Influence of Frequent used Pesticides on Population diversity species and environment interaction of Reduviidae (Hemiptera) Fauna in four Agro forest ecosystems of Campierganj, Uttar Pradesh, India.

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Abstract:

Demographic record of reduviid predators, *Rhynocoris fuscipes*, *marginatus*, *Acanthaspis megaspilla*, *Coranus spinicutis*, *Ectomoris atrox* and Black species from Campierganj agro forest ecosystem in Gorakhpur district, Uttar Pradesh, revealed the pesticides- Fungicide, Mancozeb; Herbicide- Sodium Acifluorfen and Insecticide- Alphamethrin and meteorological factors influenced the population dynamics this predators. Only one genus *Rhynocoris* was recorded in pesticide applied categories and dominated reduviid in agro ecosystem. *Acanthaspis megaspilla* was found only in forest ecosystem. Wild mustard is sheltering plant of *Rhynocoris* genus. Populations of these bugs were adequate and moderate in July, August month except *A. megaspilla*. Richnes indices (S= 6, 2; R_1= 0.86, 0.4 R_2= 0.32, 0.60) and Diversity indices (ƛ= 0.17, 0.45 H'= 1.39, 0.68, N_1= 4.01, 1.97 and E_1= 0.77, 1.04) were find out.

Key words: Application, Pesticide, Biocontrol agent, Population dynamics, Campierganj, agroecosystem.

Introduction

Population dynamics of predator is a component that negotiates with seasonal difference in immigration of population of one or more insect species in search of food, mate, shelter and tolerance of different climatic factors at particular time period (Personal observation). Population dynamics is the portion of ecology that deals with the variation in time and space population size and density for one or more species (Begon et al, 1900). Population dynamics having two broads components: first, Quantitative description of the changes in population growth or decline for a particular organisms and second, components investigations of the forces and biological and physical processes causing those changes (Juliano, 2007). Reduviidae family mainly consists of predaceous bugs which is generalist predator on wide array of the insect pests. Reduviids are potential biological control agents (Ambrose, 1995). The population density of a particular species of predatory reduviid in particular ecosystems depends upon the biotic and a biotic factor (Goel, 1978; Ambrose and Livingstone, 1978, Ambrose, 1980; Thangavelu, 1983; Haridass, 1987). Pesticides viz., Insecticides, Fungicides, Herbicides etc., are combination of one or more biological or synthetic chemical which interfere with normal body physiology of target as well as non-target species and causes death or abnormalities. Residues of pesticides pollute substrate of agro forest ecosystem. Pesticides are combination of one or more biological or synthetic chemical which interfere normal body physiology of target as well as non-target species and causes death or abnormalities. Residue of pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, mitigating any pest (insects, mites, nematodes, weeds, rats etc.) including insecticide, herbicide, fungicide and various other substances used to control pests (Giliomee, 2009). Population dynamics of reduviid fauna in Courtallum tropical rain forest, Western Ghats and in Maruthuvazhamalai scrub jungle of Southern India were studied by Ambrose (1990; 1996). Influence of variation of Habitat, Season and Prey on the Distribution and Diversity of Reduviid Predators (Hemiptera: Reduviidae) in Southern Western Ghats of Tamil Nadu described by Madasamy et al (2023). Population dynamics of the predator *Alloeocranum biannulipes* Montrouzier and Signoret (Hemiptera: Reduviidae) feeding on the larger grain borer, *Prostephanus treincatus* (Horn) (Coleoptera: Bastrichidae), infesting cassava chips informed by Loko et al (2020). The population dynamics of reduviid bugs were influenced by frequent exposure of pesticide application (Personal observation). The present investigation informed the impact of commonly used pesticides- Herbicides (Sodium Acifluorfen, Bispyribac- Sodium etc.), Fungicides (Mancozeb, Carbendazim etc.), Insecticides (Alphamethrin, Thiamethoxam etc.) by agricultural practitioners on population dynamics of reduviid bugs in Campierganj agro forest ecosystem of Gorakhpur district, Uttar Pradesh, India.

