Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(6): 401-407

Received: 22-09-2016
Accepted: 24-10-2016

Santhosh S
Entomology Laboratory, DOS in Zoology, University of Mysore Manasagangotri, Mysore, India

S Basavarajappa
Entomology Laboratory, DOS in Zoology, University of Mysore Manasagangotri, Mysore, India

Correspondence
S Basavarajappa
Entomology Laboratory, DOS in Zoology, University of Mysore Manasagangotri, Mysore, India

Impact of Pesticide application on butterfly fauna at agriculture ecosystems of Chamarajanagar District, Karnataka, India

Santhosh S and S Basavarajappa

Abstract
Field study was conducted to assess quantitatively the impact of pesticides application on native butterfly fauna in agriculture ecosystems at Chamarajanagar District, Karnataka during 2014-2015. Five hundred meter length, 15 permanent line transects (LTs) were randomly selected at paddy growing area (PGA), commercial crops growing area (CCGA) and vegetables growing area (VGA). Around 45 species which belong to the family Hesperiidae (Five species), Lycaenidae (10 species), Nymphalidae (16 species), Papilionidae (Five species) and Pieridae (Nine species) showed considerable variation in their relative density and abundance at areas with pesticides spray compared to control. In general, there was a decline of butterfly fauna at pesticides sprayed areas. The Shannon diversity index varied considerably. Further, the Simpson and Equitability index was more 97 to 98 before application and it was decreased from 95 to 96 after the spray of pesticides. Present study help understand the status of butterfly species survivorship due to pesticides impact amidst intensive agriculture ecosystems.

Keywords: Pesticides, agriculture crop, impact, butterfly species

Introduction

Butterflies are affected mainly by the changing environment in cultivated habitats [1, 2] due to intensive cultivation activities, monoculture farming, ground burning, herbicides, insecticides and inorganic fertilizers application [3-9] amidst agro-ecosystems. This has altered the habitat quality considerably and many native butterfly species facing severe threat due to non-availability of food and host plants during their development. Since, excessive use of fertilizers, herbicides and insecticides in agriculture ecosystems is inter-linked with pollinators decline due to reduced suitable host plants [10]. It is true for butterflies as they are most important components of terrestrial ecosystems [11]. Klein *et al.* (2008) have estimated that 35% of food used by human is derived from crops that are benefited from insect pollinators including butterflies in the globe. Pollinator's decline (e.g. Butterfly species) has become repercussions for cultivable crops and wild flowering plants around the globe [13-16]. Application of different type of insecticides on crops is one of the major factors [17, 18] that affect strongly the butterfly fauna [19, 20]. This becomes a major threat to butterfly species those inhabited partly or fully amidst agriculture ecosystems [21, 22]. Since, butterflies study is more relevant while understanding the structure and dynamics of biological population in a given area [23]. Kindvall and Ahlen (1992), Hanski (1994), Jansson and Angelstam (1999) and Summerville (2001) [24-27] have estimated both empirically and theoretically by showing the probability of species decline with habitat loss. It could alter local species richness and affect surrounding landscape [28- 30].

There are few studies made to understand butterflies decline in agriculture ecosystems. Their decline is associated with many factors. Of all, ruthless application of insecticides in agriculture ecosystems has direct lethal effects on their biology [19, 20]. Since few decades, butterfly population is declining considerably in India (31). Around 100 out of 1,501 butterfly species are under threat due to habitat loss [32], pesticide poisoning and are on the verge of extinction [33]. Moreover, in every butterfly species life cycle, 95% individuals are dying before they attain adulthood due to parasitic infestation, predators and parasitoids attack, habitat loss and pesticides/insecticides poisoning in agriculture ecosystems [34]. This has negative consequence for effective ecosystem service potentially [35]. Therefore, there is a dire need to understand the effects of insecticides/pesticides on non-target species like butterflies hence, the present investigation was undertaken.

Materials and Methods

Study area: Study was conducted at Chamarajanagar, Yelandur, Kollegal and Gundlupet taluks of Chamarajanagar District during different cropping seasons at agriculture ecosystems for the year 2014-2015. The sampling sites at these taluks were further classified into three major crop growing areas viz., paddy growing area (PGA), commercial crops growing area (CCGA) (e.g. Banana, Areca nut, Sugarcane, Pepper, Cashew nut, Coconut, Tobacco, Cotton, Mango, Lemon, Guava, Sapota, Pomegranate, Papaya, Jasmine, Marigold, Sugandaraja, Kanakambara, Shavanthige, Jowar, Maize, Groundnut, Sunflower, Castor, Sesamum and Niger seed) and vegetables growing area (VGA) (e.g. Potato, Tomato, Brinjal, Beans and Cluster beans, Onion, Green chilies, Cauliflower and Cabbage).

Methodology: Five hundred meter length, 15 permanent line transects (LTs) were randomly selected as per [36]. Data on different insecticides sprayed on these crops during their cultivation was collected by personal interview and filled in pre-tested questionnaire. Observations were made through Pollard Walk Method (PWM) by counting all the butterflies found in transect by employing Visual Count Method (VCM) as per [21, 36-40]. Butterfly species found around five meter radius of the observer were recorded during 0900 to 1100 and 1400 to 1700hrs at different crops as per [40-42]. Butterflies activity was recorded before and after insecticides sprays as per [20-21, 43-44]. The cultivable land used to grow different crops where there was no insecticides application was identified, selected and considered as control.

