Journal of
Plant Science & Research

Open Science Publications

Volume 3, Issue 1 - 2016

www.opensciencepublications.com

Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods

Research article

Devarassou K[1*], Ardra S Raghunath[2], Huny George[3], Reshma M[4], Saranya S Pillai[5], Archana US[6]

[1]Department of Agricultural Entomology, Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal -609 603, Union Territory of Pondicherry, India

[2-6]Department of Agricultural Entomology, Adhiparasakthi Agricultural College (APAC), G.B. Nagar, Kalavai - 632 506, Vellore district, Tamil Nadu, India

***Corresponding author:** Devarassou K, Department of Agricultural Entomology, Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal -609 603, Union Territory of Pondicherry, India; E-mail: kdevarasu@gmail.com

Article Information: Submission: 08/06/2016; Accepted: 24/06/2016; Published: 01/07/2016

Abstract

Field experiments were conducted at APAC farm, Kalavai during samba season (Nov 2012-Jan 2013) to study the effect of insecticidal spray namely Chlorpyriphos 20% EC (Organophosphorus), *Beauveria bassiana* (Entomopathogen fungus), Vijay Neem (Botanical) on the biodiversity of rice field arthropods. Exactly 2000 m² (0.5 ac) was taken for each insecticidal spray area. Totally four 0.5 ac fields were adopted for this studies including one unsprayed condition for comparison. The present study was under taken with special reference to collection and identification of insect and spider species; relative abundance of pest, insect predators, parasitoids, neutrals, spider predators and other category; computation of species richness, diversity and evenness indices on the treated rice fields. The study indicated that in Kalavai region, 16 taxa of pests, 10 taxa of insect predators, two taxa of parasitoids and neutrals, eight taxa of other insect categories and one category of spider were observed during the entire season. Considering the sum of all the insects fauna (pests, insect predators, parasitoids, neutrals) and spider predators, relative abundance under Untreated, *B. bassiana;* Vijay Neem; and Chlorpyriphos 20% EC treated fields were 31.02 %, 27.91%, 22.80% and 18.26% respectively. It was observed that total relative abundance was highest in unsprayed condition followed by *B. bassiana* and vijay neem treated fields.

Keywords: *Beauveria bassiana;* Vijay neem; Chlorpyriphos; Arthropods; Biodiversity; Rice; Relative abundance; Species richness index and Shannon-Weaver index

Introduction

Synthetic insecticides are often considered a quick, easy, and inexpensive solution for controlling insect pests in agriculture. Tremendous benefits have been derived from the use of synthetic insecticides in agriculture. The food grain production of India, which stood at a mere 50 million tonnes in 1948-49, had increased almost fourfold to 198 million tonnes by the end of 1996-97 from an estimated 169 million ha of permanently cropped land. This result has been achieved by the use of high yield varieties of seeds, advanced irrigation technologies and agricultural chemicals like insecticides (Employment Information: Indian Labour Statistics, 1994) [1]. However, insecticides have contaminated almost every part of our environment. Insecticide residues are found in soil, air, and in surface and ground water. Insecticides contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms to insects, plants, fish and birds. Ideally, an insecticide must be lethal to the targeted pests, but not to non-target species, including man. Unfortunately, this is not, so the controversy of use and abuse of pesticides has surfaced. The rampant use of these chemicals, under the adage, "if little is good, a lot more will be better" has played havoc with human and other life forms. Indiscriminate use of chemical pesticide adversely affects the natural biodiversity that resulted in the reduction of natural enemies [2]. The best way to reduce insecticide contamination in our environment is for all of us to do our part to use safer and approach towards non-chemical pest control methods. Under non-chemical control measures, bioinsecticides like Nuclear Polyhedrosis Virus, *Bacillus thuringiensis*, *Beauveria bassiana*, plays major roles, which are safer with respects to non-residual nature in farm products unlike the synthetic insecticides. However, the non-chemical biopesticides like *Beauveria bassiana* (mycoinsecticide fungus) and plant originated chemical based botanicals like neem formulations need to be verified for their effects on the natural enemies and the insect biodiversity, since both of them are broad spectrum insecticides. With this perspective a study was conducted to verify the effects of mycoinsecticide (*Beauveria bassiana*), botanicals and synthetic OP insecticides on the biodiversity of rice field arthropods at Adhiparasakthi Agricultural College, Kalavai, Vellore district, Tamil Nadu (India). A tropical rice field offers a biologically diverse and dynamic environment for microbial, floral and invertebrate population to flourish shortly after the fields are flooded and continuing well after canopy closure [3,4]. Arthropod inventories can be good indicators of habitat biodiversity because arthropods respond quickly to environmental changes, since they are highly diverse in nature [5]. Because of their diversity, insects provide the opportunity to detect smaller, more inconspicuous changes in ecosystems that might otherwise go undetected by focusing only on larger, more conspicuous vertebrate species [6]. In rice, natural bio control has a potential role to play in management of rice insect pests [7]. The present study reports the influence of various insecticides namely (i) Synthetic organophosphorous insecticides (Chlorpyriphos 20% EC), (ii) mycoinsecticide (*Beauveria bassiana*) and (iii) Botanicals (Vijay neem oil 2%) on the biodiversity of rice field arthropods.

