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Cost benefit ratio for the management of rice gundhi bug, *Leptocorisa acuta* (Thonberg) under field condition

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Abstract
An experiment was conducted during *Kharif* season in 2016, to analysis the cost benefit ratio of the treatments in rice field for control rice gundhi bug [*Leptocorisa acuta* (Thonberg)] at Central Research Farm, SHUATS, Naini, Allahabad. Three applications of seven insecticides *viz;* Imidacloprid 17.8% SL, Trizophos 25% SP, Monocrotophos 36% SL, Thiamethoxam 25% WG, Acephate 75% SP, Carbaryl 50% SP, Malathion 50% EC were evaluated against Rice Gundhi bug, *Leptocorisa acuta*. The yields among the treatment were significant. The highest yield was recorded in Imidacloprid (46.800 q/ha) followed by Triazophos (44.500 q/ha), Thiamethoxam (44.300 q/ha), Monocrotophos (43.700 q/ha), Acephate (42.400 q/ha), Carbaryl (40.900 q/ha), Malathion (39.800 q/ha) as compared to control T_0 (29.500 q/ha). When cost benefit ratio was worked out, interesting result was achieved. Imidacloprid treatment studied, the best and most economical treatment was T_1 (1:2.66), followed by Triazophos (1:2.53), Monocrotophos (1:2.49), Acephate (1:2.41), Thiamethoxam (1:2.40), Carbaryl (1:2.35), Malathion (1:2.19) as compared to control T_o (1:1.74).

Keywords: Cost benefit ratio, Gundhi bug, insecticide, rice

Introduction
Rice (*Oryza sativa* L.) being the most important cereal of the world fulfills one third food requirement of the world population. It provides some 700 calories per person, mostly residing in developing countries (Barai *et al*., 2009) [3]. According to International Rice Research Institute (IRRI) 800 million tons of rice will be required in 2025 (Ahmad *et al*., 2015) [1]. Rice is the staple food of more than 60 per cent of the world's population especially for the people in South-East Asia. Among the rice growing countries, India has the largest area under rice crop and ranks second in production next to China. It occupies about 23.3 per cent of gross cropped area of the country and plays a vital role in the national food grain supply. Rice alone contributes 43 per cent of total food grain production and 46 per cent of total cereal production of the country. (Dey *et al*., 2013) [4].
The rice earhead bug is the major sap sucking pest field of paddy. It poses serious problems in the successful cultivation of paddy in India. Both the nymphs and adults suck the sap of grains during milking stage and thus make them chaffy. Whole panicle becomes white coloured (chaffy) under severe infestation. For the control of this pest, growers resort to indiscriminate use of pesticides which directly add to problems like increased expenditure on cultivation, build up of resistance to insecticides and health hazards etc (Hosamani *et al*., 2009) [6]. The rice ear head bug (*Leptocorisa* spp.) causes appreciable grain loss up to 53% during severe attack (Rai *et al*., 2000) [7]. The use of chemical insecticides to control these pests has created many problems such as environmental hazards, resistance in target species, pest resurgence etc (Shitiri *et al.*, 2014) [10]. The rice bug, important pest of rice, caused damage by feeding on the sap of milky grain and turn them chaffy of the 15 species of bug reported to infest rice crop in India, *Leptocorisa* spp. are considered serious (Rath *et al.* 2015) [8].

Materials and Methods
The experiment was conducted during the *kharif,* 2016, at Central Research Farm, SHUATS, Naini, Allahabad. In the experiment, the variety under supervision 'Rupali' was grown for this study. Later the seedlings of sufficient age were transplanted to main field with a spacing of 20 × 10 cm in hills and all the agronomical practices *viz.*, irrigation, fertilizer application and intercultural operations were followed as recommended for rice crop in this area to raise the crop. Seven formulations of insecticides *viz.*, Imidacloprid 17.8% SL @ 300g/ha, Thiamethoxam 25% WG @ 100g/ha, Traizophos 25% @ 625g/h, Acephate 75% SP, @ 800 ml/ha, Carbaryl 50% SP @ 1000g/h, Malathion 50% EC @ 1150 ml/h with Monocrotophos 36% SL @ 1390 ml/ha against insect pest of rice.

The trial was laid out in randomized block design with three replications.
Gross return was calculated by multiplying total yield with the market price of the produce. Cost of cultivation and cost of treatment imposition was deducted from the gross returns, to find out net returns and cost benefit ratio by following formula. (Ahmad *et al.*, 2015) [1].

