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Evaluate the efficacy of some chemical pesticides and biopesticides against rice brown plant hopper (*Nilaparvata lugens* Stal.) in Paddy

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Abstract
The present investigation entitled "Evaluate the efficacy of some chemical pesticides and biopesticides against Rice brown plant hopper (*Nilaparvata lugens* Stal.) in Paddy" was carried out at. central research field, SHUATS, Prayagraj (U.P.) during *Kharif*, 2022. The efficacy of different chemical pesticides and biopesticides against Rice brown plant hopper was evaluated. Among the treatments, flonicamid 50 WG at a rate of 150 gm/ha showed the highest effectiveness (4.93), followed by Dinotefuron 20 SG at 150 gm/ha (5.40) and Lambda-cyhalothrin 5 EC at 500 gm/ha (8.04). Other effective treatments included Spinosad 45% SC at 165 gm/ha (9.26), Neem oil 2% at 20 ml/lit (11.78), Sixer plus at 1 mi/lit (12.60), and Beauveria bassiana (12 x 108) c.f.u./ml at 5 ml/lit (13.30). Flonicamid 50 WG resulted in the highest grain yield of rice (45.50 q/ha), followed by Dinotefuron 20 SG (42.80 q/ha), Lambda cyhalothrin 5 EC (40 q/ha), and Spinosad 45% SC (38 q/ha). The treatments with flonicamid 50 WG, Dinotefuron 20 SG, Lambda cyhalothrin 5 EC, and Spinosad 45% SC showed the highest cost-benefit ratios, with flonicamid 50 WG having the highest ratio of 1:2.97.

Keywords: Biopesticides and chemicals, efficacy, rice brown plant hopper, dinotefuran, seasonal incidence, benefit-cost ratio

Introduction
Rice, *Oryza sativa* Linn. (Gramineae or Poaceae), a self-pollinated crop with chromosomes number 2n=24, is considered the second most cultivated cereal crop (next to wheat) in the world (Abodolereza and Racionzer, (2009) [1]. It is widely grown in Asia, parts of Europe and America (Panda, (2010) [12] in most diverse ecosystems, such as irrigated, rainfed lowland, rainfed upland and flood-prone (Saini *et al*., 2015) [16]. Rice is a leading crop at the global level, and half of the world's population always depends upon cereal crops to maintain their daily diet (Ali, 2014) [2]. In rice, more than 100 insect species have been reported to attack rice crops at different stages of crop growth from the germination of nursery till harvest of the crop. Out of which, 20 are of major economic importance which includes yellow stem borer, *Scripophaga incertulas* (Walker), leaf folder, *Cnaphalocrocis medinalis* (Guenee), white backed plant hopper, *Sogatella furcifera* (Horvath), brown plant hopper, *Nilaparvata lugens* (Stal), gundhi bug, *Leptocorisa acuta* (Th.) and gall midge, *Orselia oryzae* (Wood-Mason). In general, yield loss due to insect pests of rice has been estimated at 25-55 per cent in different rice ecosystems (Pathak and Khan, (1994); Sachan *et al.*, (2006); Saini *et al*., (2015) and Horgan *et al*. 2016) [13, 15, 16, 5]. The rice crop is subjected to sustain damage by a considerable number of pests among them. There are sucking pests like brown plant hopper (BPH) *Nilaparvata lugens* (Stal) Rice gundhi bug *Leptocorisa acuta* (Thunberg) which cause damage by sucking cell sap. The brown plant hopper (BPH) is economic important pest and they damage plants directly by sucking the plant sap and by ovipositing in plant tissue causing plant wilting or hopper burn (Turner *et al*., 1999) [21]. Damage to the rice crop is caused directly by feeding on the phloem (Sogawa, 1992) and indirectly by transmitting plant viral diseases like grassy stunt viruses (Powell *et al*., 1995) [14]. Up to 60% of crops damaged are done by just single pests' i.e., BPH *Nilaparvata Lugens* (Li *et al.*, 2015) [9]. Due to using of the high input of fertilizer and narrow spacing, the pest status has increased in India (Lu *et al.*, 2015) [10].

Materials and Methods
The experiment was conducted during the *Kharif* season in 2022 at the central research field, SHUATS, Prayagraj using a randomized block design with three replications.

The study included eight treatments, one of which was an untreated control. The "Pusa Basmati-1" variety of Paddy was used and recommended agronomic practices were followed to raise a healthy crop. Twenty-nine days old seedlings were planted. The plot size was 2m x 2 m, with row and plant spacing maintained at 20 X 10 cm. The eight treatments tested were T1 - Lambda cyhalothrin 5 EC(500 g/ha), T2 - Neem Oil 2% (20 ml/litre), T3 - Sixer plus (1 ml/litre), T4 - Beauveria bassiana 2x10^8 Cfu/ml (5 ml/litre), T5 - Flonicamid 50 WG (150 g/ha), T6 - Spinosad 45% SC (165 g/ha), T7 - Dinotefuron 20 SG (150 g/ha), and T0 - an untreated control. The sprays were initiated once the Nymphal population of the brown plant hopper reached the economic threshold level (ETL) of 5-10 Nymph per hill, and the crop damage exceeded 10-20 percent. Spraying was repeated twice at intervals during the crop season. The BPH population (adult and nymphs) was recorded in two phases i.e., the day before treatment (DBT) and 3rd 7th, and 14th days after treatment (DAT). The observations were recorded on 5 randomly selected hills in each treatment and each treatment was replicated three times in a field.