Statistical analysis: The insecticide sprayed area and insecticide non-sprayed areas were monitored critically to record the mortality, density and abundance of butterfly species. The butterfly fauna was compared between PGA, CCGA, VGA and cropping area without insecticides application as per [21, 37]. Butterfly species were identified by using field guides and with the help of available literature as per [34, 45-47]. The density and abundance of butterfly species occurred at insecticide sprayed areas and non-insecticide sprayed areas were calculated as per [48, 49]. The difference between more than two samples and variation existed between transects were analyzed by using ANOVA as per [50]. Further, butterfly species diversity index before and after spraying insecticides was calculated by using Shannon Diversity Index (H^1), Simpson (1-D), Shannon equitability (J) and Dominance (D) was calculated by following standard methods as described by [51].

Results

Table with details about pesticides used in agriculture ecosystem: Total 114 types of pesticides, includes 54 types of insecticides, 42 types of fungicides and 18 types of herbicides are applied at different agricultural ecosystems (Table 1). Insecticides like Azadirachtin, Chlorantraniliprole, Chloropyrifos, Cypermethrin, Deltamethrin, Fipronil, Quinalphos, Bromadiolone, Dimethoate, Endosulfan, Malathion and Fungicides like Carbendazim, Copper Hydroxide, *Difenoconazole*, Hexaconazole, Mancozeb, Tebuconazole and Sulphur are commonly used. Whereas, Herbicides like Oxyfluorfen and Pretilachlor are commonly used at different agricultural ecosystems (Table 1). The application of pesticides is more at CCGA followed by PGA and VGA and insecticides use is more at all the agricultural ecosystems (Table 1).

Table 1: Pesticide sprayed on various crops at agriculture ecosystems of Chamarajanagar District

Sl. No.	Ecosystems	Pesticide types		
		Insecticides	**Fungicides**	**Herbicides**
1.	Paddy Growing Area (PGA)	Acephate, Azadirachtin, Acetamiprid, Bacillus Thringiensis, Benfuracarb, Biffnthrin, Carbosulfan, Cartap hydrochloride, Chlorantraniliprole, Chloropyrifos, Cypermethrin, Delta Methrin, Dinotefuran, Ethofenoprox, Fipronil, Flubendiamide, Imidacloprid, Quinalphos, Lambda-Chyalothrin, Thiamethoxam and Triazophos	Azoxystrobin, Copper Oxychloride, Cabendazim Dinocap, Hexaconazole, Matalaxyl, Penconazole, sulphur and Triadimefon	Anilofos, Bensulfuron Methyl, Bispyribac Sodium, Butachlor, Clomazone, Oxadiargyl, Oxyfluorfen and Pretilachlor
2.	Commercial Crop Growing Area (CCGA)	Bromadiolone, Burofezin, Carbofuran, Chlorantraniliprole, Chlorpyrifos, Clothianidin, Cypermethrin, D.D. Mixture, Deltamethrin, Dichlorvos, Dimethoate, Endosulfan and Fipronil, Imidacloprid, Lambda-Cyhalothrin, Malathion, Monocrotophos, Oxydemeton-Methyl, Quinalphos and Thiamethoxam	Aureo fungin, Capton, Carbendazim, Carpropamid, Copper Hydroxide, Copper oxy chloride, Difenoconazole Ediphenphos, Epiphenphos, Hexaconazole, Iprodione Isoprothiolan, Kasugamycin, Kitazin, Kresoxim-methyl, Mancozeb, Pencycuron, Propiconazole, Propineb, Streptomycin Sulphate, Tebuconazole and Zineb	2,4-D Dimethyl Amine, 2,4-D Sodium, 2,4-D Ethyl Ester, Diuron, Hexazinone and Metasulfuron Methyl
3.	Vegetables Growing Areas (VGA	Azadirachtin, Bromadiolone, Deltamethrin, Diflubenzuron, Dimethoate, Endosulfan, Melathione, Methomyl, Methyl Parathion, Oncentra Tecontatining, Phorate, Quinalphos and Trichlorfon	Benomyl, Biteranol, Carbendazim, Copper Hydroxide, Difenoconazole, Hexaconazole, Mancozeb, Metriam, Propiconazole Sulphur and Tebuconazole	Alachlor, Imazethapyr, Oxflourfen and Quizalofop-ethyl

Density and abundance of butterflies: Around 45 species which belong to the family Hesperiidae (Five species), Lycaenidae (10 species), Nymphalidae (16 species), Papilionidae (Five species) and Pieridae (Nine species) were observed at different cropping areas (Table 2). The relative density and abundance of these species at areas with insecticide spray is given in Figure 1. Further, *Spialia galba* (Indian Skipper), *Suastus gremius* (Indian Palm Bob) of

Hesperiidae family, *Edales pandava* (Plains Cupid) of Lycaenidae family, *Ypthima asterope* (Common three ring) of Nymphalidae family and *Eurema blanda* (Three-Spot Grass Yellow) and *Leptosia nina* (Psyche) of Pieridae family members were completely absent at CCGA. The *Telicota ancilla* (Dark Palm Dart) of Hesperiidae family, *Zizeeria otis* (Lesser Grass Blue) of Lycaenidae family, *Junonia iphita* (Chocolate Pansy), *Melanitis leda* (Common Evening Brown) of Nymphalidae family and *Eurema blanda* (Three-Spot Grass Yellow) and *Leptosia nina* (Psyche) of Pieridae family were completely absent after the spray of insecticides at PGA. However, at VGA, *Spialia galba* (Indian Skipper), *Telicota ancilla* (Dark Palm Dart) of Hesperiidae family, *Prosotas nora* (Common Line Blue), *Zizula gaika* (Tiny Grass Blue) of Lycaenidae family, *Ypthima asterope* (Common three ring) Nymphalidae family and *Eurema brigitta* (Small Grass Yellow) and *Leptosia nina* (Psyche) of Pieridae family were completely absent after the insecticides spray (Table 2). Interestingly, *Leptosia nina* was absent at all the cropping areas after the insecticides application (Table 2). Per cent occurrence of butterfly species at different crops growing areas showed decreased number of butterfly species after insecticides application (Fig.1).