Materials and Methods

The present study investigated the effects of synthetic OP, botanical and myco insecticides on the biodiversity of rice field arthropods. The study investigated documentation and identification of arthropod fauna; computation of relative abundance, species richness and diversity indices; on the sprayed and unsprayed conditions.

Experimental details: Field trials were conducted during samba season of 2012-2013 in the 'I' block of Adhiparasakthi Agricultural College, Kalavai, Vellore district, Tamil Nadu (India). Exactly 2000 m^2 (0.5 ac) was taken for each insecticidal spray area. Totally four 0.5 ac fields were adopted for this studies including one unsprayed condition for comparison. Hence, the trial comprised of four fields *viz.*, synthetic, botanical, microbial and untreated conditions. Rice variety raised was ADT 43. Random method of planting was adopted in each field. Other recommended agronomic practices were carried out regularly on the four field conditions.

Insecticidal spray details: Spraying of *Beauveria bassiana* (Balsamo) Vuillemin at the rate of 2.5 kg/ha (Obtained from biocontrol lab KVK, Pondicherry, India), neem oil 2% (vijay neem, vijay agrochemicals, Chennai, India) and chlorpyriphos 20% EC at the rate of 1250 ml/ha each at 30, 40 and 55 days after transplanting (DAT) was made using high volume backpack knapsack sprayer (Table 1). Spraying operations on different field conditions were carried out during evening hours between 4:00 to 6:00 pm.

Method of sampling insect and spider species

Main field: Visual sampling method was adopted with a hill as a sampling unit. Week wise samples of insect and spider species on 25 hills per field were taken at random for measurement of relative abundance [8], species richness, diversity and evenness index [9].

Collection and identification of insects and spider species: In each treatment the insect and spider fauna were collected on weekly basis during morning hours (6-8 am). The insect and spider species were collected using aspirators, sweep nets, and hand picks. Collected insects and spiders were sorted out based on taxon. Soft bodied insects and spider species were preserved on 85% ethyl alcohol in glass vials. Other insects were card mounted and pinned. The most common and important insect and spider fauna were identified to the lowest possible taxon, usually families or genus or species.

Relative abundance

Relative abundance was measured by the formula,

$R = \frac{a}{N} \times 100$ [8]

Where,

R= Relative abundance

a = Total population of a particular species or taxon.

N= Total population of all the species or taxon.

Note: Relative abundance measures the percentage of individuals over all the species.

Biodiversity indices: In order to assess the biodiversity of arthropods on the rice fields which are treated with different insecticides, various ecological indices have been utilized. Complete count of organisms is not practicable and hence indirect solution was adopted for practical purpose to measure the biodiversity of a community. In the present study, three species richness, four diversity and two evenness indices were utilized for measurement of biodiversity on (1) Synthetic organophosphorous insecticides

Table 1: Spraying operation done during the experimental period.

Spraying operations	*Beauveria bassiana* (2.5 kg/ha)	Neem oil (2%)	Chlorpyriphos 20% EC (1250 ml/ha)
First spray	30 DAT	30 DAT	30 DAT
Second spray	40 DAT	40 DAT	40 DAT
Third spray	55 DAT	55 DAT	55 DAT

DAT- Days after transplanting.

Citation: Devarassou K, Raghunath AS, George H, Reshma M, Pillai SS, et al.Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods. J Plant Sci Res. 2016;3(1): 152.

Table 2: Biodiversity indices utilized to assess the rice field arthropod diversity under various sprayed condition.

Sl. No.	Species richness index	Diversity index	Evenness Index
1.	(Hill's, 1973) $N_0 = S$ **Where,** **N_0 = Total number of species/taxa** **S = Number of species**	Simpson index (Simpson ,1949) $\lambda = \sum_{i=1}^{s} \frac{n_i(n_i-1)}{n(n-1)}$ **Where,** **n_i= Number of individual of the i^{th} species.** **n=Total number of individuals in the sample.** **Note: If the value of 'λ' decreases the diversity will increase.**	(Pielou, 1977) $E_1 = \frac{H'}{ln(s)}$ **Where,** **H'= Shannon index** **S = Number of species**
2.	(Margalef ,1958) $R_1 = S - \frac{1}{\ln(n)}$ **Where,** **R_1= Measure of species richness** **S=Number of species** **n=Total number of all individuals** **In= Natural logarithm**	Shannon-wiener Index (Shannon and Wiener,1949) $H' = -\sum_{i=1}^{s}[(\frac{n_i}{n}) X\ ln\left(\frac{n_i}{n}\right)]$ **Where,** **n_i= Number of individual of the i^{th} species.** **n=Total number of individuals in the sample.** **In= Natural logarithm** **Note: Higher the index value refers to higher diversity**	(Sheldon, 1969) $E_2 = \frac{e^{H'}}{S}$ **Where,** **H'= Shannon index** **S = Number of species**
3.	(Menhinick,1964) $R_2 = \frac{S}{\sqrt{n}}$ **Where,** **R_2= Measure of species richness** **S=Number of species** **n=Total number of all individuals**	(a) Hills diversity numbers 1 (Hill,1973) $N_1 = e^{H'}$ **Where,** **H'= Shannon –Wiener index** **e= Exponential** **Note: It measure number of species, which are equally less abundant.**	
4.		(b) Hills diversity numbers 2 (Hill, 1973) $N_2 = \frac{1}{\lambda}$ **Where,** **λ = Simpson index** **Note: It measures number of species, which are equally very abundant.**	