Experimental Procedures

Study Area:

Compierganj (27º1’44.32” N83º16’0.63E) is located in the North – Eastern region of Gorakhpur district,

Uttar Pradesh, India having a wide range of agro forest plantation ecosystem. This study area was divided into four zones covering in 10 km range. The study zones are Bajaha, Dharmadih, Aamghat and Alagatpur. Furthermore, each study zones were divided into two categories first one is pesticides applied field as treated and second one is without any pesticide applied field as control. This habitat is characterized by loamy, sandy soil, crops like – Okra, *Abelmuschus esculentus* (Malvaceae), Chili, *Capsicum frutescens* (Solanaceae), Yard long bean, *Vigna unguiculata* (Leguminaceae), Ridge gourd, *Luffa* (Cucurbitaceae) etc. Plantation tree namely Mango, *Mangifera indica* (Anacardiaceae), Bamboo, *Bambusa vulgaris* (Poaceae) etc. additionally forest plantation like- Sal, *Shorea robusta* (Dipterocarcapeae), many other grasses and shrubs nearest to wide canal Dhamina which is connected to Rohin River. During field visits the meteorological factors such as temperature, relative humidity and wind velocity measured by using digital thermometer, hygrometer and aeneamometer. Richness indices (S= Species richness, Margalef index (R_1): S – 1/ In(n), Menhinick index (R_2=): S/√n) and Diversity indices (Simpson's index (ƛ): $\sum^{s}_{i=1} n_i (n_i - 1)/ n (n-1)$, Shannon- Weiner index (H')= - $\sum (p_i \text{ In } p_i)$, Hill's diversity numbers – No= S, N_1=eH, N= 1/ƛ and Evenness indices E_1= In(N_1)/In(N_0), E_2= N_1/N_0, E_3= $N_1 - 1/N_0$- 1, E_4= N_2/N_1 and E_5= $N_2 - 1/N_1$- 1) were calculated by using above formulae (Ambrose, 2004).

Result and Discussion

Totally 339±62.9 and 11±0.5 number of reduviid predators belonging to five genera viz., *Rhynocoris*, *Coranus*, *Acanthaspis*, *Ectomocoris* and *Back species* were recorded in control categories and pesticides applied categories of Campierganj agro forest ecosystem, respectively. The genus *Rhynocoris* was widely distributed into agro ecosystem but, rarely in forest ecosystem. Only one genus of reduviid predator, *Rhynocoris* was reported into pesticides applied agro ecosystem. *Acanthaspis megaspilla* was recorded only in forest ecosystem under the fallen leaves, soil particles in shrubs of forest at nymphal stages and inside bark of Sal tree at adult stages. Other five genera of reduviid predators were found on tender leaves of seasonal crops, mosquito net, under dry fallen leaves and inside moist soil cracks or particles. In general all life stages and eggs clusters of *R. fuscipes* and *R. marginatus* was found on leaves of a sheltering herb, *Cleome viscose* Linn. The fluctuation in meteorological factors such as relative humidity, rain fall, and wind velocity and temperature and prey population influenced the number of reduviid predators. Adequate numbers of reduviid predators were recorded during moderate climatic factors table (1, 2, and 3). The wild mustard, *Cleome viscose* was grew up border of agro ecosystem and randomly in field. Hence, generally reduviid predators were collected from border of agro ecosystem. The adequate number of *Rhynocoris fuscipes*, *R. marginatus*, *Coranus spinicutis* and *Ectomocoris atrax* were recorded in July, August, October and September months except April, May, June, November to February months because of the fluctuation in climatic factors and harvesting season of crops in agro forest ecosystem. On another hand, *Acanthaspis megaspilla* and Black species were recorded in April, May and June month in forest ecosystem because of little fluctuation in climatic factors of forest ecosystem. Insects are poikilothermic in nature. Hence, reduviid predators undergo aestivation and hibernation in

summer (April, May, June) as well as winter (November to February) season. Consequently population of reduviid predators was declined and finally disappeared continuity missing (Personal observation). In Population dynamics of reduviid predators: Richness indices (S= 06, R_1= 0.86, R_2= 0.32) and Diversity indices (ƛ= 0.17, H'=1.39, No= 6, $N_{1=}$ 4.01, N_2= 5.8, E_1= 0.77, E_2= 0.66, E_3= 0.60, E_4= 1.44 and E_5= 1.59) in control categories as well as (S= 02, R_1= 0.41, R_2= 0.60) and (ƛ= 0.45, H'= 0.68, No= 02, N_1= 1.97, N_2= 2.22, E_1= 1.04, E_2= 0.98, E_3= 0.97, E_4= 1.12 and E_5= 1.25) in pesticides applied categories of agro forest ecosystem of Campierganj.

Table 1: Represent month and habitat wise collection of Reduviid predators from November- 23 to October- 24 in both pesticides treated and control categories agro forest ecosystem of Campierganj