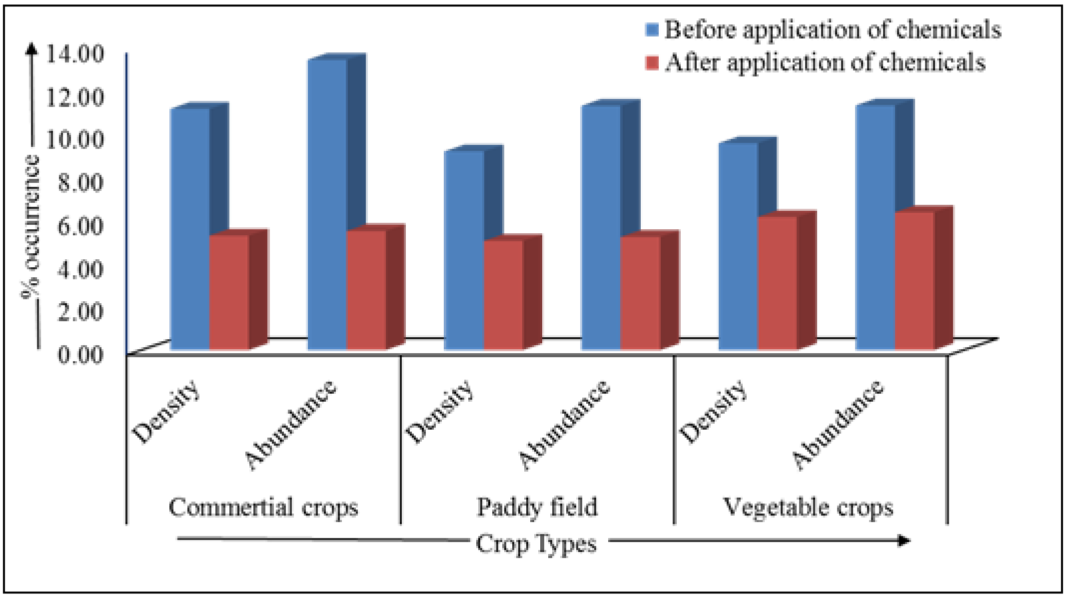

Fig 1: Average density and abundance of butterflies at different crops before and after pesticide application

Table 2: Density and abundance of butterfly species recorded at different crops before and after pesticide application at agriculture ecosystems of Chamarajanagar District