(Chlorpyriphos 20% EC), (2) Mycoinsecticide (*Beauveria bassiana*) and (3) Botanical insecticide (Vijay neem-2%) treated conditions (Table 2).

Statistical analysis: Biodiversity indices have been calculated using the software qbasic. The week wise biodiversity indices have been calculated and mean values were analyzed using Analysis of variance (ANOVA) on SPSS statistical software.

Results

Documentation of arthropod fauna

During the entire crop period of different sprayed and unsprayed conditions, 16 taxa of herbivorous insects (pest), 10 taxa of insect predators, two taxa each in parasitoids and neutrals, eight taxa of other categories and one taxon of spider categories were observed (Table 3).

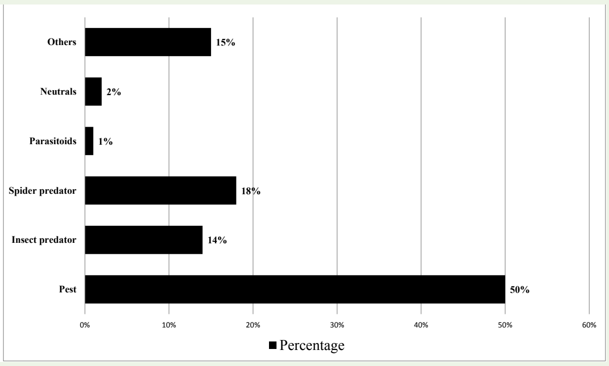
Relative abundance

The relative abundance of pest (herbivore), insect predators, spider predators, parasitoids, neutral arthropods and other insect categories for the entire Samba season has been computed on unsprayed and various insecticidal sprayed conditions. The result revealed that the relative abundance (RA) of pest category on unsprayed, *B. bassiana,* vijay neem and chlorpyriphos sprayed conditions were 50%, 42%, 42% and 40% respectively (Graph 1, Graph 2, Graph 3, Graph 4), indicating chlorpyriphos sprayed rice field documented least herbivorous taxa. It is also inferred that relative abundance of pest categories was highest on unsprayed rice field condition, which is followed by *B. bassiana* and vijay neem sprayed conditions. However, considering the sum of all the insect fauna (pests, insect predators, parasitoids, neutrals) and spider predators, relative abundance of untreated, *B. bassiana,* vijay neem and chlorpyriphos treated fields were 31.02 %, 27.91%, 22.80% and 18.26% respectively, indicating relative abundance of total arthropod biodiversity was highest under unsprayed condition which is followed by *B. bassiana* and vijay neem treated fields (Table 4). The least arthropod abundance (RA) was recorded under chlorpyriphos sprayed rice field conditions.

Species richness index

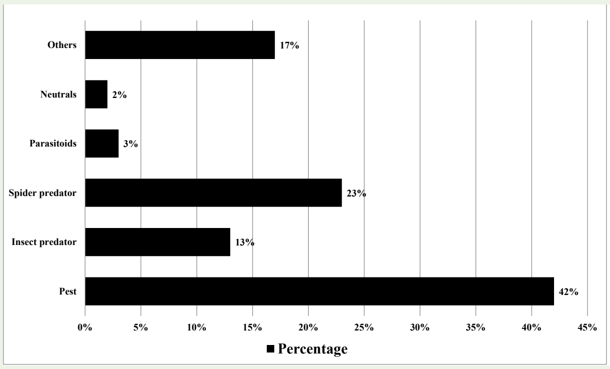
The number of all species (N_0) is the unambiguous and straight forward index of species richness, where the total number of species in a community can be calculated regardless of their abundance. The mean value of Species richness index (N_0) during the entire crop period of samba season were 9.82 ± 0.56, 9.82 ± 0.86, 8.36 ± 0.83 and 7.55 ± 0.65 for untreated, *B. bassiana*, vijay neem and chlorpyriphos treated condition respectively, which are not significantly different,

Citation: Devarassou K, Raghunath AS, George H, Reshma M, Pillai SS, et al.Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods. J Plant Sci Res. 2016;3(1): 152.



Graph 1: Relative abundance of insect and spider diversity on unsprayed condition of rice field.

