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EVALUATION OF SAFETY OF SOME INSECTICIDES ON PREDATORY SPIDERS IN RICE ECOSYSTEM

Ingle Dipak Shyamrao*, M. Raghuraman, Abhinav Kumar and Rupesh Kumar Gajbhiye

Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221005, Uttar Pradesh, India
*Email: dipakingle99@gmail.com (corresponding author)

ABSTRACT

An experimental trial in rice was conducted during kharif seasons of 2016 and 2017 at the Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi to evaluate the effect of conventional and newer insecticides viz., carbofuran 3%G @ 750 g a.i./ ha, thiamethoxam 25%WG @ 25 g a.i./ ha, fipronil 5%SC @ 50 g a.i./ ha, lambda-cyhalothrin 5%EC @ 20 g a.i./ ha, neem (Azadirachtin 0.15%EC) @ 4 ml/ l., flubendiamide 20%WG @ 25 g a.i./ ha, chlorantraniliprole 18.5%SC @ 30 g a.i./ ha, acetamiprid 20%SP @ 35 g a.i./ ha, dinotefuran 20%SG @ 40 g a.i./ ha and pymetrozine 50%WG @ 7.5 g a.i./ ha on spiders inhabitants of rice system. Except lambda-cyhalothrin 5%SP nearly all the insecticidal treatments showed slight effects against the spiders occurring in rice ecosystem. The results revealed that flubendiamide 20%WG @ 25 g a.i./ ha was the least toxic, allowing maximum occurrence of spiders (excluding untreated control). Thus, it can be considered in IPM for the best control of insect pests. Similarly, chlorantraniliprole 18.5%SC @ 30 g a.i./ ha followed by fipronil 5%SC @ 50 g a.i./ha were also found safe to spiders.

Key words: Insecticides, rice, non-target effects, spiders, predators, chlorantraniliprole, flubendiamide, lambda cyhalothrin, safety, ecofriendly IPM

Rice, *Oryza sativa* (L.) is one of the key food crops grown in as many as 117 countries in the world. As much as 800 species of pests and several natural enemies inhabit the rice ecosystem during both vegetative and reproductive phases (Hafeez et al., 2010). An experiment was conducted by Jafar et al. (2013) to assess the impact of chlorantraniliprole 20%SC, cartap hydrochloride 50%SP and fipronil 5%SC against few spiders, predatory coccinellids, *Microvelia* sp., *Paederus* sp., *Cyrtorhinus* sp. inhabiting the rice ecosystem. Similarly, Karthick et al. (2015) observed that the spiders were more with indoxacarb 14.5%SC over the remaining treatments. Spiders are known to have the potential be one of the most effective and widely distributed biocontrol agents for several phytophagous insects (Saavedra et al., 2007; Fritz et al., 2011; Tahir et al., 2009). Some spiders have the potential to curb down the total pest population as much as of 22% (Tahir et al., 2009). Many reports are available on the predatory potential of spiders in rice crop (Jose et al., 2002; Satpathi, 2004; Motobayashi et al., 2006). Hunter and weaver spider species are the most common as these occur in all crop stages and are thus most suitable candidates for assessing the impact of different chemistry on agroecosystem (Rodrigues et al., 2009). Spiders in rice fields can play pivotal role as predators of planthoppers and leafhoppers (Holt et al., 1987; Tanaka 1989). Studies on the spider fauna of rice ecosystem are known in Asia (Bambaradeniya et al., 2004; Patel et al., 2004), and spiders represent >90% (Bambaradeniya, 2008). Hence, if conserved in effective manner the spiders will provide more support in natural control of pests in rive. This study with the objective of evaluating the after effects of the indiscriminate and non-judicious application of insecticides, explored the impact of conventional/ newer insecticides on predatory spiders in the rice ecosystem.

MATERIALS AND METHODS

The filed experiment was conducted in the Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (24°56'- 25°35'N, 82°14'- 83°24'E, 82masl). The variety (Swarna sub-1) was sown in the nursery beds @ 1 kg for 500 m^2 and the 25 days old seedlings were transplanted at the spacing of 20x 15 cm, and recommended packages of practices followed. There were ten treatments viz., carbofuran 3%G @ 750 g a.i./ ha, thiamethoxam 25%WG @ 25 g a.i./ ha, fipronil 5%SC @ 50 g a.i./ ha, lamda-cyhalothrin 5%EC @ 20 g a.i./ ha, neem (Azadirachtin

0.15%EC) @ 4 ml/ l, flubendiamide 20%WG @ 25 g a.i./ ha, chlorantraniliprole 18.5%SC @ 30 g a.i./ ha, acetamiprid 20%SP @ 35 g a.i./ ha, dinotefuran 20%SG @ 40 g a.i./ ha and pymetrozine 50%WG @ 7.5 g a.i./ ha and were replicated thrice. Applications were made during morning hours. Observations on the population of spiders were made from ten randomly selected hills at one day before spray (DBS) and 1st, 3rd, 7th and 14th days after sprays (DAS), and % reduction over pretreatment count worked out.

