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A study on the Guild Interaction of predator natural Enemies in a rice field

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ABSTRACT

The present study make known that intraguild and interguild antagonism have a number of baneful sound effects in moribund the major pest density in rice field. **Study design:** Random quadrate sampling was performed at the peak season (October 2016-December 2016 and October 2017-December 2017) for two successive kharif crop year (2016-2017) in the insecticide unprocessed regions of rice field for surveillance and assortment of samples. **Results:** *Agriocnemis pygmaea* (Rambur) is the leading species out of all odonata samples. Three distinguished spider guilds were observed namely, orb-weaver, space-weber and hunting spider. Orb-weavers, *Tetragnatha mandibulata* Walck are especially copious. Most prevalency (21.78%) of *Lycosa pseudoannulata* Boes was observed. This was followed by *Atypena formosana* Oi (16.33%) and *Argiope catenulata* Dole (14.56%) in descending order. Quite a lot of predators are also usually found like, *Coccinella septempuntata, Menochilus sexmaculata* and *Micrapsis discolor* etc. **Conclusion:** Fortification of omnivore's results due to affluence of predator population in the rice field as bio-control agents.

Key words : *Predator guild (Intra and Inter), Agriocnemis pygmaea, Tetragnatha mandibulata Lycosa pseudoannulata, Coccinella, Bio-control agents.*

Introduction

Ecological guild is any species that exploit the same resources (Simberloff and Dayan, 1999; Williams and Hero, 1998). It has no stringently defined boundaries. Guilds are named in relation to locations, attributes, actions of components species, mobility, mode of acquiring nutrients and zones of habitat that they occupy or otherwise exploit. Unsystematic use of insecticides for controlling insect pest damage agro ecosystem via proliferating pests through the decline in natural animal population (Fritz *et al.*, 2011). Under modern IPM practices insect pest suppression by need based application of insecticides together with the adoption of eco friendly cultural practices are very much convincing. A variety of management practices were also employed by IPM programmers. It is worthwhile to understand the true level of compatibility of different pest control strategies used together in tropical rice agriculture (Way and Heong, 1994). Spider's, dragonflies and other pest predators diversity was affected in the rice field by the disproportionate apply of insecticides in terms of species richness, species composition, abundance and feeding guild. Control of pest population by biological means is very much encouraging. There was significantly more species richness to dragonflies, damselflies, spiders and others in untreated rice field. Spider and odonata collectively form the predatory guild to check the pest population. Here our aim of study hypothesized that intraguild and interguild predation might have some crucial effect for the interactive behavior on major pest density in rice field.

Materials and Methods

Geographic location and agro-climatic conditions of the study area

In order to observe the major spider and odonata population and *vis-a-vis* intra and inter guild competition, a field observation was carried out at Raiganj [26°35′15″(N) – 87°48′37″ (W)], Uttar Dinajpur, West Bengal for two successive *kharif* crop year (2016-2017) in insecticide untreated field.

The area belongs to upper *Gangetic* zone. The climate of this zone is sub-tropical humid in nature. The season of this area is broadly classified in three groups, viz, dry and warm (March-May), wet and warm (June-October), dry and cool (November-February) respectively. The monsoonal rain by and large sets in by the middle of June and recedes by middle of September. The average annual rain fall varies from 2100 to 3000 mm, the maximum rainfall occurs during the rainy months of June to September amounting to more than 80% of the total rain fall. The mean maximum temperature is usually high 38.9 ^{0}C in April and low 7.1 ^{0}C near the beginning part of January. The relative humidity at 8:30 hours is 58% and 88% in March and July correspondingly. The relative humidity in the afternoon at 17:30 hours is 48% and 84% in March and November respectively.

Bio-control Agents in Rice Field

Our field observation was focused on the ecological guild interactions in the rice field. Different significant ecological guilds of predators exist there (e.g. predaceous dragon fly, spider and beetles). Modern IPM frameworks become much more attractive owing to several features of this intra guild and inter guild competition (Riechert and Lockley, 1984; Nyffeler *et al.,* 1994). Lycosid wolf spider *Lycosa pseudoannulata* acts as a predator on different rice pest at high densities (30 adults/m^2) during early season when pest outbreaks begins and when more specialized natural enemies would be at low density (Way and Heong, 1994; Settle *et al.,* 1996).

Period of observation: The study was conducted for a period of 2 following crop years, 2016-2017 in insecticide untreated field. Sampling was done in 2 seasons, October 2016-December 2016 and October 2017-December 2017. Kharif season is notable for low rainfall and dry weather (Menon *et al.,* 2000).

Sampling method

Direct visual observation method was adopted to evaluate the dragonfly, spider and other species populations. In the rice field a total of 16 quadrates (size 4mx4m) were selected randomly in different locations. The random squares were marked by the poles. Observation was made in each quadrate once in a week during sun-drenched day between 9.30 to 11.30 hours. A total of 24 time's visual searching method (12/year) was performed in the untreated rice field.

