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DIVERSITY OF MAJOR PREDATORS UNDER DIFFERENT INSECTICIDE REGIMES IN TWO IMPORTANT GROWTH STAGES OF RICE

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ABSTRACT

The effect of twelve different groups of insecticides on diversity of major predators (insects and spiders) during active tillering and bootleaf stage of rice crop was evaluated in West Bengal. The results showed that spinosad, emamectin benzoate, sulfoxaflor and pymetrozine were highly safe while buprofezin, imidacloprid, indoxacarb and chlorantraniliprole were moderately so. The insecticides like lambdacyhalothrin, fipronil and chlorpyriphos were found to be toxic. During active tillering stages the predator diversity was maximum in emamectin benzoate treatment and least in case of lambdacyhalothrin. Similar trend was observed for evenness index in the emamectin benzoate and lambdacyhalothrin. During boot leaf stage, Shannon index was maximum in sulfoxaflor and minimum in lambdacyhalothrin. Overall, insecticidal treatments resulted in decrease in diversity of predators during both stages of rice crop.

Key words: Diversity, insect, spider, Shannon index, evenness index, ecosystem, insecticide, *Ophionea* spp., *Paederus* spp, *Cyrtorhinus lividipennis, Lycosa pseudoannulata, Oxyopes* spp., *Phidippus indicus*

West Bengal has wide diversity of flora and fauna due to favorable climate and therefore there exists wide varieties of predators of the crop pests in rice ecosystems. Nearly 300 species of insect pests attack rice crop (Gailce Leo Justin and Preetha 2014) of which only 23 species cause notable damage (Pasalu and Katti, 2006). Among them, yellow stem borer (YSB), *Scirpophaga incertulas* (Walk.), brown planthopper (BPH), *Nilaparvata lugens* (Stål) and Asian rice gall midge (GM), *Orseolia oryzae* (Wood-Mason) cause huge crop losses (Seni and Naik 2017). Farmers apply insecticides at indiscriminate rates and frequencies to overcome pest problems, leading to pest resurgence and destruction of natural enemies (Katti et al., 2001, Satpathi et al., 2005). Monocrotophos, chlorpyriphos, triazophos and cartap hydrochloride are commonly used against rice stem borer and leaf folder, while quinalphos and imidacloprid are used against planthoppers (Sarao and Mahal, 2012). Recent studies have shown that acephate 95%SG, rynaxypyr 20%SC, dinotefuran 20%SG, cartap hydrochloride 50%SP, fipronil 5%SC, pymetrozine 50%WDG are few newer insecticides being recommended for use against borer and hopper pests (Seni and Naik, 2017; Adhikari et al., 2019). The natural enemies often control insect pests, especially in places where use of broad spectrum pesticide is avoided. Hill et al. (2017) reported that broad spectrum pesticide application altered natural enemy communities thereby facilitating secondary pest outbreaks. Wyckhuys (2019) reported that biological pest control is annually worth hundreds of dollars but remains unknown to nearly 70% of farmers globally. Therefore it is imperative to select specific and safe insecticides to conserve the natural enemy fauna. The present study focuses on this in rice crop.

MATERIALS AND METHODS

Field experiments were conducted during (June to November 2020, 2021 at the Regional Research Station, Chakdaha, Bidhan Chandra Krishi Viswavidyalay (24.50° N, 86.00 to 89.00° 39.75 masl) 9.75 m. Short duration variety, IET 4786 was transplanted on 15th and 18th July during 2020 and 2021, respectively in plots of 5x5 m size each with spacing of 0.20 m (row to row) x 0.15 m (plant to plant) and 1 m intermediate distance between the plots. The experiment was laid out in randomized block design with thirteen treatments replicated thrice. The crop was raised following normal agronomic practices. Twelve insecticides as given in Table 1 were applied at maximum tillering (42 days after transplanting DAT) and boot leaf stage (63 DAS) using knapsac sprayer 600 l/ ha as spray fluid. Observations were recorded on the incidence of major predators on randomly selected 20 hills/ plot at 3 and 14 days after spraying. Data were converted to angular transformed values to perform ANOVA treatment means were