B: C = Gross returns / Total cost of incurred

Where,
B: C = Benefit Cost Ratio

Results and Discussion
The data on Cost benefit ratio of the treatments are presented in Tables 1, 2 and 3.
The yields among the treatment were significant. The highest yield was recorded in Imidacloprid (46.800 q/ha) followed by Triazophos (44.500 q/ha), Thiamethoxam (44.300 q/ha), Monocrotophos (43.700 q/ha), Acephate (42.400 q/ha), Carbaryl (40.900 q/ha), Malathion (39.800 q/ha) as compared to control (29.500 q/ha). When cost benefit ratio was worked out, interesting result was achieved. Imidacloprid the treatment studied, the best and most economical treatment was T1 (1:2.66), followed by Triazophos (1:2.53), Monocrotophos (1:2.49), Acephate (1:2.41), Thiamethoxam (1:2.40), Carbaryl (1:2.35), Malathion (1:2.19) as compared to control (1:1.74)
The yields among the treatment were significant. The highest yield and benefit cost ratio was recorded in T1 Imidacloprid (46.800 q/ha and 1:2.66 respectively) they suggested that Imidacloprid is a valuble chemical in the management of *L. acuta*Similar readings were found with Rath *et al*., (2014) [9] observed plots treated with imidacloprid 17.8 SL @ 500 g a.i. ha -1 recorded highest grain yield 5.18 t/ ha followed by thiamethoxam 25WG@ 25 g a.i. ha-1 (4.58 t ha-1) and triazophos 40EC @ 450 g a.i. ha-1 (4.56 t ha-1). Ashokappa *et al.*, (2015) [2] recorded insecticide imidaclorprid 17.8 SL @ 0.25ml/l thimethoxam 25 WG 0.3 g/l and malathion 5 D @ 20kg /ha recorded highest yield 7049.26, 6461.11 and 6253.33 kg/ha. Girish and Balikai (2015) [5] reported thiamethoxam 25 WG @ 0.3g/lit recorded highest net profit of Rs. 65823.75 followed by malathion 5 D @ 20kg/ha (Rs. 62070.63).

Table 1: Cost of Agronomical practices of cultivation/ha.

S. No	Particular	Requirement	Rate/unit (Rs.)	Cost (Rs.)
(A)	Land preparation			
I.	Ploughing	3 hours	550 /hours	1,650
II.	Harrow	3 hours	550 /hours	1,650
III.	Layout of field	10 labours	200 /labour	2000
(B)	Seed sowing			
I.	Seed material	40kg	100/kg	4000
II.	Sowing and transplanting	12 labours	200	2400
(C)	Weed Management	15 labours X 2 time	200 /labour	6000
(D)	Harvesting	30 labours	200 /labour	6000
(E)	Total cost of cultivation	23,700		

Table 2: Economics of Treatments:

Tr. No.	Treatment	Use of chemical for 1 time spray	Cost of Chemical (Rs.)	Total Cost of Chemical (Rs.)	No. of labours for spray @ 200 Rs/labour	Total labour cost (Rs.)	Total cost of Treatment (Rs.)
T_1	Imidacloprid	300 ml/ha	100Rs/150 ml	450.00	2	200.00	850.00
T_2	Triazophos	625g/ha	700Rs./kg	438.00	2	200.00	838.00
T_3	Monocrotophos	1,390ml/ha	350Rs./lit	460.00	2	200.00	860.00
T_4	Thiamethoxam	1 kg/ha	1,700 Rs./kg	1,700.00	2	200.00	2,100.00
T_5	Acephate	1 kg/ha	450Rs./kg	450.00	2	200.00	850.00
T_6	Carbaryl	100 g/ha	220Rs./100g	220.00	2	200.00	620.00
T_7	Malathion	500 g /ha	2,470 Rs./kg	1,235.00	2	200.00	1,635.00
T_0	Control	--------	--------	--------	-------	-------	------

Table 3: Economics of Cultivation:

Tr. No.	Treatment	Yield (q/ha)	Cost of Yield (Rs/q)	Total cost of Yield(Rs.)	Common Cost (Rs.)	Treatment Cost (Rs.)	Total cost (Rs.)	C:B Ratio
T_1	Imidacloprid	46.800	1,400.00	65520	23,700	850.00	24550	1:2.66
T_2	Triazophos	44.500	1,400.00	62300	23,700	838.00	24538	1:2.53
T_3	Monocrotophos	43.700	1,400.00	61180	23,700	860.00	24560	1:2.49
T_4	Thiamethoxam	44.300	1,400.00	62020	23,700	2,100.00	25800	1:2.40
T_5	Acephate	42.400	1,400.00	59360	23,700	850.00	24550	1:2.41
T_6	Carbaryl	40.900	1,400.00	57260	23,700	620.00	24320	1:2.35
T_7	Malathion	39.800	1,400.00	55720	23,700	1,635.00	25335	1:2.19
T_0	Control	29.500	1,400.00	41300	23,700	------	23700	1:1.74

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