Collection, Identification and preservation of the samples

The collected specimens were brought to the Department of Zoology, University of Gour Banga, Mokdumpur, Malda for identification. The number of dragonflies, spiders, beetles and others found in the field was recorded through hand picking, sweep netting and by visual observation. Some specimens were killed by putting them in a jar with CCl_4 and then finally counted under microscope. From ground areas and plant terminals spiders was collected. Whenever there was an uncertainty in species identification one or two individuals of the respective species were collected and stored in Odiman's preservative (90 parts 70% C_2H_5OH, 5 parts glycerol and 5 parts glacial acetic acid) in glass vials as Voucher specimens. Later identification was facilitated with the help of a taxonomic key provided by (Frasser, 1933, 1934, 1936; Walker, 1933, 1958; Needham and Westfall, 1954; Walker and Corbet, 1975; Westfall *et al.,* 1996; Subramanian 2005, 2009).

Prey collection from the web

Once more by three promising investigating method prey collection and web weaver's quantification was done, namely (1) Prey entangled in the web (2) Dead prey's external skeleton in the web and (3) Wrapped packages found in the web. Prey species were identified by collecting the insects and its body parts. Identification was performed by using the key of Ramalingam, 2003.

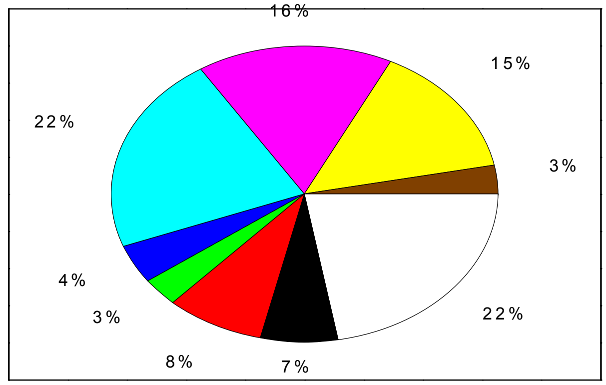
Acquisition of the Document

Photography is the only unswerving technique to preserve color in odonata, spider and others (beetles, stem borer etc) for later reference and recognition. A depiction allows one to observe the insect long after the field visit is over. Studying a shoot in detail may disclose fine points in color, structure and behavior that were missed in their natural habitat and help to contribute in detection. Picture making also provides with the prospect to distribute experiences and try to find the input of other enthusiasts. Photographs will be compulsory to authenticate and establish the record of a new or strange species at the studying area. Collection will be indispensable to validate and establish the presence of new species in that region. Since the colors of the adults may be faded or changed after preservation, thus photographs of the adults were taken either just after collection or in the field by using SONY-HD 18.2 MEGA PIXELS DSC-HX20Vdigital camera.

Results

In deliberation of odonata population, damselfly dominated in number than dragon flies. Of all the species of odonata, *Agriocnemis pygmaea* (Rambur) appeared as the dominant species representing more than 32% of the collected odonata samples. Other recognized species was *Agriocnemis femina.* Categorically, three prominent spider guilds, orb-weavers, space-webers and hunting spiders under the present observation were noted. Orb-weavers, *Tetragnatha mandibulata* Walck. followed by *T. japonica* are chiefly abundant in the rice fields. *Oxyopes javanus* Thorell and *Lycosa pseudoannulata* Boes & Strand are less abundant in uplands compared with in low lands. Irrespective of the environments, Space-web spider, *Atypena formosana* Oi dominates in all the fields. In the area of observation, *L.pseudoannulata* is most rampant approximately accounting 21.78% in the paddy fields. This was followed by *Atypena formosana* Oi (16.33%) and *Argiope catenulata* Dole (14.56%) in descending order (Diagram 1). Coccinellid predators like *Coccinella septempunctata, Menochilus sexmaculata and Micrapsis discolor* are further common.

In rare instance, individual odonate fly entrapped in spider web was observed (Fig.1a). Instances were also recorded where coccinellid beetle was found to predate on spider (Fig.1b). Individuals of dragon fly predating on immature coccinellid beetle was also noted (Fig.1c). All of these represent intra guild predation of the predatory guild. All the



22%=*Agriocnemis pygmaea* 22%=*Lycosa pseudoannulata*
16%=*Atypena formosana* 15%=*Argiope catenulata*
08%=*Tetragnatha mandibulata* 07%=*Agriocnemis femina*
04%=*Oxyopes javanus* 03%= *Tetragnatha japonica*
03%= others

Diagram 1. Relative abundance of predators in rice field (%) during 2016-2017.

competition has imparted exploitive function on population structure. Large number of hopper population along with considerable number of yellow stem borer and brown plant hopper individuals caught in the spider web was also noted (Fig. 1d and 1e). Adults of spiders are recurrently noted to predate directly on yellow stem borer with no embellishment of the web (Fig. 1f). All the observation represent the inter guild predation of the predatory guild.