Categories	Percentage
Pest	50%
Insect predator	14%
Spider predator	18%
Parasitoids	1%
Neutrals	2%
Others	15%



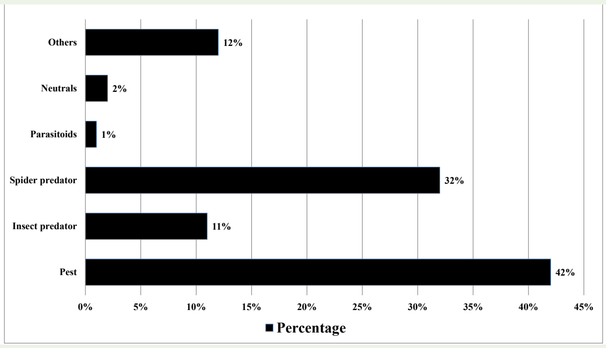
Graph 2: Relative abundance of insect and spider diversity on *B. bassiana* treated condition of rice field.

Categories	Percentage
Pest	42%
Insect predator	13%
Spider predator	23%
Parasitoids	3%
Neutrals	2%
Others	17%

indicating number of taxa in all the sprayed and unsparyed conditions were similar (Table 5).

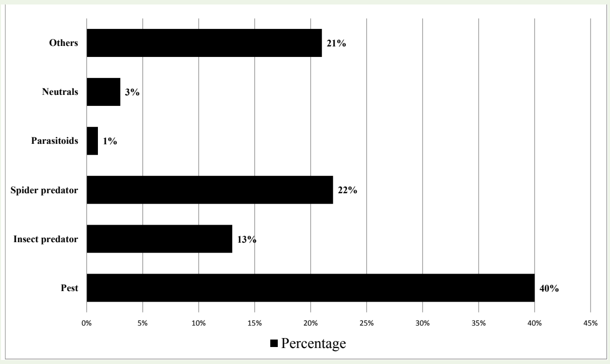
The species richness index R_1 (Margalef) [10], includes total number of individuals taxa along with their abundance. The mean index values of R_1 during the entire crop period of samba season were 2.53 ± 0.15, 2.54 ± 0.31, 2.33 ± 0.27 and 2.15 ± 0.16 for untreated, *B. bassiana*, vijay neem and chlorpyriphos treated condition respectively, which are not significantly different, indicating all the differently sprayed and one unsprayed rice field conditions follows similar type of species richness (Table 5).

The species richness index R_2 (Mehinick) [11], is another type of index similar to Margalef index, also consider the total number of species along with their abundance. According to this index, the mean value of R_2 during the samba season were 1.72 ± 0.11, 1.73 ± 0.23, 1.71 ± 0.18 and 1.66 ± 0.09 for untreated, *B. bassiana*, vijay neem and chlorpyriphos sprayed fields, which were not significantly different, indicating all the sprayed and unsprayed conditions follows



Graph 3: Relative abundance of insect and spider diversity on vijay neem oil 2% treated condition of rice field.

Categories	Percentage
Pest	42%
Insect predator	11%
Spider predator	32%
Parasitoids	1%
Neutrals	2%
Others	12%



Graph 4: Relative abundance of insect and spider diversity on chlorpyriphos 20% EC treated condition of rice field.

Categories	Percentage
Pest	40%
Insect predator	13%
Spider predator	22%
Parasitoids	1%
Neutrals	3%
Others	21%

Citation: Devarassou K, Raghunath AS, George H, Reshma M, Pillai SS, et al.Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods. J Plant Sci Res. 2016;3(1): 152.

Table 3: Arthropod fauna documented on the rice fields during samba season (2012-13) on *B. bassiana*, Vijay Neem, Chlorpyriphos and untreated condition.

