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EFFICACY OF BIOPESTICIDES AGAINST PLANT HOPPERS IN DIRECT SEEDED RICE

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ABSTRACT

This study evaluates the field efficacy of some biopesticides i.e., azadirachtin 1%EC @ 250, 500 & 750 ml, *Bacillus thuringiensis* @1500, 2000 & 2500 g, *Beauveria bassiana* 10%SC @2000, 2250 & 2500 ml and chlorpyriphos 20EC @2500 ml (check)/ ha against the brown plant hopper *Nilaparvata lugens* (Stål) and white backed plant hopper, *Sogatella furcifera* (Horváth) in direct seeded rice. The experiment was carried out at the Punjab Agricultural University, Ludhiana and Punjab Agricultural University Regional Research Station, Gurdaspur during 2017-18. It was observed that all tested biopesticides were found significantly effective. *Beauveria bassiana* @2500 ml/ ha was the most effective, while the maximum cost-benefit ratio was obtained with chlorpyriphos 20EC @2500 ml (standard check) followed by azadirachtin 1% EC @250 and 500 ml/ ha. Despite less cost benefits, biopesticides can be safer to environment.

Key words: Rice, *Nilaparvata lugens, Sogatella furcifera,* azadirachtin, *Beauveria bassiana*, field efficacy, cost: benefits, chlorpyriphos

Rice (*Oryza sativa* L) is an important cereal crop, and farmers around the world are increasing plant densities, which have resulted in an increased population of certain pests (Mekonnen et al., 2015). Nearly 300 species of insect pests have been reported, among these 23 species cause economic damage (Bhogadhi and Bentur, 2015; Kaur et al., 2020). The plant hoppers [*Nilaparvata lugens* (Stål) and *Sogatella furcifera* (Horváth)] are the major pests causing economic crop losses, as these attack the rice crop from late vegetative to grains hardening stage. Both nymphs and adults suck cell sap from base of plants resulting in chlorotic, wilting and drying up of crop, leading to 'hopper-burn', besides acting as vectors of viruses (Anonymous, 2021). Farmers rely heavily on insecticides for management of these pests, and almost 50% of the insecticides used in rice are targeted against these alone (Reddy et al., 2018). The frequent over-optimum pesticidal use has negative environmental and economic implications (Brevik and Sauer, 2015). Hence, biopesticide are ecofriendly alternatives, and these fall into two major categories viz., microbial pesticides and botanical pesticides (Ranga Rao et al., 2007; Prakash et al., 2008). The present study evaluates some of these against *N. lugens* and *S. furcifera* in direct seeded rice.

MATERIALS AND METHODS

The experiment in direct seeded rice (DSR) was conducted at the Punjab Agricultural University (PAU), Ludhiana and its Regional Research Station, Gurdaspur. The cultivar PR 121 was sown in first week of June during 2017-18, and crop raised following all the recommended PAU practices except plant protection. The experiment was laid out with three replication and eleven treatments (insecticides+ untreated control) in a randomized block design (RBD). The plot size was 25 m^2 with buffers maintained by 1.0 and 0.5 m between replication and treatment plots, respectively. The tested biopesticides with different doses viz. T_1- Azadirachtin 1% EC @ 250, T_2- Azadirachtin 1% EC @ 500, T_3- Azadirachtin 1% EC @ 750 ml, T_4- *Bacillus thuringiensis* @ 1500, T_5- *Bacillus thuringiensis* @ 2000, T_6- *B. thuringiensis* @ 2500 g, T_7- *Beauveria bassiana* 10% SC @ 2000, T_8- *B. bassiana* 10% SC @ 2250, T_9- *B. bassiana* 10%SC @ 2500 ml, T_{10}- chlorpyriphos 20EC @ 2500 ml (check)/ ha and untreated control (T_{11}). The biopesticides were applied using water @ 250 l/ ha at 60, 70, 80 and 90 days after sowing. The data on plant hoppers incidence was enumerated on ten randomly selected hills/ treatment before spray, and 3, 7 and 10 days after each spray. At maturity, the crop was harvested with single plot thresher; grains were cleaned, dried and weighed separately of each plot and converted into / ha. The data were subjected to statistical analysis by using ANOVA after square root transformations (Sheoran et al., 1998).