RESULTS AND DISCUSSION

The data revealed that prior to first application, counts of spiders varied from 8.77 to 10.81/ 10 hills devoid of significant variations during kharif 2016 (Table 1); there was a decline in the count of spiders from first day after spray (DAS) which continued till 14th DAS, with maximum counts being in the control followed by flubendiamide 20%WG @ 25 g a.i./ ha, chlorantraniliprole 18.5%SC @ 50 g a.i./ ha, fipronil 5%SC @ 50 g a.i./ ha (11.87, 10.06, 9.13 and 8.30, respectively) and thus safe against spiders. In the second foliar application, similar trend was noticed- after one DAS, flubendiamide 20%WG @ 25 g a.i./ ha was observed with maximum number of spiders (9.10) next to control check (11.51), followed by chlorantraniliprole 18.5%SC @ 50 g a.i./ ha, fipronil 5%SC @ 50 g a.i./ ha and neem (Azadirachtin 0.15% EC) @ 4 ml/ l (8.95, 8.14 and 8.10, respectively) rendering them safe. In similar way data after third, seventh and fourteen DAS of second spray flubendiamide 20%WG @ 25 g a.i./ ha with maximum counts of spiders (7.27, 9.00 and 10.37) followed by fipronil 5%SC @ 50 g a.i./ ha (6.93, 7.17 and 9.13), neem (Azadirachtin 0.15%EC) @ 4 ml/ l. (6.00, 7.75 and 9.74) and chlorantraniliprole 18.5%SC @ 50 g a.i./ ha (5.66, 7.75 and 9.74, respectively). Lambda cyhalothrin 5%EC @ 20 g a.i./ ha was observed with least number of spiders in all days after spray. Thus, after the second spray flubendiamide 20% WG @ 25 g a.i./ ha was observed to be the safest.

During kharif 2017, before the first application, the spider counts ranged from 8.67 to 11.41/ 10 hills without significant differences among the treatments (Table 2); at one, third, seventh and fourteen DAS flubendiamide 20%WG @ 25 g a.i./ ha was observed with maximum counts of spiders followed by fipronil 5%SC @ 50 g a.i./ ha, chlorantraniliprole 18.5%SC @ 50 g a.i./ ha and neem (Azadirachtin 0.15%EC) (9.49, 8.97, 8.09 and 7.41, respectively; ambda-cyhalothrin 5%EC @ 20 g a.i./ha led to the least number of spiders (4.12/) making it the most toxic treatment. After the first spray, flubendiamide 20%WG @ 25 g a.i./ ha was proved the safest (9.49/ 10 hills). It was followed by fipronil 5%SC @ 50 g a.i./ ha, neem (Azadirachtin 0.15 %EC) @ 4 ml/ l and chlorantraniliprole 18.5%SC @ 30 g a.i./ ha. After the second spray, at one, third, seventh and fourteen DAS, again flubendiamide 20%WG @25 g a.i./ ha was observed with maximum number of spiders (10.95) followed by chlorantraniliprole 18.5%SC @ 30 g a.i./ha (10.75) and fipronil 5%SC @ 50 g a.i./ ha (10.23) rendering them safe, and lambda-cyhalothrin 5%EC @ 20 g a.i./ ha was the most toxic; at three DAS, chlorantraniliprole 18.5%SC @ 30 g a.i./ ha was observed with maximum number of spiders (8.87) followed by flubendiamide 20%WG@ 25 g a.i./ ha (7.47) and lamda-cyhalothrin 5%EC @ 20 g a.i./ ha (4.05) was observed with least number of spiders. At seven DAS after the second spray, flubendiamide 20%WG@ 25 g a.i./ ha was observed with maximum number of spiders (11.74) and lambda-cyhalothrin 5%EC @ 20 g a.i./ha with the least (5.61). Again, on fourteen DAS, flubendiamide 20% WG@ 25 g a.i./ha was observed with maximum number of spiders (12.42), and thus proved the safest (Table 2).

These observations are similar to that of Mishra (2008) with rynaxpyr 20EC at 40 g a.i./ ha and flubendiamide 480SC at 30 g a.i./ ha as safer to predators of rice pests. The results of Shanwei *i* (2009) on chlorantraniliprole 20SC at 40 g a.i./ ha as highly safe to beneficial arthropods corroborate with this study; Jafar et al. (2013) observed that indoxacarb 15.8EC at 30 g a.i./ ha, chlorantraniliprole 18.5%SC at 30 g a.i./ ha, cartap hydrochloride 50%SP at 500 g a.i./ ha and fipronil 5%SC 625 ml/ ha are safer to rice natural enemies. Javaregowda and Naik (2005) with flubendiamide at 12.5, 25 and 50 g a.i./ ha observed 23.42, 23.82 and 24.33 spiders/ 10 hills, respectively, on par with the untreated check (22.47/ 10 hills). Thus, it can be concluded that all the treatments except lambda-cyhalothrin 20%SP @ 20 g a.i./ ha which is toxic to spider, flubendiamide 20%WG @ 25 g a.i./ha was found to be the least toxic.

