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Research article

IMPORTANT NATURAL ENEMIES OF PADDY INSECT PESTS IN THE UPPER GANGETIC PLAINS OF WEST BENGAL, INDIA

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ABSTRACT: Survey was conducted at six districts of northern parts of Bengal to investigate the occurrence of natural enemies of insect pests of paddy. A total of 49 predators and 7 parasitoid species were recorded. Spiders appeared to be the most abundant among the predators followed by coleopterans. Greater abundances of enemies of pests were noticed at IPM and SRI fields.

Key words: Insect pest of paddy, Natural enemies of pest, Predators

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INTRODUCTION

Plains of West Bengal offer diversified agro-ecological conditions enduring a congenial environment for rice cultivation. Studies on natural enemy of pests have been carried out in several parts of rice producing regions around the globe. Heong *et al.* [1] have recorded 46 species of predators (heteropteran bugs and spiders) and 14 species of hymenopteran parasitoids of auchenorrynnchous homopteran pests in Philippine rice fields. Barrion *et al*. [2] have also recorded about 342 species of spiders from rice having repressive action on pest population. The importance and abundance of natural enemies have not hitherto been thoroughly investigated in the rice field of the northern parts of Bengal. Therefore, importance of natural enemies as bio-control agents is hardly documented from both entomological and ecological aspect [3], [4], [5], [6], [7]. The current work was taken up to address the paucity of information on enemies of paddy pests thriving around the northern plains of West Bengal.

MATERIALS AND METHODS

Field surveys were carried out for five consecutive years (2006-2010) encompassing six districts (Cooch Behar, Jalpaiguri, Darjeeling, Uttar Dinajpur, Dakshin Dinajpur and Malda). Geographically, northern parts of West Bengal [26°35´15´´(N) – 87°48´37´´(W)] covers an area of 3140 sq. km. which is in average 15m above mean sea level. The climate of this zone is sub-tropical humid in nature. The average annual rainfall varies from 1200 to 3000 mm, the maximum rainfall occurs during the months of June to September amounting to more than 80% of the total rainfall. The annual average day and night temperatures range between 19.7 and 27.9°C with the mercury soaring even as high as 38°C in April and cascading to a low of 3°C in January. The relative humidity at 8:30 hours is 60% and 87% in March and July respectively. Major cash crop in this area is rice.

Observation encompasses almost all the paddy ecosystems like irrigated, rain-fed, deep water, shallow water, conventionally cultivated and transplanted rice fields covering all the rice growing seasons and the main growth stages of rice. Fields under system rice intensification (SRI) and integrated pest management (IPM) were also examined. Both the fields of high yielding and local cultivars were also assessed for the presence of natural enemies. Adjoining areas of rice field like edge of bund, a common roadside habitat was also observed as it serves as a source of natural enemies for the rice field.

For such field estimation basically sweep-net method was employed. Sweep-net was 3.5 cm in diameter. All the arthropods in the confined enclosure (1m x1m) were kept in vials containing 75% alcohol. In some specific cases, the eggs and larvae of the pest insects were taken to the laboratory for future emergence of the parasitoids. Field incidence was assessed by quadrate estimation (1.5m x1.5m) and also by visual counting (individuals/hill). The arthropods were identified into species, genera and families based on their roles in rice ecosystem, and sorted into guilds as described by Moran & South wood [8].

RESULTS AND DISCUSSION

In total 49 predator and 7 parasitoid species were recorded of which spiders dominated the predator group (Table-1). Incidence of predator and parasite, relative frequency, species richness and species diversity was observed to increase gradually with crop age, but declined following the crop maturity.

Proportionally, IPM and SRI Fields represented 25% and 23% of the collected natural enemy population. This was followed by conventionally cultivated fields (21%), transplanted fields (17%) and randomly transplanted fields (17%) in descending order (Figure 1).

In predatory guild, spiders were dominant group occupied over 41% which was followed by Coleoptera (29%), Hemiptera (8%), Odonata (8%), Diptera (5%), Hymenoptera (6%) and Neuroptera (2%) in descending order (Figure 2). Variability was noted in the guild composition in relation to the seasons. Three guilds of spider are found in rice ecosystem: orb-weaving spiders, hunting spiders and space-web spiders. Orb-weavers cover the families Araneidae, Tetragnathidae and Theridosomatidae. The most common orb-weaver genera are *Tetragnatha*, *Araneus* and *Argiope*. Lycosids dominate the guild of hunters, while the guild of space-web spiders contains three families Theridiidae, Linyphiidae and Agelenidae. Grossly, the dominant predators are *Pardosa* sp., *Micraspis* sp., *Cyrtorhinus lividipennis*, *Veliidae* sp. and *Mesoveliidae* sp. Moreover *P. pseudoannulata* is found to be the important predator against Brown plant hopper and can also suppresses effectively the pest population of leafhoppers, plant hoppers, leaf folders, case worms and stem borers. The egg parasitoids of yellow stem borer were predominated by *Trichogramma* sp. and *Telenomus* sp.