Sl.No.	Arthropod fauna	Untreated	*B. bassiana*	Vijay Neem	Chlorpyriphos
I	**Herbivore (Pest)**				
1.	*Scirpophaga incertulas* (Stem borer)	√	√	√	√
2.	*Nephotettix sp* (Green Leaf Hopper)	√	√	√	√
3.	*Hydrellia sasakii* (Whorl maggot)	√		√	√
4.	*Dicladispa armigera* (Hispa beetle)	√	√	√	√
5.	*Pelopidas mathias* (Skipper butterfly)	√	√	√	√
6.	*Orseolia oryzae* (Gall midge)	√	√	√	√
7.	*Cnaphalocrocis medinalis* (Leaf roller)	√	√	√	√
8.	*Oxya nitidula* (Grass hopper)	√	√	√	√
9.	*Leptocorisa acuta* (Ear head bug)	√	√	√	√
10.	*Sogatella furcifera* (White Backed Plant Hopper)	√	√	√	√
11.	*Eysarcoris guttiger* (Black sting bug)	√	√	√	√
12.	*Pygomenida sp* (Colouring bug)	√	√	√	√
13.	*Melanitis leda ismene* (Horned caterpillar)	√	√		
14.	*Psalis pennatula* (Hairy caterpillar)	√	√	√	√
15.	*Gryllotalpa sp* (Mole Cricket)	√	√	√	
16.	*Nezara viridula* (Green bug)	√	√	√	√
II	**Predators**				
1.	*Harmonia octomaculata* (Coccinellid beetle)	√	√	√	√
2.	*Micraspis discolour* (Coccinellid beetle)	√	√	√	√
3.	*Ophionea indica* (Ground beetle)	√	√	√	√
4.	*Paederus fuscipes* (Rove beetle)		√		
5.	*Brachythemis contaminate* (Dragon fly)	√	√	√	√
6.	*Ischneura sp* (Damsel fly)	√	√	√	√
7.	*Leptispa pygmoea* (Water beetle)		√	√	
8.	*Polididus armatissimus*		√		√
9.	Nabidae (Water scorpion)		√		√
10.	*Limnogonus fossarum* (Water skater)	√	√	√	√
11.	Arenae (Spider)	√	√	√	√
III	**Parasitoids**				
1.	*Macrocentrus sp* (Hymenoptera)	√	√	√	√
2.	*Temelucha sp* (Hymenoptera)	√	√	√	√
IV	**Neutrals**				
1.	Ephemeropterans (May fly)	√	√	√	√
2.	Culicidae (Mosquito)	√	√	√	√
V	**Other insect categories**				
1.	Dipterans	√	√	√	√
2.	Hemipterans	√	√	√	√
3.	*Camponotus sp* (Black ant)	√	√	√	√
4.	*Apis cerana indica* (Indian honey bee)	√	√	√	√
5.	*Musca domestica* (House fly)		√	√	
6.	Carpenter bee	√	√		
7.	*Spodoptera litura*	√	√		
8.	Arctiidae		√		

√ - Indicates presence of arthropod in the particular rice field.

similar species richness (Table 5).

Diversity Index

The diversity indices incorporate both species richness and evenness into a single value. Shannon index (H') is the most popular and widely used index in community ecology. It is the average degree of 'uncertainity' and if this average 'uncertainity' increases, the number of species increases and then distribution of individuals among the species also become even. The mean value of Shannon index (H') for the entire samba season were 1.84 ± 0.08, 1.94 ± 0.11, 1.69 ± 0.12 and 1.64 ± 0.08 for untreated, *B. bassiana*, vijay neem and chlorpyriphos sprayed condition respectively, which were not significantly different, saying differently sprayed and unsprayed rice fields follows similar arthropod diversity (Table 5).

Citation: Devarassou K, Raghunath AS, George H, Reshma M, Pillai SS, et al.Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods. J Plant Sci Res. 2016;3(1): 152.

Table 4: Total relative abundance of rice field arthropods under untreated, *B. bassiana*, vijay neem and chlorpyriphos treated conditions.

Sl.No.	Categories	Total number of arthropods per 275 rice hills	Relative abundance in % (RA)
1.	Untreated	389	31.02
2.	*Beauveria bassiana*	350	27.91
3.	Vijay neem 2%	286	22.80
4.	Chlorpyriphos 20% EC	229	18.26
	Total	**1254**	**100**

Table 5: Mean value of ecological indices (species richness, diversity and evenness index) on untreated, *B. bassiana*, vijay neem oil and chlorpyriphos treated conditions.

Indices	Untreated	*B. bassiana*	Vijay neem	Chlorpyriphos	'F' value	p value
Richness						
N0	9.82 ± 0.56	9.82 ± 0.86	8.36 ± 0.83	7.55 ± 0.65	2.144	0.110 NS
R1	2.53 ± 0.15	2.54 ± 0.31	2.33 ± 0.27	2.15 ± 0.16	0.734	0.538 NS
R2	1.72 ± 0.11	1.73 ± 0.23	1.71 ± 0.18	1.66 ± 0.09	0.059	0.981 NS
Diversity						
λ	0.21 ± 0.03	0.28 ± 0.09	0.25 ± 0.05	0.21 ± 0.04	0.528	0.666 NS
H'	1.84 ± 0.08	1.94 ± 0.11	1.69 ± 0.12	1.64 ± 0.08	1.818	0.159 NS
N1	6.33 ± 0.51	7.26 ± 0.70	5.90 ± 0.76	5.33 ± 0.39	1.609	0.202 NS
N2	6.05 ± 1.09	7.42 ± 0.99	6.40 ± 1.31	5.08 ± 0.49	0.810	0.496 NS
Evenness						
E_1	0.80 ± 0.03	0.86 ± 0.07	0.78 ± 0.04	0.83 ± 0.03	1.837	0.156 NS
E_2	0.64 ± 0.06	0.74 ± 0.03	0.70 ± 0.04	0.72 ± 0.03	1.535	0.220 NS

ANOVA: Since, analysed *p* value is greater than 0.05, mean difference between insecticide are non-significant at 95%.
NS: Non-Significant.