Family	Sl. No.	Common name	Scientific name	Butterfly density and abundance at different crop types																	
				Commercial Crop Growing Area (CCGA)						Paddy Growing Area (PGA)						Vegetables Growing Areas (VGA)					
				BPA			APA			BPA			APA			BPA			APA		
				T	D	A	T	D	A	T	D	A	T	D	A	T	D	A	T	D	A
Hesperidae	1.	Chestnut Bob	*Iambrix salsala* Moore	37	3.08	3.08	15	1.33	1.25	40	3.33	3.33	16	1.42	1.33	27	2.25	2.25	17	1.42	1.42
	2.	Indian Skipper	*Spialia galba* Fabricius	25	2.08	3.13	0	0.00	0.00	23	1.92	2.88	17	1.55	1.79	12	1.00	1.50	0	0.00	0.00
	3.	Indian Palm Bob	*Suastus gremius* Fabricius	28	2.33	3.53	0	0.00	0.00	35	2.92	4.83	17	1.47	2.58	33	2.75	4.50	8	0.68	1.25
	4.	Common Gras Dart	*Taractrocera maevius* Fabricius	32	2.67	3.20	17	1.58	1.71	29	2.42	2.90	14	1.17	1.75	31	2.58	3.10	27	2.48	0.00
	5.	Dark Palm Dart	*Telicota ancilla* Herrich-Schaffer	41	3.42	4.73	27	2.48	2.47	26	2.17	2.85	0	0.00	0.00	13	1.08	1.53	0	0.00	0.00
Lycaenidae	6.	Leaf Blue	*Amblypodia anita* Hewitson	29	2.42	3.20	16	1.45	1.48	15	1.25	1.83	9	0.85	0.80	28	2.33	3.10	18	1.63	1.67
	7.	Forget-me-not	*Catochrysops strabo* Fabricius	30	2.50	3.00	4	0.33	1.00	29	2.42	2.90	7	0.65	1.08	29	2.42	2.90	7	0.67	0.92
	8.	Plains Cupid	*Edales pandava* Horsfield	37	3.08	3.58	0	0.00	0.00	22	1.83	2.21	5	0.50	0.42	5	0.42	0.50	7	0.68	0.60
	9.	Grass Jewel	*Freyeria trochylus* Freyer	42	3.50	3.85	14	1.17	1.75	26	2.17	2.35	16	1.47	1.67	49	4.08	4.47	12	1.10	1.25
	10.	Common Cerulean	*Jamides celeno* Cramer	35	2.92	4.03	9	0.83	0.75	44	3.67	4.95	16	1.42	1.33	41	3.42	4.45	8	0.67	0.67
	11.	Common Lineblue	*Prosotas nora* Felder	46	3.83	5.75	3	0.30	0.25	16	1.33	2.00	15	1.37	1.92	26	2.17	3.25	0	0.00	0.00
	12.	Pale Grass Blue	*Pseudozizeeria maha* Kollar	6	0.50	0.58	4	0.37	0.37	25	2.08	2.33	16	1.53	1.40	18	1.50	1.65	18	1.60	1.70
	13.	Dark Grass Blue	*Zizeeria lysimon* Hübner	49	4.08	5.43	27	2.57	2.25	38	3.17	4.28	20	1.85	1.67	44	3.67	4.88	39	3.52	3.25
	14.	Lesser Grass Blue	*Zizeeria otis* Fabricius	23	1.92	3.05	10	0.95	1.08	28	2.33	4.90	0	0.00	0.00	25	2.08	4.45	15	1.45	1.50
	15.	Tiny Grass Blue	*Zizula gaika* Trimen	55	4.58	5.50	19	1.82	1.58	53	4.42	5.30	1	0.10	0.08	40	3.33	4.00	0	0.00	0.00
Nymphalidae	16.	Tawny Coster	*Acraea terpsicore* Linnaeus	79	6.58	7.03	28	2.60	2.53	40	3.33	3.70	21	1.95	1.90	54	4.50	4.87	29	2.60	2.72
	17.	Angled Castor	*Ariadne ariadne* Linnaeus	67	5.58	6.08	26	2.37	2.17	45	3.75	4.05	26	2.35	2.17	46	3.83	4.18	38	3.50	3.17
	18.	Common Castor	*Ariadne merione* Cramer	66	5.50	6.02	18	1.72	1.71	39	3.25	3.57	34	3.08	3.63	64	5.33	5.88	43	3.90	4.58
	19.	Plain Tiger	*Danaus chrysippus* Linnaeus	85	7.08	8.50	41	3.60	3.42	56	4.67	5.60	31	2.85	2.58	67	5.58	6.70	47	4.38	3.92
	20.	Common Indian Crow	*Euploea core* Cramer	46	3.83	4.25	41	3.67	3.85	31	2.58	2.78	27	2.43	2.52	39	3.25	3.55	35	3.18	3.23
	21.	Yellow Pansy	*Junonia hierta* Fabricius	59	4.92	5.50	57	4.98	5.47	43	3.58	3.88	33	2.97	3.08	51	4.25	4.80	37	3.38	3.40
	22.	Chocolate Pansy	*Junonia iphita* Cramer	84	7.00	8.40	16	1.60	1.33	57	4.75	5.70	0	0.00	0.00	79	6.58	7.90	49	4.57	4.42
	23.	Lemon Pansy	*Junonia lemonias* Linnaeus	82	6.83	10.2	59	5.15	4.92	45	3.75	5.63	6	0.58	0.50	81	6.75	10.1	44	3.98	3.67
	24.	Blue Pansy	*Junonia orithya* Linnaeus	29	2.42	3.20	17	1.62	1.50	56	4.67	6.40	23	2.12	2.10	29	2.42	3.15	20	1.85	1.82
	25.	Common Evening Brown	*Melanitis leda* Linnaeus	32	2.67	3.13	26	2.37	2.40	32	2.67	3.21	0	0.00	0.00	40	3.33	4.25	28	2.53	2.60
	26.	Common Bushbrown	*Mycalesis perseus* Fabricius	41	3.42	3.73	29	2.60	3.17	23	1.92	2.12	19	1.73	2.00	54	4.50	4.85	27	2.43	2.92
	27.	Long-Brand Bushbrown	*Mycalesis visala* Moore	55	4.58	5.50	30	2.73	2.77	23	1.92	2.30	30	2.85	2.65	51	4.25	5.10	32	2.83	3.03
	28.	Nigger	*Orsotriaena medus* Fabricius	27	2.25	2.70	4	0.33	1.00	27	2.25	2.70	7	0.63	1.25	24	2.00	2.40	10	0.97	1.17
	29.	Common three ring	*Ypthima asterope* Klug	13	1.08	1.63	0	0.00	0.00	28	2.33	2.75	1	0.08	0.08	25	2.08	2.50	0	0.00	0.00
	30.	Common Fivering	*Ypthima baldus* Fabricius	36	3.00	3.92	7	0.62	1.42	55	4.58	5.38	26	2.42	4.00	37	3.08	3.71	26	2.42	4.00
Papilionidae	31.	Common Fourring	*Ypthima huebneri* Kirby	66	5.50	6.60	16	1.33	2.00	54	4.50	5.40	16	1.42	1.79	35	2.92	3.50	24	2.22	2.46
	32.	Tailed Jay	*Graphium agamemnon* Linnaeus	48	4.00	4.00	30	2.77	2.50	50	4.17	4.17	33	3.12	2.75	66	5.50	5.50	29	2.60	2.42
	33.	Common Rose	*Pachliopta aristolochiae* Fabricius	50	4.17	5.00	36	3.33	3.27	30	2.50	3.00	30	2.83	2.67	40	3.33	4.00	39	3.57	3.58
	34.	Crimson Rose	*Pachliopta hector* Linnaeus	55	4.58	5.20	14	1.17	1.40	41	3.42	3.63	27	2.57	2.38	47	3.92	4.35	34	3.15	3.08
	35.	Lime Butterfly	*Papilio demoleus* Linnaeus	56	4.67	4.67	38	3.42	3.17	55	4.58	4.58	42	4.00	3.50	57	4.75	4.75	48	4.48	4.00
	36.	Common Mormon	*Papilio polytes* Linnaeus	41	3.42	4.10	30	2.73	2.77	42	3.50	4.20	34	3.18	3.05	41	3.42	4.10	35	3.23	3.18
Pieridae	37.	Common Emigrant	*Catopsilia pomona* Fabricius	80	6.67	7.20	34	3.08	3.15	64	5.33	5.97	38	3.52	3.45	117	9.75	10.8	42	3.87	3.83
	38.	Mottled Emigrant	*Catopsilia pyranthe* Latreille	77	6.42	8.63	41	3.73	4.33	47	3.92	5.18	30	2.82	2.96	54	4.50	4.87	30	2.73	3.17
	39.	Common Gull	*Cepora nerissa* Fabricius	60	5.00	5.00	34	3.10	3.13	50	4.17	4.17	33	3.05	3.00	45	3.75	5.15	23	2.12	2.10
	40.	Small Salmon Arab	*Colotis amata* Fabricius	69	5.75	6.32	35	3.18	2.92	56	4.67	5.07	30	2.68	2.50	39	3.25	3.25	51	4.73	4.25
	41.	One spot Gras Yellow	*Eurema andersoni* Moore	33	2.75	3.30	30	2.73	3.83	31	2.58	3.10	8	0.72	1.08	54	4.50	4.87	19	1.58	3.17
	42.	Three-Spot Grass Yellow	*Eurema blanda* Boisduval	41	3.42	4.78	0	0.00	0.00	36	3.00	4.20	0	0.00	0.00	42	3.50	4.20	28	2.52	2.62
	43.	Small Grass Yellow	*Eurema brigitta* Cramer	47	3.92	4.70	24	2.20	2.20	30	2.50	3.00	9	0.88	0.77	32	2.67	3.63	0	0.00	0.00
	44.	Common Grass Yellow	*Eurema hecabe* Linnaeus	47	3.92	4.38	15	1.25	1.50	54	4.50	4.73	5	0.42	0.50	34	2.83	3.40	30	2.58	2.92
	45.	Psyche	*Leptosia nina* Fabricius	89	7.42	7.42	0	0.00	0.00	52	4.33	4.33	0	0.00	0.00	61	5.08	5.43	0	0.00	0.00

