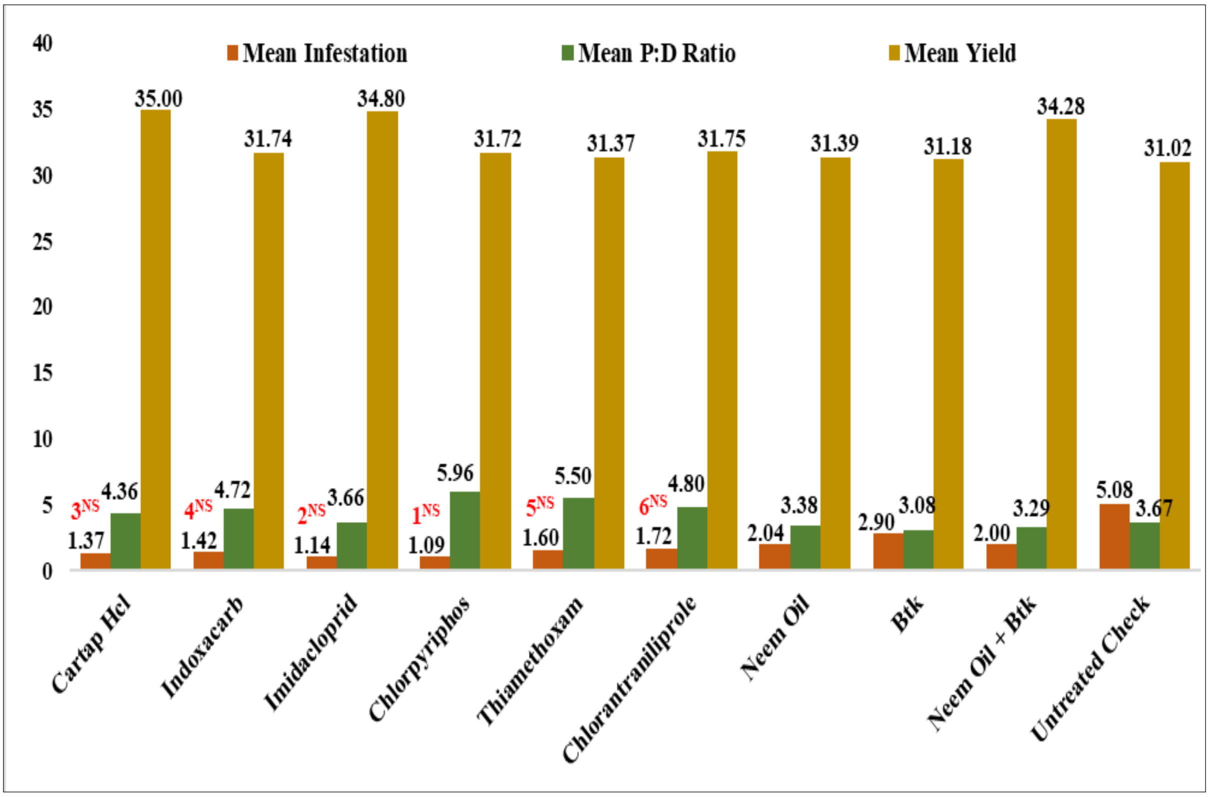

Fig 1: Mean Evaluation of Ecofriendly Insecticides for Rice Earhead bug (Pooled of 2014 & 15). (% Infestation (Infestation) and Pest: Defender Ratio (P:D))

Table 2: Mean Evaluation of Ecofriendly Insecticides for Rice Earhead bug (Pooled of 2014 & 15).* (% Infestation (Infestation) and % Suppression of Infestation over Check (SPOC))