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Table 1. Effect of insecticidal treatments on the population of spiders in rice (kharif 2016)

Treatments	Dose (g a.i./ ha)	No. of spiders/ 10 hills											
		First spray						Second spray					
		1 DBS	1 DAS	3 DAS	7 DAS	14 DAS	Mean	1 DBS	1 DAS	3 DAS	7 DAS	14 DAS	Mean
Acetamiprid 20 SP	35	7.67* (2.94)**	6.46 (2.72)	3.81 (2.18)	5.20 (2.48)	6.10 (2.66)	5.39 (2.51)	8.10 (3.01)	5.97 (2.63)	3.34 (2.07)	4.50 (2.33)	5.86 (2.61)	4.91 (2.41)
Carbofuran 3% G	750	9.21 (3.19)	7.05 (2.83)	5.50 (2.54)	5.83 (2.60)	7.91 (2.98)	6.57 (2.73)	9.90 (3.29)	7.34 (2.88)	5.07 (2.45)	6.06 (2.65)	7.75 (2.95)	6.55 (2.73)
Chlorantraniliprole 18.5 % SC	30	10.51 (3.39)	9.15 (3.18)	7.97 (2.99)	8.42 (3.06)	11.00 (3.46)	9.13 (3.17)	11.20 (3.34)	8.95 (3.15)	5.66 (2.57)	6.10 (3.01)	10.00 (3.31)	7.68 (3.01)
Dinotefuran 20% SG	40	9.00 (3.15)	6.10 (2.66)	5.05 (2.45)	7.54 (2.91)	9.00 (3.15)	6.92 (2.79)	12.10 (3.61)	8.79 (3.43)	6.74 (2.77)	8.23 (3.03)	7.47 (3.23)	7.81 (3.11)
Fipronil 5 % SC	50	9.67 (3.26)	8.05 (3.00)	7.54 (2.91)	7.97 (2.99)	9.65 (3.26)	8.30 (3.04)	11.75 (3.56)	8.14 (2.01)	6.93 (2.81)	7.17 (2.85)	9.13 (3.17)	7.84 (2.96)
Flubendiamide 20% WG	25	10.61 (3.40)	9.41 (3.22)	8.87 (3.13)	10.16 (3.33)	11.81 (3.57)	10.06 (3.31)	13.90 (3.72)	9.10 (3.17)	7.27 (2.87)	9.00 (3.15)	10.37 (3.36)	8.93 (3.14)
Lamda- Cyhalothrin 5% EC	20	8.90 (3.14)	4.55 (2.35)	2.76 (1.93)	4.34 (2.30)	4.86 (2.41)	4.12 (2.24)	8.86 (3.13)	5.31 (2.50)	2.89 (1.96)	3.81 (2.18)	5.40 (2.52)	4.35 (2.29)
Neem (Azadiractin 0.15% EC)	4 ml/ lit.	10.81 (3.43)	7.87 (2.97)	5.86 (2.61)	8.29 (3.04)	10.30 (3.35)	8.08 (2.99)	12.50 (3.67)	8.10 (3.01)	6.00 (2.64)	7.75 (2.95)	9.74 (3.27)	7.90 (2.97)
Pymetrozine 50% WG	7.5	8.77 (3.12)	7.63 (2.93)	4.86 (2.41)	6.93 (2.81)	8.42 (3.06)	6.96 (2.80)	10.00 (3.31)	7.75 (2.95)	5.45 (2.53)	6.46 (2.72)	8.10 (3.01)	6.94 (2.80)
Thiamethoxam 25% WG	25	9.10 (3.17)	5.13 (2.47)	4.35 (2.30)	5.34 (2.51)	6.46 (2.72)	5.32 (2.50)	10.46 (3.38)	6.61 (2.75)	4.20 (2.27)	5.23 (2.49)	6.12 (2.66)	5.54 (2.54)
Control	Water spray	9.41 (3.22)	10.57 (3.39)	11.41 (3.52)	11.88 (3.58)	13.65 (3.82)	11.87 (3.57)	10.55 (3.54)	11.51 (3.53)	12.41 (3.66)	13.95 (3.86)	15.35 (4.04)	13.30 (3.77)
CD (p=0.05)	--	--	0.15	0.20	0.17	0.22	--	--	0.10	0.15	0.12	0.20	--
SE (m)±	--	--	0.05	0.06	0.05	0.07	--	--	0.03	0.05	0.04	0.06	--