The Simpson index of diversity (**λ**) is another familiar type of ecological index, which are used to assess the biodiversity of an ecosystem. Simpson index value varies from 0 to 1 and if the value tends towards zero it indicates higher diversity; (*i.e*) the probability of individuals drawn at random from a population will not belong to the same species, meaning diversifications. The mean index value (**λ**) for the entire crop period during samba season were 0.21 ± 0.03, 0.28 ± 0.09, 0.25 ± 0.05 and 0.21 ± 0.04 for untreated, *B. bassiana*, vijay neem and chlorpyriphos treated condition respectively, which are not significantly different, indicating unsprayed and different sprayed rice fields follows similar trend of arthropod diversity (Table 5).

Hills diversity number N_1 and N_2 are called effective number of taxa present in a sample and their unit is number of species. N_1 is the number of 'equally less abundant species'; and N_2 is number of 'equally very abundant species'. The less abundant species (N_1) may be parasitoids, neutrals or a pollinator in rice fields. These less abundant species in the rice fields plays a major role in maintenance of a balance in the ecosystem, as they are serving as a check for the buildup of herbivore population as in the case of parasitoids or may serve as a food for predators as in the case of neutrals species. The significance of very abundant species (N_2) is that, mostly they belong to herbivorous with one or two species of predator populations with respect to rice fields.

The mean index value of 'equally less abundant species' (N_1) during entire crop period were 6.33 ± 0.51, 7.26 ± 0.70, 5.90 ± 0.76 and 5.33 ± 0.39 for untreated, *B. bassiana*, vijay neem and chlorpyriphos sprayed condition respectively which were not significantly different at 5% level, indicating all the differently sprayed and an unsprayed rice field follows similar trend of less abundant species (Table 5).

The mean index value of 'equally very abundant species' (N_2) for the entire crop period during samba season were 6.05 ± 1.09, 7.42 ± 0.99, 6.40 ± 1.31 and 5.08 ± 0.49 for untreated, *B. bassiana*, vijay neem and chlorpyriphos treated condition respectively, which were not significantly different, indicating all the three different sprayed and an unsprayed rice fields follows similar trend of 'equally very abundant species' (Table 5).

Evenness index

The evenness index E_1 value for the entire crop period during samba season were 0.80 ± 0.03, 0.86 ± 0.07, 0.78 ± 0.04 and 0.83 ± 0.03 for unsprayed, *B. bassiana,* vijay neem and chlorpyriphos sprayed rice fields respectively, indicating the evenness of arthropods distribution over the rice field remain similar for all the treated and untreated conditions.

The mean value of evenness index E_2 for the total crop period during samba season were 0.64 ± 0.06, 0.74 ± 0.03, 0.70 ± 0.04 and

Citation: Devarassou K, Raghunath AS, George H, Reshma M, Pillai SS, et al.Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods. J Plant Sci Res. 2016;3(1): 152.

0.72 ± 0.03 for unsprayed, *B. bassiana,* vijay neem and chlorpyriphos sprayed conditions respectively, indicating evenly distribution of rice field arthropods for all treated and untreated conditions.

Discussion

Documentation of arthropod fauna

The documented arthropods seem to be almost similar in different sprayed (synthetic, botanical, mycoinsecticide) and unsprayed condition (Table 3). This finding was in confirmatory with that of Devarassou and Adiroubance [12,13], who reported that similar kind of arthropod fauna were documented on Integrated pest management adopted and non-adopted rice field conditions, where non-adopted rice field condition was sprayed with two organophosphorous insecticides namely chlorpyriphos 20% EC at the rate of 1250 ml/ha and monocrotophos 36 SL at the rate of 625ml/ha.

Relative abundance

The result furnishes, among the three insecticidal spray conditions, the chlorpyriphos treated condition suppresses the pest category effectively. Whereas, *B. bassiana* and vijay neem sprayed conditions were equally effective in controlling the rice pest, but follows next to chlorpyriphos treated conditions. This finding was in confirmatory with that of Radha et al. [14,15] who reported that chlorpyriphos proved to be highly effective against aphid pest of cowpea as compared to that of spinosad and neem seed kernel extract.

From the result, it is also inferred that the total relative abundance which considered, all the arthropod fauna irrespective of categories indicated that unsprayed rice field follows highest RA, which is followed by *B. bassiana* and vijay neem sprayed conditions. The least RA was followed under chlorpyriphos treated condition (Table 4). These findings were in agreement with those of Hassan and Rashid [9] who reported that, in the University Pertanian Malaysia (UPM), where pesticides had never been sprayed, recorded higher number of total arthropod taxa when compared to Tanjung Karang (TK) and Bukit Cawi (BC) of Malaysia. The result also inferred that, biopesticide and botanical insecticide sprayed field recorded highest arthropod fauna over synthetic chlorpyriphos treated conditions. This finding was in confirmatory with that of Adiroubance and Devarassou [12], who reported that the relative abundance of Integrated Pest Management (IPM) adopted rice field conditions have recorded highest percent of arthropod fauna, where biopesticide namely *Bacillus thuringeinsis* and neem coated urea was applied.