Diversity Indices of butterfly species: The Shannon diversity index was 3.71 at CCGA and it was 3.75 at PGA. However, it was 3.70 at VGA. But, it was reduced to 3.49 to 3.5 respectively at CCGA, PGA and VGA. Further, the Simpson and Equitability index was more 97 to 98 before application. But, it was decreased from 95 to 96 after the spray of insecticides (Table 3). The Dominance index was 0.25, 0.24 to 0.26 before insecticides application. But, it was increased to 0.33, 0.33 and 0.31 respectively at CCGA, PGA and VGA (Table 3).

Species richness: The species richness decreased at all the cropping areas viz., PGA, CCGA & VGA. It was reduced to 39 at both CCGA and PGA, whereas at VGA it was 38 species only (Table 3). The Shannon diversity index was 3.71, 3.75 and 3.70 and it was supported with 0.97 Simpson (1-D) index and equitability at different crop types before the spray of insecticides (Table 3). But, Shannon Index (H) was reduced to 3.49, 3.49 each and 3.5 with increased dominance (D) 0.033 each and 0.031 at both CCGA and PGA, and at VGA (Table 3).

Table 3: Diversity Indices calculated between crop types before and after pesticide application

Sl. No.	Study site		Species Richness	Shannon Diversity Index (H)	Simpson Index (1-D)	Equitability (J)	Dominance (D)
1.	CCGA	BPA	45	3.71	0.97	0.97	0.025
		APA	39	3.49	0.96	0.95	0.033
2.	PGA	BPA	45	3.75	0.97	0.98	0.024
		APA	39	3.49	0.96	0.95	0.033
3.	VGA	BPA	45	3.70	0.97	0.97	0.026
		APA	38	3.5	0.96	0.97	0.031

Discussion

Impact of pesticides application on butterfly fauna: Application of different insecticides on various crops at PGA, CCGA and VGA during different stages of plants has decreased the butterfly species density and abundance considerably. Butterflies are very sensitive did responded immediately to the changing environment due to insecticide spray amidst agriculture ecosystem. Different types of insecticides are spraying commonly on one or the other crops at CCGA, VGA and it is a regular practice due to mixed cropping. Frequent application of various insecticides on commercial crops, vegetables and periodic use of insecticides on paddy might result in accumulating on to the foraging plants [52-54]. Vyas (1977) and Chaudhary (1990) have reported the insecticides deposition on leaves, pods, grains and other parts of plant body. The residual toxicity of insecticides interfered with the growth and development of cells, tissues and organ system of plants [57]. Finally, it could induce morphological and biochemical alternations, inhibit the biosynthesis of chlorophyll [57] and finally plants will die. In this way, regular applications of insecticides will reduce the local floral diversity [58]. When flora is scanty, certainly butterflies will move to some other places in search of host and food plants. Otherwise, they become victimized to pesticide poisoning. Perhaps, due to all these reasons, the density and abundance of butterfly species was less at insecticide sprayed areas. Our observations are corroborating the observations of previous researchers.

