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Neem formulation in conjunction with novel insecticides: Efficacy on rice plant hoppers

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Abstract
During the Kharif of 2021, a field experiment was carried out at the farmer's field in selected villages of sirguppa taluk of Karnataka to assess the efficacy of some novel insecticides in combination with neem products against BPH and WBPH in a direct seeded rice (DSR) crop. The results showed that Buprofezin 25% SC @ 200 G.A.I. ha^{-1} was the most effective treatment for the control of both BPH and WBPH, with 64.40 and 68.29 percent reductions over the untreated control, respectively. Buprofezin 25% SC A.I. ha^{-1} (4954 kg ha^{-1}) increased grain yield by 63.55 percent compared to the untreated control.

Keywords: DSR, brown plant hopper (BPH), white backed plant hopper (WBPH), buprofezin, pymetrozine, carbosulfan and neem formulation

Introduction

Due to its nutritional qualities and low cost (Hirzel *et al*. 2020) [4], rice is the most important cereal crop in the world, with nearly half of the human population relying on it for daily sustenance (Singh *et al*., 2016) [9]. DSR has lately gained popularity due to its low input requirements. DSR yields more panicles and has a shorter growth period than manual and mechanical transplanting techniques (Deng *et al*. 2020) [1]. It requires 35-57 percent less water and 67 percent less labour than transplanting rice, among other advantages (Patel *et al*. 2018) [7]. From seedling to maturity, rice is plagued by more than one hundred insect parasite species, of which twenty are economically damaging (Basit and Bhattacharya, 2001). The rice planthopper is considered Asia's most economically significant paddy pest (Zhang *et al*. 2014). Despite the development of several methods for rice pest management, insecticides continue to play a significant role in the field. Chemical management constitutes the first line of defence (Pasalu *et al*. 2002) [6]. The exclusive use of chemical insecticides has resulted in the annihilation of natural enemies, which has led to the resurgence of numerous primary and secondary pest species and the evolution of insecticide-resistant pest populations. This research examines the effectiveness of novel insecticides in conjunction with neem products against rice planthoppers.

Material and Methods

A field experiment was conducted at the farmers' field of karchiganur village, Siruguppa Tq, Karnataka during *Kharif and Rabi*, 2021. DSR crop was raised with Telangana Sona (RNR 15048) variety and the experiment was laid in a simple Randomized Block Design (RBD) with eight treatments including untreated check. These treatment plots were replicated thrice with each plot measuring 4000m^2(≈1 acre) area. The treatments include T_1: Buprofezin 25% SC @ 200 G.A.I. ha^{-1}, T_2: Pymetrozine 50 WG @150 G.A.I. ha^{-1}, T_3: Carbosulfan 25% EC @ 200 g A.I. ha^{-1}, T_4: Neem formulation 1500ppm @ 5 ml l^{-1}, T_5: Buprofezin + Neem formulation @ 100 G.A.I. ha^{-1} + 5 ml l^{-1}, T_6: Pymetrozine + Neem formulation @ 75 G.A.I. ha^{-1} + 5 ml l^{-1}, T_7: Carbosulfan + Neem formulation @ 100 G.A.I ha^{-1} + 5 ml l^{-1}, T_8: Untreated control. The treatment sprays were imposed twice during the period of crop growth at an interval of 25 days coinciding with peak tillering and panicle initiation stages when the pest density crossed the ETL. The data on the population of BPH and WBPH on 10 randomly selected paddy hills from each plot was recorded one day before imposing the treatments, three and five days after imposing the treatments. The data on the population of BPH and WBPH were transformed to square root values. ANOVA was used to analyzed the data, and mean values were compared using LSD (Duncan, 1951). The percent population reduction of planthopper at each count was also calculated by using Abbott's formula as given by (Fleming and Ratnakaran, 1985).

Results and Discussion

The results revealed that the overall cumulative efficacy of different insecticidal treatments on BPH after both sprays revealed that Buprofezin 25% SC @ 200 g A.I. ha^{-1} was the best treatment, with a 64.40 percent reduction over untreated control, followed by Pymetrozine 50 WG @ 150 g A.I. ha^{-1} (57.97%) and Carbosulfan 25% EC @ 200 g A.I. ha^{-1} (55.62%), which were on par with Buprofezin 25% SC. (Table: 1).

Overall cumulative efficacy of different insecticidal treatments on WBPH after both sprays followed the same trend as that of BPH with Buprofezin 25% SC @ 200 g A.I. ha^{-1} as the best treatment with a 68.29 percent reduction over untreated control, followed by Pymetrozine 50 WG @ 150 g A.I. ha^{-1} (60.58%) and Carbosulfan 25% EC @ 200 g A.I. ha^{-1} (58.65%), which were on par with Buprofezin 25% SC (Table: 1)

Buprofezin 25% SC @ 200 g A.I. ha^{-1} was found to be the most effective insecticide in reducing BPH and WBPH populations. The effect of insecticides on grain yield revealed that Buprofezin 25% SC @ 200 g A.I. ha^{-1} treated plots produced the highest grain yield of 4905 kg ha^{-1}, representing a yield increase of 63.55 percent over the untreated control. The next best treatments were Pymetrozine 50 WG @ 150 g A.I. ha^{-1} (4690 kg ha^{-1}) and Carbosulfan 25% EC @ 200 A.I. ha^{-1} (4588 kg ha^{-1}) with yield increases of 54.83 and 51.46 per cent over the untreated control, respectively.