Results and Discussion

Data revealed that flonicamid 50 WG @ 150 gm/ha was found effective and it was the best treatment among all the treatments of the field experiment with (4.20) BPH infestation followed by Dinotefuron 20 SG @ 150 gm/ha with (5.40) BPH in the field and it was also statically at par with better treatments.

Table 1: Evaluate the efficacy of some chemical pesticides and biopesticides against rice brown plant hopper (*Nilaparvata lugens* Stal.)

S. No.	Treatments	Population of *Nilaparvata lugens* / 5 plants							Overall mean	Yield (q/ha)	B: C ratio
		First spray				Second spray					
		1 DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS			
T_0	Control	12.60 (3.55)	16.86 (4.10)	17.66 (4.20)	19.33 (4.39)	20.60 (4.53)	21.40 (4.66)	22.20 (4.71)	19.67	25.50	1:1.79
T_1	Lambda cyhalothrin 5 EC 500 g/ha	13.66 (3.69)	10.07 (3.17)	7.60 (2.75)	8.80 (2.96)	8.00 (2.82)	6.60 (2.56)	7.20 (2.68)	8.04	40.00	1:2.71
T_2	Neem Oil 2% 20 ml/litre	15.40 (3.92)	13.13 (3.62)	11.00 (3.31)	12.00 (3.46)	12.00 (3.46)	10.80 (3.28)	11.80 (3.44)	11.78	35.00	1:2.19
T_3	Sixer plus 1 ml/litre	14.13 (3.75)	13.80 (3.70)	13.00 (3.59)	13.40 (3.65)	13.00 (3.60)	11.80 (3.43)	12.60 (3.55)	12.93	30.00	1:2.01
T_4	Beauveria bassiana 2*10^8 Cfu/ml 5 ml/litre	14.33 (3.78)	14.00 (3.73)	13.60 (3.68)	13.80 (3.71)	13.60 (3.68)	12.00 (3.46)	12.80 (3.57)	13.30	28.00	1:1.78
T_5	Flonicamid 50 WG 150 g/ha	14.86 (3.85)	6.60 (2.56)	5.00 (2.23)	6.00 (2.44)	4.80 (2.19)	3.00 (1.73)	4.20 (2.04)	4.93	45.50	1:2.97
T_6	Spinosad 45% SC 165 g/ha	13.06 (3.61)	12.40 (3.52)	8.00 (2.82)	9.00 (3.00)	9.40 (3.06)	7.80 (2.79)	9.00 (3.00)	9.26	38.00	1:2.44
T_7	Dinotefuron 20 SG 150 g/ha	15.13 (3.88)	9.87 (3.14)	6.00 (2.44)	7.00 (2.64)	6.20 (2.49)	4.00 (2)	5.40 (2.32)	6.41	42.80	1:2.56
	F-test	NS	S	S	S	S	S	S			
	S. Ed (±)	1.053	0.815	0.769	0.722	0.100	0.214	0.205			
	C.D. (P = 0.5)		1.747	1.649	1.548	0.215	0.459	0.440			

*Figures in parentheses are square root transformed values
DBS=Day Before Spray
DAS=Day After Spray

On the 14th day of application, the order of effectiveness was Lambda cyhalothrin 5 EC @ 500 gm/ha > Spinosad 45% SC @ 165 gm/ha > Neem oil 2% @ 20 ml/lit > Sixer plus @ 1 mi/lit >and *Beauveria bassiana* 2 x 10^8) c.f.u./ml @ 5 ml/lit, respectively According to Dash *et al.*, (2018) [3], and Matharu *et al.*, (2020) [11] showed that flonicamid 50 WG @ 150 gm/ha was an effective insecticide for Brown plant hopper in a rice field. In the present investigation was Dinotefuron 20 SG @ 150 gm/ha also found effective against the rice BPH, which proved the result reported by Uddin *et al.*, (2021) [21] Konchada *et al.*, (2015) [7] also reported that Lambda cyhalothrin 5EC @ 500 gm/ha also effective against brown plant hopper that is agreed by Uddin *et al.*, (2021) [21], Sulagitti *et al.*, (2017) [19], Kumar and Kumar (2017) [8], Jafar *et al.*, (2013) [6] and Elanchezhian *et al.*, (2008) [4]. The present study recorded higher grain yield and net profit in the treatment of flonicamid 50 WG @ 150 gm/ha. which is in agreement with the finding of Matharu *et al.*, (2020) [11]. The best cost-benefit ratio in the present finding was recorded with the treatment flonicamid 50 WG @ 150 gm/ha (1:1.297) followed by Dinotefuron 20 SG @ 150 gm/ha (1:2.56) this finding was partially similar to the finding of Uddin *et al.*, (2021) [21]. In the third position Lambda cyhalothrin 5 EC @ 500 gm/ha in all treatments with a cost-benefit ratio (of 1:2.71) which was partially similar to Seni and Naik (2016) [17]. In the fourth place Spinosad 45% SC @ 165 gm/ha in all treatments with the cost-benefit ratio (1:2.44) which was partially similar to the present finding of Sreeja and Kumar (2022) [18].

Conclusion

Flonicamid 50 WG @ 150 gm/ha was found most effective against BPH infestation followed by Dinotefuron 20 SG @ 150 gm/ha. The maximum Cost: Benefit ratio was obtained in a treated plot with Flonicamid (50 WG @ 150 gm/ha) followed by Dinotefuron (20 SG @ 150 gm/ha). The observations are based on one season of data, to get more precise information, it is suggested that the experiment should be repeated in future with the same treatments, soil and layout.

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