Further, density of Hesperiidae, Lycaenidae and Pieridae family members were decreased at PGA, CCGA and VGA. Butterflies of these families are very much sensitive to insecticides spray. This might have discouraged their activity at these areas and resulted less density and abundance. However, *Spialia galba* (Indian Skipper), *Suastus gremius* (Indian Palm Bob), *Telicota ancilla* (Dark Palm Dart) of Hesperiidae family, *Edales pandava* (Plains Cupid), *Zizeeria otis* (Lesser Grass Blue), *Prosotas nora* (Common Line Blue), *Zizula gaika* (Tiny Grass Blue) of Lycaenidae family, *Ypthima asterope* (Common three ring), *Junonia iphita* (Chocolate Pansy), *Melanitis leda* (Common Evening Brown) of Nymphalidae and *Eurema blanda* (Three-Spot Grass Yellow), *Eurema brigitta* (Small Grass Yellow) and *Leptosia nina* (Psyche) of Pieridae family members were completely absent at PGA, CCGA and VGA after insecticides application. Since, Hesperiidae and Lycaenidae family members are small in size with less dispersal ability [45, 34] can't fly away easily for long distance like Nymphalidae, Papilionidae and Pieridae family members. Moreover, they depend mainly on plants (e.g. weeds) of Poaceae family for rest [58]. Further, besides insecticides spray, weedicides were also used more often to control weeds amidst agriculture ecosystems. Perhaps, ruthless application of insecticides along with weedicides might have spoiled the larval forage and contaminated the nectar of few adult butterflies of Hesperiidae, Lycaenidae and Pieridae families. Certain insecticides (e.g. Neonicotinoids) whey they sprayed on to the plants would enter into tissues via nectar and envenom the nectar feeding butterflies [9]. Lewis *et al*. (2011) have estimated that 3% concentration of methionine is sufficient to bring 100% mortality of certain butterflies (e.g. *Heraclides cresphontes*). Further, laboratory bioassay experiments revealed that the application of insecticides in butterfly diet would alter the diet quality inturn affect the physiological processes including growth and development of butterflies [19-20, 59]. Thus, repeated applications of insecticides, weedicides and general pesticides in large quantity on agriculture crops might have envenomed the habitat and affected the butterfly species at agriculture ecosystems [52]. Thus, insecticides spray at different crop fields has positive effect on the local butterfly diversity, density and abundance. Further, reduction of butterfly diversity and density at various crop fields could cause pollinators decline inturn reduce the process of pollination of several plant species [60]. This would alter the survival rate of different butterfly species due to non-availability of suitable host plants, food plants and cause death of egg, larva and pupa. Perhaps, this might be one of the main reasons for the decline of few butterfly species as mentioned earlier at PGA, CCGA and VGA. In this regard, few members of Hesperiidae and Lycaenidae families could be used as indicator species to access the poisoning effect of insecticides on native butterfly diversity at agriculture ecosystem. Understanding insecticides interaction with plants and pests at agriculture ecosystems is very much essential in the view of conservation of native flora and fauna that is likely to be one of the key areas for supporting local butterfly population [43]. Since, agriculture landscapes are the patches of man-made ecosystems harbor certain wild flora and fauna with limited species diversity [61]. In agriculture ecosystem, the landscape is grown with different crop types, which are used by different species of insects including butterfly species for foraging, roosting, breeding and resting activities [62]. Although, this type of studies would provide base-line scientific information on butterfly species survivorship at pesticide sprayed agriculture ecosystems, scientific data generated during the present study could help conduct further in depth studies to make strategies to conserve the native butterfly species amidst agriculture ecosystems.

Conclusion: Butterflies are flagship species at various ecosystems; their presences amidst agriculture ecosystems help reveal the healthy status of an ecosystem. Therefore, it is high time to think about native butterfly species to restore local biodiversity.

Acknowledgement
We thank The Director, Chamarajanagar Agricultural Research Institute, Haradanahalli for providing information. Thanks are also due to The Chairman, Department of Studies in Zoology, University of Mysore, Mysore for the facilities extended during the conduct of this work.