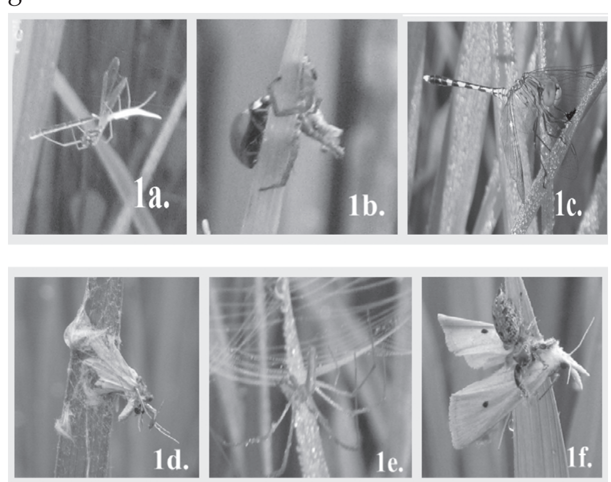


Fig. 1. (1a, 1b & 1c) - Intra guild competition 1(a): Spider predating on damsel fly, 1(b): Coccinellid beetle predating on spider, 1(c): Dragon fly predating on spider.
(1d, 1e & 1f) – Inter guild competition 1(d): Yellow stem borer entrapped in spider web, 1(e): Brown plant hopper entrapped in spider web, 1(f): Spider predating on yellow stem borer.

Discussion

In general, evaluation of food chain length or web height is the easiest way to assess the vertical diversity of a community. Vertical diversity strappingly influences magnitude and efficiency of trophic transfer. Additional web height is straightly related to ecosystem functioning (Duffy *et al.*, 2007). Finke *et al.*, 2005 and Schmitz, 2007 have reported that the diversity of predators together with intra-guild predation result to reduce their pest control functions. While Wilby *et al.*, 2005 and Byrnes *et al.*, 2006 have opined that predator richness strengthens each stage of trophic cascades. Intra-guild predation, in general, may diminish trophic cascades and results in the generation of comparatively small food webs (Denno *et al.*, 2004). But the presence of omnivores may change this effect by ontogenetic prey switching exercising effect from one trophic level to another in a large ecosystem (Deb, 1995; Polis *et al.*, 1991). For this, addition of omnivores in a given ecosystem can increase the producer biomass through trophic cascades by reducing intermediate predation pressure (Katano *et al.*, 2006). Spider abundancy in rice fields depend on the crop age. At early season spider population immigrate from the neighboring areas and their number reach maximum (70-150/m^2) in the middle of rice season when conditions are optimal. During crop harvesting they leave the field due to disturbancy. Thus their abundancy is roughly proportional to the habitat quality factor. Spiders act as biological control agents for phytophagous insects (Young and Lockley, 1985; Riechrt and Lockley, 1984; Saavedra *et al.*, 2007; Tahir *et al.*, 2009) with some species can reduce even 22% pest population/day (Tahir *et al.*, 2009). Hunter and weaver spider species can be recorded in all developmental stages of the rice culture (Ambalagan and Narayanaswamy, 1999; Bandaradeniya and Edirisinghe, 2001; Rodrigues *et al.*, 2009) and thus serve as admirable subjects for evaluating the effect of chemical substances on agro-ecosystem. A size dependent factor is concerned in intraguild and interguild predation (Diehl, 1992, 1993; Rosenheim *et al.*, 1993) where larger predators prey widely on smaller species but not vice versa. Intraguild predation (IGP) interactions along with results in prey consumption were conducted among three aphidophagous predators and their instars in combinations of two or three species i.e., *Adalia bipunctata* (2nd, 3rd and 4th larval instar), *Macrolophus pygmaeus* (2nd and 5th nymphal instar) and *Aphidoletes aphidimyza* (2nd and 3rd larval instar) in the absence and presence of extraguild prey (the aphid *Myzus persicae*). Ultimately, inequitable aphid consumption rates showed confirmation on behalf of IGP interactions between *A. aphidimyza* and *M. pygmaeus* (Devee *et al.*, 2018). Gall midge *A. aphidimyza* is an effectual predator far and wide used in aphid biological control in glasshouse crops (Messelink *et al.*, 2013; Higashid *et al.*, 2016 and Watanabe *et al.*, 2016).

Conclusion

In the rice field food web represents 'large operating system'. Subsequently increase in predator richness contributes to the enrichment of omnivores. In view of the fact that no observation and data collection was conducted from the nearby habitats, further potential studies can be done including long period and more varied methods to disclose the influence of these zones on the abundance of various predator populations in rice field suitable.

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