The present findings were in conformity with the findings of Yaligar *et al*. 2017 [10] who has reported the superiority of Buprofezin 25% SC @ 200g A.I. ha^{-1} by registering only 9.21 BPH and 9.61 WBPH per hill. Seni and Naik, 2017 [8] reported that the pymetrozine 50 WG @ 150 g A.I. ha^{-1} recorded significantly higher per cent reduction (76.0 & 77.0) of hoppers over the control during *kharif*, 2014 and *Rabi*, 2014-15 respectively.

Table 1: Cumulative efficacy of insecticides against BPH and WBPH after two sprays during *kharif*, 2021

T. No.	Particulars of the insecticides	Dosage	BPH Population reduction over control (%)					WBPH Population reduction over control (%)					Yield kg ha^{-1}
			First Spray		Second spray		Mean	First Spray		Second spray		Mean	
			3 DAS	5 DAS	3 DAS	5 DAS		3 DAS	5 DAS	3 DAS	5 DAS		
1	Buprofezin 25% SC	200g A.I. ha^{-1}	54.65^{a} (47.69)	75.53^{a} (60.38)	53.80^{a} (47.20)	73.61^{a} (59.12)	64.40^{a} (53.40)	57.90^{a} (49.57)	80.08^{a} (63.52)	57.49^{a} (49.33)	77.69^{a} (61.84)	68.29^{a} (55.76)	4954
2	Pymetrozine 50 WG	150g A.I. ha^{-1}	46.51^{ab} (43.02)	69.75^{ab} (56.66)	45.48^{a} (42.43)	70.14^{ab} (56.90)	57.97^{ab} (49.61)	52.11^{ab} (46.23)	74.33^{ab} (59.59)	51.61^{ab} (45.94)	71.89^{ab} (58.01)	62.48^{ab} (52.25)	4690
3	Carbosulfan 25% EC	200g A.I. ha^{-1}	44.19^{abc} (41.68)	68.21^{ab} (55.71)	43.64^{a} (41.36)	66.44^{ab} (54.62)	55.62^{ab} (48.25)	50.17^{ab} (45.12)	72.41^{ab} (58.35)	51.15^{ab} (45.68)	69.66^{ab} (56.60)	60.85^{ab} (51.29)	4588
4	Neem formulation 1500ppm	5ml l^{-1}	22.29^{d} (28.18)	42.77^{c} (40.87)	18.92^{b} (25.80)	34.95^{c} (36.26)	29.73^{c} (33.06)	28.93^{c} (32.56)	35.25^{c} (36.44)	29.44^{d} (32.88)	36.19^{c} (37.00)	32.45^{c} (34.75)	3435
5	Buprofezin 25% SC + Neem formulation 1500ppm	100g A.I. ha^{-1} +5 ml l^{-1}	41.67^{abc} (40.22)	64.74^{ab} (53.60)	43.87^{a} (41.50)	59.26^{ab} (50.36)	52.38^{ab} (46.39)	48.24^{ab} (44.02)	66.28^{ab} (54.53)	47.08^{abc} (43.35)	64.75^{ab} (53.60)	56.59^{ab} (48.81)	4187
6	Pymetrozine 50 WG + Neem formulation 1500ppm	75g A.I. ha^{-1} + 5ml l^{-1}	35.66^{bc} (36.68)	59.73^{b} (50.64)	40.86^{a} (39.76)	56.94^{b} (49.02)	48.30^{b} (44.05)	44.38^{b} (41.79)	63.22^{ab} (52.69)	39.85^{bcd} (39.16)	61.18^{ab} (51.49)	52.16^{b} (46.26)	4000
7	Carbosulfan 25% EC + Neem formulation 1500ppm	100g A.I ha^{-1} + 5ml l^{-1}	32.36^{cd} (34.69)	58.77^{b} (50.07)	39.94^{a} (39.22)	53.94^{b} (47.28)	46.25^{b} (42.87)	42.84^{b} (40.90)	61.30^{b} (51.56)	36.68^{cd} (37.29)	58.05^{b} (49.66)	49.72^{b} (44.86)	3957
8	Untreated control		-	-	-	-	-	-	-	-	-	-	3029
	S.Em±		2.40	2.37	2.50	2.88	2.45	2.04	3.30	2.17	3.03	2.57	-
	Fcal		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	-
	CD (P= 0.05)		8.29	8.20	8.66	9.96	8.46	7.04	11.41	7.51	10.48	8.90	-
	CV (%)		16.31	11.92	16.72	15.07	14.26	12.56	16.22	13.70	15.23	14.26	-

Sig - Significant, DAS- Days after spraying, BPH- Brown Planthopper, WBPH- White Backed Planthopper, Figures in parentheses are arc sine transformed values, In column means with same letters do not differ significantly by LSD (p<0.05).

Conclusion

Buprofezin 25% SC controlled BPH and WBPH better than Pymetrozine 50 WG and Carbosulfan 25% EC. Using neem with these pesticides reduces chemical use but lessens yield.

Authorship Contribution

Author M.N. Rudra Gouda collected data, written manuscript, and Author Ashwini L.M.B. helped in data collection and Vineeth Vijayan in statistical calculation.

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