Treatments	First Application (ADBAp)	First Application (Mean)		Second Application (Mean)		Total Mean Infestation DAAp	Total Mean SPOC DAAp	Mean Yield (q/ha)
	Infestation	Infestation	SPOC	Infestation	SPOC			
1.Cartap Hcl	–	0.83 $^{3\ NS}$ (1.15)	69.42 $^{3\ NS}$ (8.35)	1.91 $^{3\ NS}$ (1.53)	69.81 (8.29)	1.37 $^{3\ NS}$ (1.34)	69.62 (8.32)	35.00 $^{1\ NS}$
2.Indoxacarb	–	0.86 $^{4\ NS}$ (1.17)	69.07 $^{4\ NS}$ (8.34)	1.98 $^{4\ NS}$ (1.55)	68.98 (8.24)	1.42 $^{4\ NS}$ (1.36)	69.02 (8.29)	31.74
3.Imidacloprid	–	0.61 $^{2\ NS}$ (1.05)	77.80 $^{2\ NS}$ (8.84)	1.77 $^{2\ NS}$ (1.49)	74.10 $^{2\ NS}$ (8.58)	1.14 $^{2\ NS}$ (1.25)	75.95 $^{2\ NS}$ (8.71)	34.80 $^{2\ NS}$
4.Chlorpyriphos	–	0.59 $^{1\ NS}$ (1.04)	78.77 $^{1\ NS}$ (8.90)	1.60 $^{1\ NS}$ (1.43)	89.05 $^{1\ NS}$ (9.46)	1.09 $^{1\ NS}$ (1.24)	83.91 $^{1\ NS}$ (9.18)	31.72
5.Thiamethoxam	–	0.89 (1.18)	67.71 $^{5\ NS}$ (8.25)	2.31 $^{5\ N}$ (1.66)	64.65 (7.97)	1.60 $^{5\ NS}$ (1.42)	66.18 (8.11)	31.37
6.Chlorantraniliprole	–	0.96 (1.21)	64.21 (8.01)	2.47 $^{6\ N}$ (1.71)	62.60 (7.83)	1.72 $^{6\ NS}$ (1.46)	63.41 (7.92)	31.75
7.Neem Oil	–	1.37 (1.37)	49.47 (7.03)	2.71 $^{8\ NS}$ (1.77)	58.95 (7.56)	2.04 (1.57)	54.21 (7.30)	31.39
8.Btk	–	1.54 (1.43)	43.82 (6.64)	4.26 (2.17)	39.32 (6.15)	2.90 (1.80)	41.57 (6.39)	31.18
9.Neem Oil + Btk	–	1.33 (1.35)	51.06 (7.14)	2.66 $^{7\ NS}$ (1.76)	59.66 (7.61)	2.00 (1.55)	55.36 (7.38)	34.28
10.Untreated Check	–	2.77 (1.81)	–	7.38 (2.78)	–	5.08 (2.30)	–	31.02
SE $_{(m)}$	–	0.04	0.26	0.12	0.38	0.10	0.20	0.25
CD $_{(5\%)}$	–	0.13	0.76	0.34	1.11	0.29	0.59	0.72
CV $_{(\%)}$	–	5.89	5.69	11.42	8.28	9.09	3.50	1.33

* Values in parentheses are square root transformation (√ (x + 0.5)) for uniform sample size (Steel and Torrie, 1960); 1, 2, 3 numerals are rank orders and NS stands for non-significant respectively; Comparison of all data respective to the non-significant lowest insect pest infestation.