Table 1. Important predators associated with rice crop

Sl. No.	Scientific name	Target pests	Number of predators (Mean± SE, n=20)	
			Tillering	Boot leaf
	Insects			
1.	*Ophionea ishii ishii* (Habu), Coleoptera	SB, LF, H	3.15± 0.177	3.15± 0.135
2.	*Ophionea indica* (Thunberg), Coleoptera	SB, LF, H	5.14± 0.157	4.10± 0.105
3.	*Drypta japonica* (Bates), Coleoptera	SB, LF, H	-	2.08± 0.103
4.	*Micraspis discolor* (F.), Coleoptera	SB, LF, H	5.15± 0.131	3.09± 0.087
5.	*Paederus riparius* (L.), Coleoptera	SB, LF, H	3.13± 0.105	2.08± 0.078
6.	*Paederus fuscipes* (Curtis), Coleoptera	SB, LF, H	3.26± 0.189	2.14± 0.117
7.	*Cyrtorhinus lividipennis* Reuter, Hemiptera	H	1.07± 0.136	8.16± 0.142
8.	*Camponotus compressus* (F.), Hymenoptera	SB, LF, GB	2.13± 0.125	1.17± 0.082
9.	*Solenopsis geminata* (F.), Hymenoptera	SB, LF, GB	1.12± 0.187	2.08± 0.078
10.	*Andrallus spinidens* (F.), Hemiptera	SB, LF	1.13± 0.125	1.20± 0.105
11.	*Cheilomenes sexmaculata* (F.), Coleoptera	SB, LF	2.07± 0.094	1.23± 0.110
12.	*Brumoides suturalis* (F.), Coleoptera	SB, LF	3.08± 0.078	1.11± 0.099
	Spiders			
13.	*Lycosa pseudoannulata* (Boes and Strand), Lycosidae	SB, LF, H	4.1± 0.081	4.11± 0.11
14.	*Marpisa bengalensis* Tikader, Lycosidae	SB, LF, H	2.10± 0.063	3.09± 0.091
15.	*Oxyopes javanus* Thorell, Oxyopidae	SB, LF, H	4.10± 0.094	4.09± 0.087
16.	*Oxyopes lineatipes* (C.L. Koch), Oxyopidae	SB, LF, H	3.09± 0.087	2.11± 0.11
17.	*Phidippus indicus* Tikader, Salticidae	SB, LF, H	3.09± 0.087	3.38± 0.078
18.	*Pardosa sumatrana* Thorell, Salticidae	SB, LF, H	2.15± 0.108	1.08± 0.079
19.	*Thomisus sikkimensis* Tikader, Thomisidae	SB, LF, H	1.08± 0.091	-
20.	*Zygoballus narmadaensis* Tikader, Thomisidae	SB, LF, H	1.06± 0.084	-
21.	*Araneus inustus* (L. Koch), Araneidae	SB, LF, H	1.13± 0.069	2.17± 0.13
22.	*Argiope aemula* (Walckenaer) Araenidae	SB, LF, H	1.06± 0.084	2.16± 0.12
23.	*Argiope aemula* (Walckenaer), Araenidae	SB, LF, H	2.07± 0.082	2.08± 0.091
24.	*Neoscona bengalensis* Tiader. and Bal., Araneidae	SB, LF, H	2.11± 0.079	2.08± 0.091
25.	*Tetragnatha bengalensis* Walck, Tetragnathidae	SB, LF, H	3.12± 0.078	3.11± 0.089
26.	*Tetragnatha maxillosa* Thorell, Tetragnathidae	SB, LF, H	1.08± 0.078	2.14± 0.108

SB=Stem borer, LF=Leaf folder, H=Green leaf hopper, brown planthopper and whitebacked planthopper, GB: Gandhi bug

separated by LSD, at p=0.05 (Gomez and Gomez 1984). The predator diversity was worked out by computing diversity (Shannon and Weaver 1949) and evenness index (Pielou, 1966).

RESULTS AND DISCUSSION

The insect predators observed belonged to the orders Coleoptera, Hemiptera, Hymenoptera and Araneae (Table 1). *Ophionea ishii ishii* and *Ophionea indica*, *Drypta japonica*, *Paederus riparius* and *Paederus fuscipes* were the common carabid beetles observed to predate on lepidopteran larvae, hopper pests and gallmidge in rice field. Among the coccinellid beetles *Micraspis discolor*, *Cheilomenes sexmaculata* and *Brumoides suturalis* were predominant. Black ant *Camponotus compressus* and red ant *Solenopsis geminata* population were prevalent when the field became dry (Fig 1). *Cyrtorhinus lividipennis* and *Andrallus spinidens* consumed both mature and immature stages of hopper and lepidopteran pests, respectively. 15 species of predacious spiders belonging to 8 families under the order of Araneae were also recorded (Fig 2). The food preferences of these were mostly identical. The effect of insecticides on these are given in Table 2. At maximum tillering stage, both at 3 and 14 DAS, predator diversity was maximum in untreated control. Among the insecticides emamectin benzoate (1.75 to 1.76) treatment recorded maximum Shannon index. Least diversity was recorded in lambda cyhalothrin 5%EC and chlorpyriphos 20%EC treated plots. Similar trend was observed in case of evenness index and emamectin benzoate 5%SG showed the