Species richness Index

The mean value of species richness indices N_0, R_1, R_2 during the entire crop period of samba season were not significantly different for *B. bassiana*, vijay neem, chlorpyriphos and unsprayed rice field. This finding was in agreement with those of Devarassou and Adiroubane [12], who reported that IPM adopted rice field had maintained better species richness, which was sprayed with biopesticide *Bacillus thuringeinsis* as well as applied with neem coated urea, indicating application of biopesticides like *B. bassiana* and neem oil on rice fields shall be safer to non-target organism and also maintain stable arthropod population in the rice field. Also, application of chlorpyriphos being a synthetic OP compounds, on rice fields did not reduced the arthropod diversity considerably, indicating organophosphorus group of insecticides are safer to rice field arthropods. This may be due to less persistent nature of OP compounds. This finding was in confirmatory with that of Michelle Fountain, [16] who reported applications of soil insecticide chlorpyriphos on grassland had increased the species richness, diversity and evenness of soil collembolan *Ceratophysella denticulate*, but had reduced the spider population drastically.

Hence, from the result it is concluded that application of myco-insecticde, botanicals and synthetic OP compounds did not reduce the species richness of arthropods in the rice fields considerably. These results clearly indicated, the concept of complete eradication or local extinction of arthropods cannot be possible by application of above mentioned insecticides. Hence, application of *B. bassiana*, vijay neem and chlorpyriphos on rice fields, though make some impact on the non-target arthropods fauna like predators, parasitoids, neutrals and pollinators immediately after insecticidal applications, but had regained its populations and abundance later. This might be due to diverse nature of rice field arthropods.

Diversity index

Shannon index (H') and Simpson index (**λ**) of diversity for the entire rice crop period during samba season were not different significantly [17,18], indicating similar trend of arthropod diversity was maintained for chlorpyriphos, vijay neem and *B. bassiana* sprayed and one unsprayed field conditions. Similar results were reported by Devarassou and Adiroubance [12], where IPM adopted field conditions had higher arthropod diversity over Non-IPM adopted condition, in which IPM adopted rice fields were treated with neem coated urea, *B. thuringiensis* and synthetic insecticide carbofuron 3G (during nursery). The results confirm that application of biopesticide and synthetic insecticides in rice ecosystem would not affect the arthropod diversity permanently. If affected, it would be temporary till the toxicity of insecticide remains in the fields. Since, all the three insecticide namely chlorpyriphos, *B. bassiana* and vijay neem taken for the study are less-persistent, re-colonization's of arthropods had occurred few days after application. This principle of re-colonization's could be attributed to higher reproductive potential, different mode of life stages, smaller size and diverse nature of rice field arthropods.

The number of 'equally less abundant taxa' (N_1) for the entire crop period during samba season was not different significantly, implying unsprayed and all the sprayed rice field conditions namely *B. bassiana*, vijay neem and chlorpyriphos had maintained similar trend. 'Equally less abundant taxa' are the most important component in the rice field which is significant in maintaining the balance of overall diversity. The range of N_1 fluctuate between 5.33 to 7.26 on unsprayed and differently sprayed rice field conditions, indicating the 5 to 7 species are equally less abundant.

The numbers of 'equally very abundant taxa' (N_2) for the entire crop period during samba season were not significantly different, indicating untreated and treated conditions had followed similar trend. The value of N_2 decides the overall diversity of the rice fields. From the results it is inferred that the value of N_2 ranges from 5.08 to 7.42, implying about 5-7 species are equally very abundant during

Citation: Devarassou K, Raghunath AS, George H, Reshma M, Pillai SS, et al.Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods. J Plant Sci Res. 2016;3(1): 152.

the entire trail period. From the result it is also inferred that the value of 'equally less abundant species' (N_1) and 'equally very abundant species' (N_2) remain same (5-7 taxa), indicating about 10-14 arthropod taxa were dominating the entire rice fields irrespective of insecticidal sprayings. This was in agreement with Heong and Aquino who reported that the arthropod diversity was determined by 6-9 taxa of arthropods in the rice fields of IRRI farm, Phillipines [19-22].

The results revealed that the mean value of various species richness index (N_o, R_1, R_2) and diversity index (λ, H', N_1 and N_2) under different insecticide treated and an untreated condition of rice field remain same. This has indicated that due to applications of various insecticides like botanical, myco-insecticide and synthetic OP compounds under irrigated rice field, the diversity of arthropods was not reduced considerably. Hence, in order to conclude, the different insecticide taken for the study seems to be safer with respect to maintenance of arthropod biodiversity. It can also be concluded that applications of three sprayings of insecticides by myco-insecticide (*B. bassiana*), botanicals (vijay neem) and synthetic OP compound (chlorpyriphos), did not make any critical effects on the biodiversity of rice field arthropods.