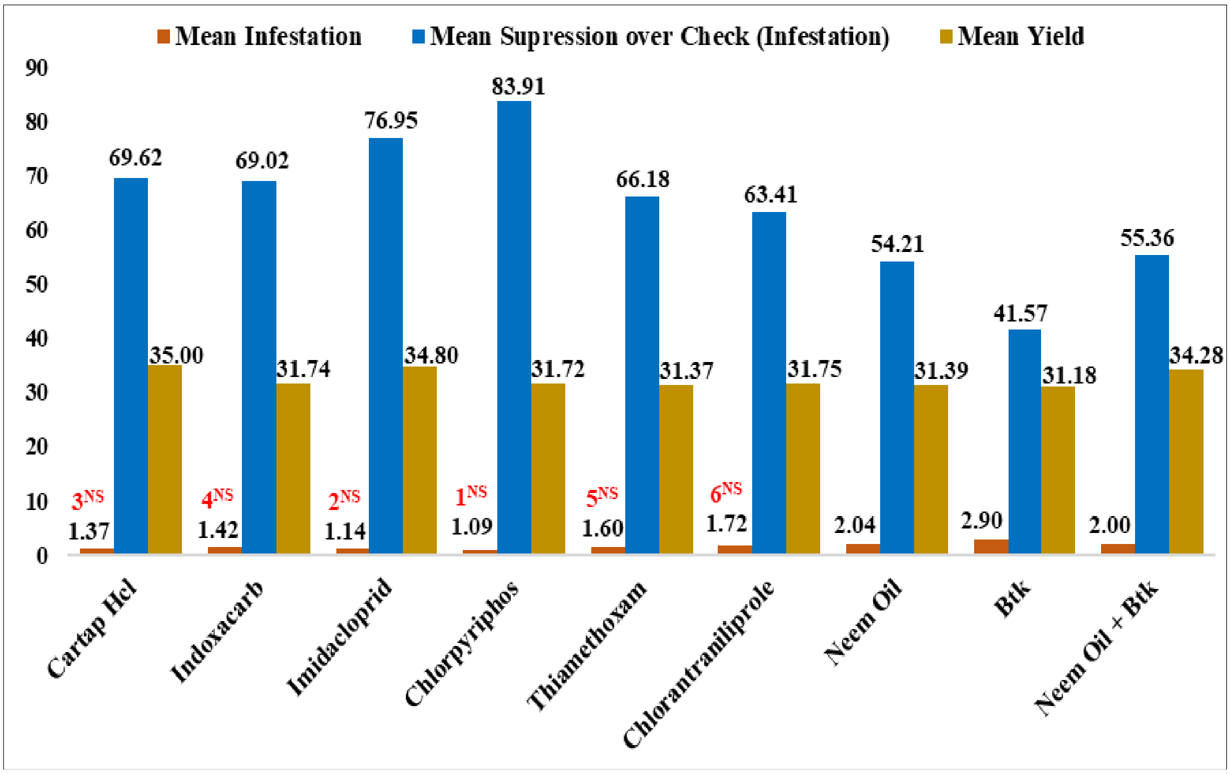

Fig 2: Mean Evaluation of Ecofriendly Insecticides for Rice Earhead bug (Pooled of 2014 & 15). (% Infestation (Infestation) and % Suppression of infestation over Check (SPOC))

Table 3: Rank Evaluation of Ecofriendly Insecticides for Rice Earhead bug (Pooled of 2014 & 15).* (Infestation/ P:D Ratio/ Yield/ Mean)

Rank	Infestation (%) (Lowest)	P:D (Ratio) (Lowest)	Yield (q/ ha) (Highest)	Mean Rank
1	Chlorpyriphos 1.09 [1 NS] (1.24)	Btk 3.08 (1.88)	Cartap Hcl 35.00 [1 NS]	Imidacloprid 2.67 [1 NS]
2	Imidacloprid 1.14 [2 NS] (1.25)	Neem Oil + Btk 3.29 (1.94)	Imidacloprid 34.80 [2 NS]	Cartap Hcl 3.00 [2 NS]
3	Cartap Hcl 1.37 [3 NS] (1.34)	Neem Oil 3.38 (1.96)	Neem Oil + Btk 34.28	Neem Oil + Btk 4.00
4	Indoxacarb 1.42 [4 NS] (1.36)	Imidacloprid 3.66 [1 NS] (2.03)	Chlorantraniliprole 31.75	Indoxacarb 5.00 [3 NS]
5	Thiamethoxam 1.60 [5 NS] (1.42)	Cartap Hcl 4.36 (2.20)	Indoxacarb 31.74	Chlorpyriphos 5.33 [4 NS]
6	Chlorantraniliprole 1.72 [6 NS] (1.46)	Indoxacarb 4.72 (2.28)	Chlorpyriphos 31.72	Chlorantraniliprole 5.67 [5 NS]
7	Neem Oil + Btk 2.00 (1.55)	Chlorantraniliprole 4.80 (2.29)	Neem Oil 31.39	Neem Oil 6.00
8	Neem Oil 2.04 (1.57)	Thiamethoxam 5.50 (2.44)	Thiamethoxam 31.37	Btk 6.33
9	Btk 2.90 (1.80)	Chlorpyriphos 5.96 (2.54)	Btk 31.18	Thiamethoxam 7.00 [6 NS]
$SE_{(m)}$	0.10	0.03	0.25	–
CD $_{(5\%)}$	0.29	0.10	0.72	–
CV $_{(\%)}$	9.09	2.16	1.33	–

* Values in parentheses are square root transformation ($\sqrt{(x + 0.5)}$) for uniform sample size (Steel and Torrie, 1960); 1, 2, 3 numerals are rank orders and NS stands for non-significant respectively; Comparison of all data respective to the non-significant lowest insect pest infestation.

Conclusion

There was only 1 insecticide (Imidacloprid) inference most effective eco-friendly insecticide for rice earheadbug (*Leptocorisa acuta* Thunberg). There were 6 insecticides (Chlorpyriphos, Imidacloprid, Cartap Hcl, Indoxacarb, Thiamethoxam, and Chlorantraniliprole) inference non-significant for lowest infestation; 1 insecticide (Imidacloprid) inference non-significant for lowest P:D ratio; 2 insecticides (Cartap Hcl and Imidacloprid) inference non-significant for highest yield. Though, Chlorpyriphos was being most effective insecticides for rice earheadbug among 6 insecticides (Chlorpyriphos, Imidacloprid, Cartap Hcl, Indoxacarb, Thiamethoxam, and Chlorantraniliprole) as inference non-significantly for lowest infestation, but interestingly this observation was changed in P:D ratio as it did not inference non-significantly for lowest P:D ratio with only 1 insecticide (Imidacloprid). The Imidacloprid was observed only one most effective ecofriendly insecticide as a chemical insecticide, because the rice earheadbug infestation was started abundantly, where bioagents population could not get opportunity to check the rice earheadbug population before first 40 days after transplanting when bioagents were strengthening their build up.

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