Ophionia indica, Ophionia ishii ishii, Paederus fuscipes (first row); *Micraspis discolor, Cheilomenes sexmaculata, Brumoides suturalis* (second row); *Camponotus compressus*, *Solenopsis geminate, Andrallus spindens* (Third row)

Fig. 1. Important insect predators

Tetragnatha maxillosa, Tetragnatha bengalensis, Phidippus indicus (first row); *Lycosa pseudoannulata, Pardosa sumatrana, Neoscona bengalensis* (second row); *Marpisa* sp (immature), *Oxyopes* sp. (Immatur*)*, *Argioe aemula* (third row)

Fig. 2. Important spiders

Table 2. Effect of different insecticides on the diversity indices of predators on rice (Rainy season, 2020 and 2021)

Sl. No.	Name of insecticides	Dose a.i. g/ ha	Diversity indices of predators							
			Maximum tillering stage				Booting stage			
			3D		14D		3D		14D	
			H	J	H	J	H	J	H	J
1.	Chlorpyriphos 20%EC	315	1.46	0.70	1.47	0.70	1.42	0.66	1.68	0.76
2.	Lambdacyhalothrin 5%EC	50	1.02	0.57	1.19	0.49	0.90	0.55	1.00	0.62
3.	Imidacloprid 17.8%SL	25	1.70	0.81	1.73	0.83	1.72	0.82	1.74	0.83
4.	Cartap hydrochloride 50%SP	300	1.71	0.82	1.72	0.82	1.71	0.82	1.71	0.82
5.	Fipronil 5%SC	75	1.45	0.70	1.46	0.70	1.40	0.64	1.66	0.75
6.	Spinosad 45%SC	75	1.72	0.83	1.74	0.95	1.72	0.82	1.74	0.83
7.	Emamectin benzoate 5%SG	10	1.75	0.84	1.76	0.84	1.73	0.83	1.74	0.83
8.	Sulfoxaflor 24%SC	93.75	1.74	0.83	1.75	0.84	1.72	0.82	1.75	0.83
9.	Indoxacarb 14.5%SC	30	1.70	0.82	1.72	0.95	1.70	0.94	1.71	0.95
10.	Chlorantraniliprole 18.5%SC	30	1.71	0.82	1.72	0.82	1.72	0.82	1.72	0.82
11.	Buprofezin 25%SC	250	1.73	0.81	1.73	0.83	1.72	0.83	1.73	0.83
12.	Pymetrozine 50%WG	125	1.74	0.83	1.76	0.84	1.74	0.83	1.74	0.83
13.	Untreated control	0	1.88	0.90	1.95	0.93	1.91	0.91	1.92	0.92

H =Shannon index, J=Evenness index

maximum value. During boot leaf stage, maximum diversity was recorded in sulfoxaflor 24%SC followed by pymetrozine 50%WG (1.74), emamectin benzoate 5%SG, spinosad 45%SC, imidacloprid 17.8%Sl. Minimum diversity was recorded in lambdacyhalothrin 5%EC. Eveness index revealed similar trend and while it was reverse with lambdacyhalothrin 5% both at maximum tillering and boot leaf stages, respectively. Thus, insecticides reduced predator population both at maximum tillering and boot leaf stages except emamectin benzoate 5%SG followed by pymetrozine 50%WG and spinosad 45% treated plots. Baehaki et al. (2017) also reported that emamectin benzoate and pymetrozine were highly safe to coleopteran predator viz *Paederus fuscipes* and *Coccinella* sp. Applications of lambdacyhalothrin 5%EC and chlorpyrifos 20%EC were relatively unsafe to predators (Fritz 2013). In the present study, the spider population was more in sulfoxaflor 25%SC followed by pymetrozine 50%WG and emamectin benzoate 5%EC. Baehaki et al. (2017) reported on toxicity and persistence of emamectin benzoate 5%SC vis a vis wolf spider *L. pseudoannulata* recording spider mortality rate less than 25%. Deekshita et al. (2017) also reported that sulfoxaflor was the safest for spider followed by pymetrozine 50%WG Kumar et al. (2019) in rice found that lambdacyhalothrin and chlorpyriphos are not safe. Kumar and Veluswami (1997) reported that chlorpyriphos was highly toxic to spiders. Diversity of predator in rice was more in sulfoxaflor 24%SC treated plot followed by pymetrozine 50%WG and emamectin benzoate 5%SG. Sarao and Mahal (2012) also reported that relatively less toxic chemicals showed maximum population and diversity of natural enemies.

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CONFLICT OF INTEREST

No conflict of interest.

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