*Mean of three replications' **Figures in the parentheses square root transformed values; DAS- Days after spray; DBS- Day before spray

Table 2. Effect of insecticidal treatments on the occurrence of spiders in rice (kharif 2017)

Treatments	Dose (g a.i./ha)	No. of spiders/ 10 hills											
		First spray						Second spray					
		1 DBS	1 DAS	3 DAS	7 DAS	14 DAS	Mean	1 DBS	1 DAS	3 DAS	7 DAS	14 DAS	Mean
Acetamiprid 20 SP	35	9.81 (3.28)	7.61 (2.93)	5.86 (2.61)	7.35 (2.88)	8.14 (3.18)	7.24 (2.90)	8.74 (3.11)	6.72 (2.77)	4.81 (2.40)	5.35 (2.51)	6.72 (2.77)	5.90 (2.61)
Carbofuran 3%G	750	9.64 (3.10)	7.94 (2.98)	5.65 (2.57)	6.00 (2.64)	7.66 (2.93)	6.81 (2.78)	12.14 (3.62)	8.85 (3.13)	6.89 (2.80)	8.05 (3.00)	9.81 (3.28)	8.40 (3.05)
Chlorantraniliprole 18.5%SC	30	10.48 (3.38)	8.34 (3.05)	6.48 (2.73)	7.65 (2.93)	9.89 (3.29)	8.09 (3.00)	13.00 (3.73)	10.75 (3.42)	8.87 (3.13)	9.71 (3.56)	10.27 (3.35)	9.90 (2.29)
Dinotefuran 20%SG	40	10.38 (3.37)	8.05 (3.00)	5.20 (2.48)	6.66 (2.76)	8.16 (3.02)	7.01 (2.81)	10.10 (3.32)	8.66 (3.10)	5.71 (2.58)	7.29 (2.87)	9.16 (3.18)	7.70 (2.93)
Fipronil 5%SC	50	11.21 (3.49)	8.41 (3.06)	7.17 (2.85)	9.68 (3.26)	10.61 (3.40)	8.97 (3.14)	11.51 (3.53)	10.23 (3.34)	7.10 (2.84)	8.54 (3.08)	10.87 (3.44)	9.38 (3.21)
Flubendiamide 20%WG	25	11.41 (3.52)	10.61 (3.40)	7.35 (2.88)	9.05 (3.16)	10.95 (3.45)	9.49 (3.22)	12.28 (3.50)	10.95 (3.45)	7.47 (2.90)	11.74 (3.56)	12.42 (3.66)	10.64 (3.39)
Lamda- cyhalothrin 5%EC	20	8.81 (3.12)	5.81 (2.60)	3.34 (2.07)	4.40 (2.31)	6.10 (2.66)	4.91 (2.41)	9.24 (3.19)	6.34 (2.70)	4.05 (2.24)	5.61 (2.56)	7.00 (2.82)	5.75 (2.58)
Neem (Azadiractin 0.15% EC)	4 ml/lit.	9.41 (3.22)	8.78 (3.12)	5.34 (2.51)	6.91 (2.80)	8.61 (3.09)	7.41 (2.88)	10.34 (3.86)	9.09 (3.20)	7.29 (2.87)	8.61 (3.09)	11.51 (3.52)	9.12 (3.17)
Pymetrozine 50%WG	7.5	8.67 (3.10)	5.18 (2.48)	3.57 (2.13)	4.86 (2.41)	6.61 (2.75)	5.05 (2.44)	10.22 (3.34)	9.61 (3.25)	7.00 (2.82)	9.10 (3.17)	10.10 (3.32)	8.95 (3.14)
Thiamethoxam 25%WG	25	10.20 (3.34)	7.17 (2.85)	4.91 (2.42)	5.61 (2.56)	7.00 (2.82)	6.17 (2.66)	9.21 (3.19)	7.69 (2.94)	5.40 (2.52)	5.89 (2.62)	7.66 (2.93)	6.66 (2.75)
Control	Water spray	9.51 (3.23)	10.40 (3.37)	11.88 (3.58)	12.41 (3.66)	13.26 (3.77)	11.98 (3.59)	14.36 (3.91)	14.74 (3.96)	15.10 (4.01)	16.58 (4.19)	17.10 (4.25)	15.88 (4.10)
CD (p=0.05)	--	--	0.13	0.18	0.22	0.25	--	--	0.11	0.15	0.20	0.24	--
SE (m)±	--	--	0.04	0.06	0.07	0.08	--	--	0.04	0.05	0.06	0.08	--

*Mean of three replications; **Figures in parenthesis square root transformed values; DAS- Days after spray; DBS- Day before spray

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