References
1. Pullin AS, McLean IF, Webb MR. Ecology and conservation of *Lycaena dispar*: British and European perspectives. In: Ecology and Conservation of Butterflies, 1995, 150-164.
2. Van Swaay C, Warren M. Red data book of European butterflies (Rhopalocera). Council of Europe, 1999, 1-100.
3. Kearns CA, Inouye DW, Waser NM. Endangered mutualisms: the conservation of plant-pollinator interactions. Annual Review of Ecology and Systematic. 1998; 1:83-112.
4. Kevan PG, Viana BF. The global decline of pollination services. Biodiversity. 2003; 1, 4(4):3-8.
5. Naranjo SE. Long-term assessment of the effects of transgenic Bt cotton on the abundance of no target arthropod natural enemies. Environmental Entomology, 2005; 1, 34(5):1193-210.
6. Steffan-Dewenter I, Westphal C. The interplay of pollinator diversity, pollination services and landscape change. Journal of Applied Ecology, 2008l; 1, 45(3):737-41.
7. Basavarajappa S. Studies on the impact of anthropogenic interference on wild honeybees in Mysore District, Karnataka, India. African Journal of Agricultural Research. 2010; 8, 5(4):298-305.
8. Winfree R, Bartomeus I, Cariveau DP. Native pollinators in anthropogenic habitats. Annual Review of Ecology, Evolution and Systematics. 2011; 4, 42(1):1.
9. Goulson D. Review: An overview of the environmental risks posed by neonicotinoid insecticides. Journal of Applied Ecology. 2013; 1, 50(4):977-87.
10. Hanley ME, Wilkins JP. On the verge? Preferential use of road-facing hedgerow margins by bumblebees in agro-ecosystems. Journal of Insect Conservation, 2015; 1, 19(1):67-74.
11. Thomas JA, Bourn NA, Clarke RT, Stewart KE, Simcox DJ, Pearman GS *et al*. The quality and isolation of habitat patches both determine where butterflies persist in fragmented landscapes. Proceedings of the Royal Society of London: Biological Sciences. 2001; 7, 268(1478):1791-6.
12. Klein BA, Olzsowy KM, Klein A, Saunders KM, Seeley TD. Caste-dependent sleep of worker honey bees. Journal of Experimental Biology. 2008; 15, 211(18):3028-40.
13. Ghazoul J. Floral diversity and the facilitation of pollination. Journal of Ecology. 2006; 1, 94(2):295-304.
14. Gallai N, Salles JM, Settele J, Vaissière BE. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecological Economics. 2009; 15, 68(3):810-21.
15. Potts SG, Biesmeijer JC, Kremen C, Neumann P, Schweiger O, Kunin WE. Global pollinator declines: trends, impacts and drivers. Trends in Ecology and Evolution, 2010; 30, 25(6):345-53.
16. Vanbergen AJ. Threats to an ecosystem service: pressures on pollinators. Frontiers in Ecology and the Environment, 2013; 1, 11(5):251-9.
17. Goulson D, Hanley ME, Darvill B, Ellis JS. Biotope associations and the decline of bumblebees (*Bombus* spp.). Journal of Insect Conservation. 2006; 1, 10(2):95-103.
18. Winfree R, Aguilar R, Vázquez DP, LeBuhn G, Aizen MA. A meta-analysis of bees' responses to anthropogenic disturbance. Ecology. 2009; 1, 90(8):2068-76.
19. Rands MR, Sotherton NW. Pesticide use on cereal crops and changes in the abundance of butterflies on arable farmland in England. Biological Conservation. 1986; 1, 36(1):71-82.
20. Feber RE, Firbank LG, Johnson PJ, Macdonald DW. The effects of organic farming on pest and non-pest butterfly abundance. Agriculture, Ecosystems & Environment. 1997; 31, 64(2):133-9.
21. Saarinen K. A comparison of butterfly communities along field margins under traditional and intensive management in SE Finland. Agriculture, Ecosystems & Environment, 2002; 30, 90(1):59-65.
22. Mattila N, Kotiaho JS, Kaitala V, Komonen A, Paivinen J. Interactions between ecological traits and host plant type explain distribution change in noctuid moths. Conservation Biology. 2009; 1, 23(3):703-9.
23. Ehrlich PR. Ecological economics and the carrying capacity of earth. Investing in natural capital (AM. Jansson, M. Hammer, C. Folke & R. Costanza, Eds.). Island Press, Washington. 1994, 1.
24. Kindvall O, Ahlen I. Geometrical factors and metapopulation dynamics of the bush cricket, *Metrioptera bicolor* Philippi (Orthoptera: Tettigoniidae). Conservation Biology, 1992; 1, 6(4):520-9.
25. Hanski I. A practical model of metapopulation dynamics. Journal of Animal Ecology. 1994; 1:151-62.
26. Jansson G, Angelstam P. Threshold levels of habitat composition for the presence of the long-tailed tit (*Aegithalos caudatus*) in a boreal landscape. Landscape Ecology. 1999; 1, 14(3):283-90.
27. Summerville KS, Crist TO. Effects of experimental habitat fragmentation on patch use by butterflies and skippers (Lepidoptera). Ecology, 2001; 1, 82(5):1360-70.
28. Hanski I, Ovaskainen O. The metapopulation capacity of a fragmented landscape. Nature, 2000; 13, 404(6779):755-8.
29. Weibull AC, Bengtsson J, Nohlgren E. Diversity of butterflies in the agricultural landscape: the role of farming system and landscape heterogeneity. Ecography, 2000; 1, 23(6):743-50.
30. Söderström BO, Svensson B, Vessby K, Glimskär A. Plants, insects and birds in semi-natural pastures in relation to local habitat and landscape factors. Biodiversity & Conservation. 2001; 1, 10(11):1839-63.