Table 1. Efficacy of insecticides against plant hoppers of rice (Ludhiana and Gurdaspur, pooled data)

No.	Plant hoppers/ hill at different days after sowing (Mean± SE)																				Yield (q/ ha)	Profit (Rs/ ha)	C:B (Rs.)
	60					70					80					90							
	BS	Days after spray				BS	Days after spray				BS	Days after spray				BS	Days after spray						
		3	7	10	Mean		3	7	10	Mean		3	7	10	Mean		3	7	10	Mean			
T1	1.67± 0.04	1.09± 0.16^{bcd} (1.45)	1.24± 0.30^{cd} (1.50)	1.38± 0.50^{cde} (1.54)	1.24± 0.08^{bcd} (1.49)	1.52± 0.06^{cd} (1.58)	1.00± 0.16^{cde} (1.41)	1.14± 0.30^{cd} (1.46)	1.19± 0.50^{cd} (1.48)	1.11± 0.06^{cd} (1.45)	1.33± 0.12^{cd} (1.52)	0.95± 0.16^{cd} (1.40)	1.09± 0.30^{cd} (1.45)	1.24± 0.50^{cd} (1.49)	1.10± 0.08^{cd} (1.44)	1.71± 0.06^{de} (1.64)	1.00± 0.16^{cd} (1.41)	1.19± 0.30^{cd} (1.48)	1.43± 0.50^{c} (1.56)	1.21± 0.12^{bcd} (1.48)	71.30 (8.50)^{e}	111437	1:8.68
T2	1.71± 0.08	1.00± 0.15^{bc} (1.41)	1.14± 0.24^{bc} (1.46)	1.29± 0.21^{bc} (1.51)	1.14± 0.09^{bc} (1.46)	1.43± 0.08^{c} (1.55)	0.91± 0.15^{bc} (1.38)	1.05± 0.24^{bc} (1.43)	1.09± 0.21^{bc} (1.45)	1.02± 0.05^{bc} (1.42)	1.19± 0.06^{c} (1.47)	0.81± 0.15^{bc} (1.34)	1.00± 0.24^{c} (1.41)	1.14± 0.21^{c} (1.46)	0.98± 0.09^{bc} (1.41)	1.48± 0.08^{c} (1.57)	0.91± 0.15 ^{c} (1.38)	1.05± 0.24^{bc} (1.43)	1.29± 0.21^{bc} (1.51)	1.08± 0.11^{bc} (1.44)	73.40 (8.63)^{c}	113620	1:9.09
T3	1.57± 0.08	0.95± 0.27^{b} (1.39)	1.05± 0.50^{b} (1.43)	1.19± 0.09^{b} (1.48)	1.06± 0.07^{b} (1.43)	1.24± 0.05^{b} (1.49)	0.81± 0.27^{b} (1.46)	0.90± 0.50^{b} (1.38)	0.95± 0.09^{b} (1.40)	1.00± 0.07^{b} (1.41)	1.00± 0.07^{b} (1.41)	0.66± 0.27^{b} (1.28)	0.81± 0.50^{b} (1.34)	0.91± 0.09^{b} (1.38)	0.79± 0.07^{b} (1.34)	1.24± 0.06^{b} (1.49)	0.71± 0.27^{b} (1.31)	0.90± 0.50^{b} (1.38)	1.05± 0.09^{b} (1.43)	0.89± 0.10^{b} (1.37)	74.95 (8.72)^{b}	107410	1:8.37
T4	1.67± 0.04	1.33± 0.22^{d} (1.53)	1.38± 0.38^{d} (1.54)	1.57± 0.33^{f} (1.60)	1.43± 0.08^{e} (1.56)	1.71± 0.02^{e} (1.64)	1.24± 0.22^{h} (1.49)	1.38± 0.38^{e} (1.54)	1.52± 0.33^{g} (1.59)	1.38± 0.08^{e} (1.54)	1.67± 0.09^{e} (1.63)	1.33± 0.22^{f} (1.53)	1.57± 0.38^{f} (1.60)	1.71± 0.33^{h} (1.65)	1.54± 0.11^{f} (1.59)	2.33± 0.14^{g} (1.82)	1.52± 0.22^{g} (1.59)	1.81± 0.38^{h} (1.68)	2.19± 0.33^{g} (1.78)	1.84± 0.19^{f} (1.68)	68.30 (8.33)^{h}	100432	1:0.33
T5	1.57± 0.09	1.29± 0.13^{d} (1.51)	1.33± 0.35^{d} (1.52)	1.52± 0.14^{ef} (1.59)	1.38± 0.08^{de} (1.54)	1.57± 0.08^{cd} (1.60)	1.19± 0.13^{gh} (1.48)	1.29± 0.35^{de} (1.51)	1.43± 0.14^{fg} (1.56)	1.30± 0.07^{de} (1.52)	1.48± 0.08^{de} (1.57)	1.24± 0.13^{ef} (1.50)	1.43± 0.35^{ef} (1.56)	1.62± 0.14^{gh} (1.62)	1.43± 0.11^{ef} (1.56)	2.05± 0.07^{f} (1.74)	1.43± 0.13^{g} (1.56)	1.66± 0.35^{gh} (1.63)	2.00± 0.14^{f} (1.73)	1.70± 0.16^{ef} (1.64)	69.25 (8.38)^{g}	101312	1:0.41