Month	Agro forest ecosystem						
	Bajaha		Dharmadiha		Aamghat		Alagatpur
	Treated cat.	Control cat.	Treated cat.	Control cat.	Treated cat.	Control cat.	Only Control
	A,B,C,D, E,F	A,B,C,D, E,F	A,B,C,D, E,F	A,B,C,D, E,F	A,B,C,D, E,F	A,B,C,D, E,F	A,B,C,D, E,F
Jan	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	-, -, -, -, -, -
Feb	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	-, -, -, -, -, -
Mar	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	-, -, -, -, -, -
Apr	- - - - - -	3,2,-, -, -,2	- - - - - -	2,-, -, -,2, -	- - - - - -	2,1,-,-, 1,12	-, -,7, -, 1, -
May	- - - - - -	5,3,-, -, 2, 1	- - - - - -	-, -, -, -, -, 1	- - - - - -	-, -, -, -, 2, 8	-, -, 12, -, 2,-
Jun	- - - - - -	- - - - - - -	- - - - - -	-, -, -, -,-, 2	- - - - - -	-, -, -, -, 1, 11	-, -, -, -, -, -

Jul	2, 3, - - - - -	6,4,-, -,1, 2	- - - - - -	12,-, -, 5,-, -	- - - - - -	6,4,-,12, -, -	-,-,11,-,-,-
Aug	3,3,- - - - -	4, 2,-, 8,2,-	- - - - - -	11,6,-, 6,-, -	- - - - - -	5, 2, -, 3, 1, 6	-, -,13, -, 2,-
Sep	- - - - - -	5,7,-, 3,-, -	- - - - - -	7,5, -, 3,-, -	- - - - - -	6, 8, -, 2, 5, -	-, -, 9, -, 1, -
Oct	- - - - - -	3, 5,-,2,-, -	- - - - - -	6,4, -, 4,-, 1	- - - - - -	4, 2, -, 3, 1, 2	1, -, -, -, -, -
Nov	- - - - - -	- - - - - -	- - - - - -	-, -, -, -, -, -	- - - - - -	- - - - - -	-, -, -, -, -, -
Dec	- - - - - -	- - - - - -	- - - - - -	-, -, -, -, -, -	- - - - - -	- - - - - -	-, -, -, -, -, -

A= *Rhynocoris fuscipes*, B= *Rhynocoris marginatus*, C= *Acanthaspis megaspilla*, D= *Coranus spiniscutis*, E= *Ectomocoris species*, F= *Black species*

Similarly Rabeesh et al, 2024 suggested that natural enemies of Tea mosquito bug especially the *R. marginatus*, *Sycanus collaris*, *Odontomantis* sp. *Episyrphus* sp. *Orthetrum sobina* etc. population were declined after spraying of pesticides. Ambrose, 1993 pointed that peak population of *A. pedestris* recorded in July 1988, population of *E. slateri* was found during August and September. Most dominated reduviids were *Rhynocoris fuscipes* and *Edocla slateri* than other reduviids reported by Madasamy et al, 2023. Murugan, 1988 and Ravichandran, 1988 recorded 317 reduviid species from Indian faunal limits. Thanasingh and Ambrose, 2006 recorded that reduviid population was directly influenced by a number of a biotic factors in scrub jungles as well as semi- arid zones Exposure to pesticides can profoundly alter zooplankton community dynamics (Almeida et al, 2003). Pesticides released to the environment can indirectly affect target and non- target species in ways that are often contrary to their intended use (Bayo, 2021). We were suggested from the above recorded result that pesticides adversely effect the population of reduviid predators. Hence, population of reduviid predators inversely proportional to application of pesticides in agro forest ecosystem.

Table 2 Represent Total Number of Different genera and species of Reduviid Predators in four habitat of Campierganj Agro forest Ecosystem

Reduviid Predator	Agro forest								Sum ±SD
	Bajaha		Dharmadiha		Aamghat		Alaghatpur		
	Treated	Control	Treated	Control	Treated	Control	Treated	Control	
R. fuscipes	05	26		38	-	31	-	01	101±12.5
R. marginatus	06	23		15	-	18	-	-	62±8.9
A. megaspilla	-	18		-	-	-	-	52	52±17.1
C. spinicutis	-	07		22		11	-	-	51±8.7
B. species	-	05		04		38	-	-	55±12.1
E. atrox	-	-		02		11	-	06	18±3.6

Table Represent Meteorological data of Campierganj Agro forest ecosystem from November-23 to October- 24

Month	Temperature (ºC)		Relative humidity (%)		Wind velocity Km/h	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Nov. 23	30.3	14.0	87	60		--
Dec. 23	25.7	8.9	97	70		--
Jan. 24	24.1	5.2	92	65		--

Feb. 24	30.8	8.0	78	63		--
Mar. 24	36.6	12.7	55	38	4.7	1.8
Apr. 24	37.0	21.0	52	38	17.2	6.3
May 24	37.5	20.0	53	37	10.2	1.4
Jun. 24	38.2	25.0	50	32	8.1	2.0
Jul. 24	30.4	22.0	80	75	12.1	4.2
Aug. 24	30.8	22.7	80	72	3.8	2.5
Sep. 24	33.0	22.3	65	55		--
Oct. 24	35.0	20.1	61	65		--

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