31. De Niceville L. The Butterflies of India, Burmah and Ceylon. Рипол Классик, 1890, 22-54.
32. Tiple AD, Khurad AM. Butterfly species diversity, habitats and seasonal distribution in and around Nagpur City, central India. World Journal of Zoology, 2009; 4(3):153-62.
33. Solman Raju AJ, Rao PS. A case study on the decline of butterfly colonies in habitats of Vishakhapatnam. Bulletin of Andhra University Research Forum. 2002; 7(10):57-59.
34. Kunte K. India - A Lifescape: Butterflies of Peninsular India. Indian Academy of Sciences, Bangalore, Universities Press. 2000, 14-32.
35. Ollerton J, Winfree R, Tarrant S. How many flowering plants are pollinated by animals? Oikos, 2011; 1, 120(3):321-6.
36. Kunte K, Sondhi S, Sangma BM, Lovalekar R, Tokekar K, Agavekar G. Butterflies of the Garo Hills of Meghalaya, northeastern India: their diversity and conservation. Journal of Threatened Taxa, 2012; 12, 4(10):2933-92.
37. Dufrene M, Legendre P. Species assemblages and indicator species: the need for a flexible asymmetrical approach. Ecological Monographs, 1997; 1, 67(3):345-66.
38. Pollard E, Moss D, Yates TJ. Population trends of common British butterflies at monitored sites. Journal of Applied Ecology. 1995; 1:9-16.
39. Kunte KJ. Seasonal patterns in butterfly abundance and species diversity in four tropical habitats in northern Western Ghats. Journal of Biosciences, 1997; 1, 22(5):593-603.
40. Guptha MB, Rao PVC, Reddy DS, Maddala SRSCS, Babu PM. A preliminary observation on butterflies of Seshachalam Biosphere Reserve, Eastern Ghats Andhra Pradesh, India. World Journal of Zoology, 2012; 7(1):83-89.
41. Caldas A, Robbins RK. Modified Pollard transects for assessing tropical butterfly abundance and diversity. Biological Conservation. 2003; 30, 110(2):211-9.
42. Sodhi NS, Koh LP, Brook BW, Ng PK. Southeast Asian biodiversity: an impending disaster. Trends in Ecology & Evolution, 2004; 31, 19(12):654-60.
43. Longley M, Sotherton NW. Factors determining the effects of pesticides upon butterflies inhabiting arable farmland. Agriculture, Ecosystems & Environment. 1997; 31, 61(1):1-2.
44. Pekin BK. Effect of widespread agricultural chemical use on butterfly diversity across Turkish provinces. Conservation Biology, 2013; 1, 27(6):1439-48.
45. Evans WH. The Identification of Indian butterflies. (II Eds). Journal of Bombay Natural History, Mumbai. 1932, 54.
46. Gunathilagaraj K, Perumal TNA, Jayaram K, Kumar MG. Some South Indian Butterflies. Nilgiri Wildlife and Environment Association, Tamil Nadu, India. 1998, 274.
47. Kehimkar I. The Book of Indian Butterflies. Bombay Natural History Society. Oxford University Press. Mumbai. 2008, 61-445.
48. Mathew G, Rahamathulla VK. Studies on the butterflies of the Silent Valley National Park, Kerala, India. Entomon, 1993; 18:185-192.
49. Jayson EA, Mathew DN. Structure and composition of two bird's communities in Souter Western Ghats. Journal of Bombay Natural History Society. 2002; 99(1):8-29.
50. Saha TK. Biostatics in Theory and Practice. Emkay Publications, Delhi, 2002, 1-100.
51. Magurran AE. Measuring Biological Diversity. John Wiley and Son's, UK. 5-48.
52. Brittain CA, Vighi M, Bommarco R, Settele J, Potts SG. Impacts of a pesticide on pollinator species richness at different spatial scales. Basic and Applied Ecology, 2010; 31, 11(2):106-15.
53. Dutt DN. Residual toxicity and dissipation of residues of Monocrotophos and Endosulfan on mustard, cowpea and cabbage. Ph.D. Thesis, IARI, New Delhi. 1977, 55-63.
54. Pandey SY, Jain HK, Agnihotri NP, Dewan RS, Saxena HP. Residues from foliar application of carbophenothrin tetrachovinphos, dicrotophos and Endosulfan on Bengal gram (*Cicer arietinum*). Indian Journal of Plant Protection. 1977; 5(1):45-50.
55. Vyas HN. Toxicological and persistence studies of some insecticides in relation to pest complex of green-gram. Ph.D. Thesis. IARI, New Delhi, 1977, 63-72.
56. Chaudhary H. Studies on the toxicity, residues and allied properties of some insecticides against pest of soybean (*Glycine max* Merril). Ph.D. Thesis, Rajasthan Agri. Uni. Udiapur. 1990, 34.
57. Agarwal SK. Pesticide Pollution. A.P.H. Publishing Corporation, New Delhi. 2009, 120-121.
58. Moreby SJ, Southway SE. Influence of autumn applied herbicides on summer and autumn food available to birds in winter wheat fields in southern England. Agriculture, Ecosystems & Environment, 1999; 22, 72(3):285-97.
59. Tiple AD, Khurad AM, Dennis RL. Butterfly diversity in relation to a human-impact gradient on an Indian university campus. Nota Lepidopterologica, 2007; 30(1):179.
60. Kleijn D, Verbeek M. Factors affecting the species composition of arable field boundary vegetation. Journal of Applied Ecology, 2000; 1, 37(2):256-66.
61. Hannon LE, Sisk TD. Hedgerows in an agri-natural landscape: potential habitat value for native bees. Biological Conservation. 2009; 31, 142(10):2140-54.
62. Klein AM, Vaissiere BE, Cane JH, Steffan-Dewenter I, Cunningham SA, Kremen C, Tscharntke T. Importance of pollinators in changing landscapes for world crops. Proceedings of the Royal Society of London B: Biological Sciences. 2007; 7, 274(1608):303-13.