T6	1.62± 0.07	1.24± 0.27^{bcd} (1.49)	1.24± 0.47^{cd} (1.50)	1.43± 0.25^{cdef} (1.56)	1.30± 0.09^{cde} (1.51)	1.52± 0.06^{cd} (1.58)	1.09± 0.27^{efg} (1.45)	1.19± 0.47^{cd} (1.48)	1.34± 0.25^{def} (1.53)	1.21± 0.07^{cde} (1.48)	1.38± 0.06^{cd} (1.54)	1.09± 0.27^{de} (1.45)	1.24± 0.47^{de} (1.49)	1.43± 0.25^{ef} (1.56)	1.25± 0.10^{cdef} (1.50)	1.86± 0.12^{ef} (1.69)	1.19± 0.27^{ef} (1.48)	1.43± 0.47^{ef} (1.56)	1.76± 0.25^{de} (1.66)	1.46± 0.17^{cdef} (1.57)	70.80 (8.47)^{f}	103520	1:0.70
T7	1.71± 0.05	1.31± 0.11^{d} (1.52)	1.29± 0.06^{cd} 1.51)	1.48± 0.24^{def} (1.57)	1.36± 0.08^{de} (1.53)	1.62± 0.07^{de} (1.61)	1.14± 0.06^{fgh} (1.46)	1.24± 0.11^{de} (1.50)	1.38± 0.24^{efg} (1.54)	1.25± 0.09^{de} (1.50)	1.52± 0.05^{de} (1.58)	1.14± 0.06^{de} (1.46)	1.34± 0.11^{e} (1.53)	1.52± 0.24^{fg} (1.59)	1.33± 0.11^{def} (1.53)	2.00± 0.13^{f} (1.73)	1.29± 0.06^{f} (1.51)	1.57± 0.11^{fg} (1.60)	1.91± 0.24^{ef} (1.70)	1.59± 0.18^{def} (1.61)	69.40 (8.39)^{g}	107633	1:2.43
T8	1.62± 0.04	1.29± 0.46^{d} (1.51)	1.24± 0.40^{cd} (1.49)	1.38± 0.28^{cde} (1.54)	1.27± 0.07^{bcd} (1.51)	1.48± 0.09^{cd} (1.57)	1.05± 0.40^{def} (1.43)	1.14± 0.46^{cd} (1.46)	1.24± 0.28^{cde} (1.49)	1.14± 0.06^{bcd} (1.46)	1.33± 0.06^{cd} (1.52)	1.00± 0.40^{cd} (1.41)	1.14± 0.46^{cd} (1.46)	1.33± 0.28^{de} (1.53)	1.16± 0.09^{cde} (1.47)	1.76± 0.8^{de} (1.66)	1.09± 0.40^{de} (1.45)	1.33± 0.46^{de} (1.53)	1.62± 0.28^{d} (1.62)	1.35± 0.15^{bcde} (1.53)	71.00 (8.49)^{ef}	110156	1:4.25
T9	1.67± 0.04	1.21± 0.18^{cd} (1.48)	1.14± 0.33^{bc} (1.46)	1.34± 0.49^{bcd} (1.53)	1.23± 0.08^{bc} (1.49)	1.43± 0.03^{c} (1.55)	0.95± 0.33^{cd} (1.39)	1.05± 0.18^{bc} (1.43)	1.14± 0.49^{c} (1.46)	1.05± .005^{bc} (1.43)	1.24± 0.11^{c} (1.49)	0.86± 0.33^{c} (1.36)	1.05± 0.18^{cd} (1.43)	1.19± 0.49^{cd} (1.48)	1.03± 0.09^{bcd} (1.42)	1.57± 0.09^{cd} (1.60)	0.95± 0.33^{c} (1.40)	1.14± 0.18^{c} (1.46)	1.38± 0.49^{c} (1.54)	1.16± 0.13^{bcd} (1.47)	72.55 (8.58)^{d}	114187	1:5.99
T10	1.62± 0.04	0.52± 0.26^{a} (1.23)	0.62± 0.30^{a} (1.27)	0.71± 0.52^{a} (1.31)	0.62± 0.05^{a} (1.27)	0.90± 0.06^{a} (1.38)	0.24± 0.26^{a} (1.11)	0.29± 0.30^{a} (1.13)	0.33± 0.52^{a} (1.15)	0.29± 0.03^{a} (1.13)	0.52± 0.16^{a} (1.23)	0.14± 0.26^{a} (1.07)	0.19± 0.30^{a} (1.09)	0.24± 0.52^{a} (1.11)	0.19± 0.03^{a} (1.09)	0.57± 0.10^{a} (1.25)	0.09± 0.26^{a} (1.04)	0.14± 0.30^{a} (1.07)	0.19± 0.52^{a} (1.09)	0.14± 0.03^{a} (1.07)	76.55 (8.81)^{a}	110597	1:13.99
T11	1.67± 0.12	1.57± 0.25^{e} (1.60)	1.61± 0.38^{e} (1.62)	1.76± 0.46^{g} (1.66)	1.65± 0.06^{f} (1.63)	1.95± 0.07^{f} (1.72)	1.81± 0.25^{i} (1.67)	1.91± 0.38^{f} (1.70)	1.95± 0.46^{h} (1.72)	1.89± 0.04^{f} (1.70)	2.29± 0.08^{f} (1.81)	2.14± 0.25^{g} (1.77)	2.34± 0.38^{g} (1.83)	2.47± 0.46^{i} (1.86)	2.32± 0.10^{g} (1.82)	3.52± 0.11^{h} (2.12)	2.76± 0.25^{h} (1.94)	3.04± 0.38^{i} (2.01)	3.52± 0.46^{h} (2.13)	3.11± 0.22^{g} (2.03)	67.40 (8.07)^{i}	107350	-
CD (p= 0.05)	NS	(0.071)	(0.051)	(0.047)	(0.021)	(0.049)	(0.93)	(0.57)	(0.49)	(0.041)	(0.058)	(0.592)	(0.601)	(0.573)	(0.021)	(0.066)	(0.481)	(0.483)	(0.531)	(0.038)	(0.02)	-	-