Evenness index

The results furnished that the evenness indices E_1 and E_2 for the entire rice growing period of samba season seems to be maintaining similar trend for all the sprayed and an unsprayed condition. This was in agreement with that of Devarassou and Adiroubane, [12] who reported that under IPM adopted rice field conditions, the evenness was in a higher trend, where the field was treated with neem coated urea and biopesticide namely *B. thuringiensis*. However, chlorpyriphos being a synthetic insecticide also show similar trend of arthropod evenness like botanicals and mycoinsecticide. This might be due to less persistent nature of OP compounds.

Conclusion

The result inferred that, three sprayings each from synthetic OP insecticides, myco-insecticide and botanicals did not reduces the rice field arthropods, indicating the concept of eradication of arthropods is not at all possible. After each insecticidal spray, the arthropod population were reduced, but had rebuilt similar type of population after few days, which depends upon the persistence of insecticide compounds. Hence, application of mycoinsecticide, botanical and synthetic organophosphorous insecticide did not pose a serious threat to biodiversity of rice field arthropods.

References

1. Employment Information: Indian Labour Statistics (1994) Chandigarh: Labour Bureau, Ministry of Labour, 1996.
2. Ranga Rao GV, Rameshwar Rao V, Reddy YVR, Murthy KSRK (2005) Status of safety in pesticide use in Asia: Option for improvement. ***In:*** proceeding of the National Seminar on Pesticide Residues and their Risk Assessment organized by Food and Drug Toxicology Research Centre, National Institute of Nutrition, Hyderabad, January 20-21, 2005: 129-136.
3. Schoenly KG, Justo HD, Barrion AT, Harris MK, Bottrell GD (1998) Analysis of invertebrate biodiversity in Philippines farmers irrigated rice field. Envrion Entomol 27: 1125-1136.
4. Settle WH, Ariawan H, Triastute E, Cahyana W, Hakim AL, et al. (1996) Managing tropical rice pests through conservation of generalist natural enemies. Ecology 77: 1975-1988.
5. Longino JF (1994) Project ALAS (arthropod of la selva) summary. May. Estacion Biologist La Selva Costa Rica, Central America.
6. Danks HV (1996) How to assess insect biodiversity without wasting your time. Document Series No. 5, Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 20 pp.
7. Way MJ, Heong KL (1994) The role of biodiversity in the dynamics and management of insect pests of tropical irrigated rice- a review. Bull Entomol Res 84: 567-587.
8. Singh NN, Rai S (2000) Relative abundance of different Coccinellids in Mustard ecosystem. Indian J Ent 62: 422-426.
9. Hassan STS, Rashid MM, Arshad MA (1995) Sampling of paddy field arthropods. ***In:*** Proceedings of IRPA Seminar of the Faculty of Science and Environment Studies, Universiti Pertanian Malayasia, Serdang, 20-21 June 1995.
10. Margalef R (1958) Information theory in ecology. General Systematics 3: 36-71.
11. Mehinick EF (1964) A comparison of some species-individuals diversity indices applied to samples of field insects. Ecology 45: 859-861.
12. Devarassou K, Adiroubance D (2006) Arthropod biodiversity in integrated pest management adopted tropical rice ecosystem. ***In:*** proceedings of the National symposium on Biodiversity and Insect Pest Management. Organized by Entomology Research Institute, Loyola College, Chennai, February 3 - 4, 2005: 93-103.
13. Adiroubane D, Devarassou K (2006) Relative abundance of arthropod fauna in tropical rice ecosystem in Karaikal region. ***In:*** proceedings of the National symposium on Biodiversity and Insect Pest Management. Organized by Entomology Research Institute, Loyola College, Chennai, February 3 - 4, 2005: 71-79.
14. Radha R (2013) Comparitive studies on the effectiveness of pesticides for aphid control in cowpea. Res J Agriculture and Forestry Sci 1: 1-7.
15. Fountain MT, Brown VK, Gange AC, Symondson WOC, Murray PJ (2001) The effects of the insecticide chlorpyrifos on spider and Collembola communities. Pedobiologia 51: 147-158.
16. Shannon CE, Wiener W (1949) The mathematical theory of communication. University Illinois Press, Urban.
17. Simpson EH (1949) Measurement of diversity. Nature 163: 688.
18. Heong KL, Aquino GB (1990) Arthropod diversity in tropical rice ecosystem. IRRI 15: 31-32.
19. Hill MO (1973) Diversity and evenness: A unifying notation and its consequences. Ecology 54: 427-432.
20. Sheldon AL (1969) Equitability indices: dependence on the species count. Ecology 50: 466-467.
21. Pielou EC (1977) Mathematical Ecology, Wiley, New York.

Citation: Devarassou K, Raghunath AS, George H, Reshma M, Pillai SS, et al.Effects of Botanicals, Myco-Insecticide and Organophosphorous Insecticidal Spray on Biodiversity of Rice Field Arthropods. J Plant Sci Res. 2016;3(1): 152.