BS – Before spray; Figures in parentheses means of √n+1 transformation

RESULTS AND DISCUSSION

The results given in Table 1 and from both the locations (Ludhiana and Gurdaspur) revealed that all the treatments significantly reduced the plant hoppers incidence. Ten days after spray the hoppers/ hill varied between 0.71± 0.52 to 1.57± 0.33, 0.33± 0.52 to 1.52± 0.33, 0.24± 0.52 to 1.71± 0.33 and 0.19± 0.52 to 2.19± 0.33 at 60, 70, 80 and 90 days after sowing, respectively. Chlorpyriphos @ 2500 ml/ ha proved to be the most effective, and among the biopesticides the higher dose of azadirachtin 1% EC @ 750 ml/ ha was found significantly superior (1.34/ hill0 at par with its median dose (1.41/ hill) at 80 days after sowing. Also, *B. bassiana,* azadirachtin, *B.thuringiensis* were variously effective dosewise. The pooled data revealed that the all the tested doses of biopesticides were found significantly effective; with the higher doses (750 & 500 ml/ ha) of azadirachtin 1%EC maintaining supremacy. Significantly higher yield was obtained with the insecticidal treatments, with maximum yield (76.55 q/ ha) being with chlorpyriphos 20EC @ 2500 ml/ ha, closely followed by azadirachtin 1%EC @ 750 ml/ ha. Maximum cost: benefit was achieved with chlorpyriphos i.e*.,* Rs. 1: 13.99 and it was followed by azadirachtin 1%EC @ 500 ml/ ha with C:B ratio of Rs. 1: 9.09. Thus, the results of the present study underline the utility of plant and microbial based biopesticides corroborating with the earlier studies (Saxena et al., 1987- on Neemazal 1%, Karanja oil 2% and Myco-Jaal 10%SC). Ramraju and Sundarababu (1989) also reported that seedlings root soaking with neem kernel extract and 5% neem cake extract spray reduced emergence of *S. furcifera*. Likewise, neem extract and Biovip (*B. Bassiana)* affected the biology and growth of plant hoppers up to 60 days after spray (Sharma and Aggarwal, 2014).

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