In conventionally tilled rice cultivations, spider habitat is distressed by flooding and puddling before transplanting. In contrary to this, in untilled rice cultivation, the structural complexity of the spider habitat is maintained by plant residues until seedling transplanting. Raising high yielding cultivar by no-tillage management systems enhanced spider assemblages through improvement of the structural complexity of the habitat and thereby providing substitute prey. In the present study, the most abundant arthropods were sampled at the late panicle formation growth stage of rice, totaling 35 species identified into 10 insect orders and 12 species of spider in all samples. The number of arthropod species significantly higher with rice growth and the diversity indices increased in the field fertilized with high doses of inorganic Nitrogen fertilizer. Incidence of *C. lividipennis* and *Micraspis* sp. were augmented significantly at the milking growth stage of rice following the high dose of Nitrogen top dressing in high yielding rice fields. Both booting and milking stages of rice supported maximum number of pest and predators. But the number and web area of dominant residential spiders *Tetragnatha* sp. and *Araneus* sp. in rice canopy significantly reduced with the increase of nitrogen fertilizer.

Rice growth stage dependent successional variation of the spider community was also noted. At early growth stage, irrespective of paddy cultivar, *P. pseudoannulata* and *C. formosana* predominated the field. Population of *L. pseudoannulata* build up during early vegetative growth stage and attained the peak at about 55 DAT (Days after transplanting), while *A. catenulata* roam the field during later tillering stage of the crop achieving the highest abundance at about 90 - 105 DAT. Incidence of *C. formosona* found maximum at mid-growth stage of the rice plant. However rice cultivation by SRI and IPM techniques harbour nearly all the spider communities irrespective of the rice growth stage. Adequate number of *T. javanas* was noted during 40 to 65 DAT. *A. catenulata* was predominant at about 85 DAT. In case of local rice cultivar, incidence of *A. catenulata* found to be more during early growth stage followed by *Plexippus* species during late growth stage. In that condition *T. javanas* was maximum at about 60-65 DAT. In plantation by random technique and seedling throwing techniques comparatively more number of *L. pseudoannulata* and *C. formosana* was observed during 50-55 and 40-45 DAT respectively. In such plantation, *A. catenulata* attained the peak in the late crop growth stages.

SRI method accommodates comparatively higher number of *L. pseudoannulata*, *C. formosana* and *Plexippus* whereas, *A. catenulata* than the other methods of crop establishment. Distribution and abundane of *T. javanas and T. bengalensis* was independent to the crop establishment methods. Throwing seedling rampantly support less number of spiders due to canopy heterogeneity. However an even distribution of *A.catenulata* was noted irrespective of the crop establishment methods.

Out of the total collection, herbivores (41%) top the list. This was followed by predators (21%), parasitoids (16%), detrivours (13%) and plankton feeders (9%) in descending order. Regional variation of the efficiency of predator (Pr) and parasitoids (Ps) were also noted (Figure 3). District-wise relative abundance of parasites (Pr) and predators (Ps) is as follows -Cooch Behar (Pr-78.11%, Ps- 21.89%), Jalpaiguri (Pr- 75.12%, Ps- 24.88%), Darjeeling (Pr- 81.23% ,Ps- 18.77%), Uttar Dinajpur (Pr-72.03%, Ps-27.97%), Dakshin Dinajpur (Pr- 70.22%, Ps- 29.78%), Malda (Pr- 78.12% ,Ps- 21.88%) (Figure 4). Grossly in consideration of natural enemy abundance IPM followed by SRI occupied the prime position. Seedling transplanting, random planting and seedling throwing ranked afterwards.

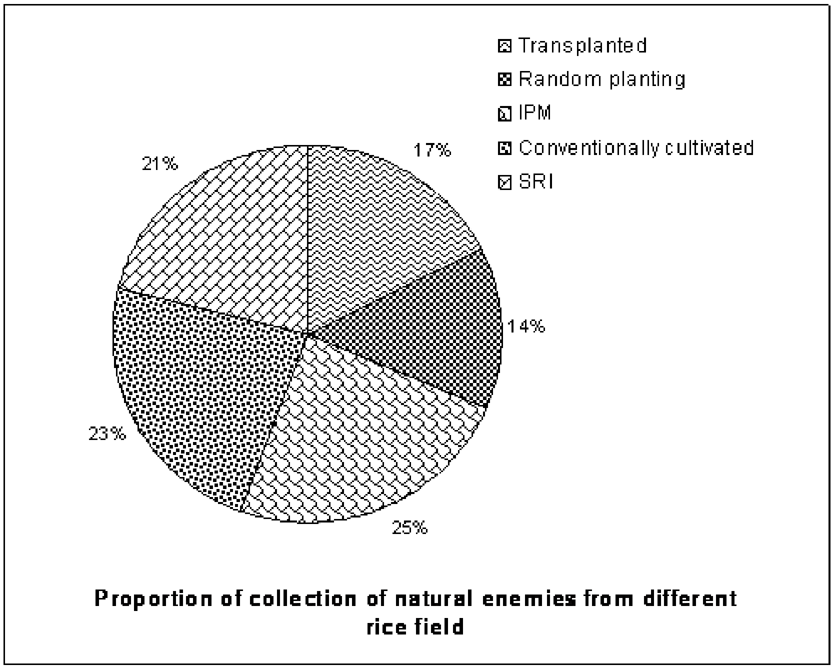

Figure 1: Proportion of collection of natural enemies from different rice fields.

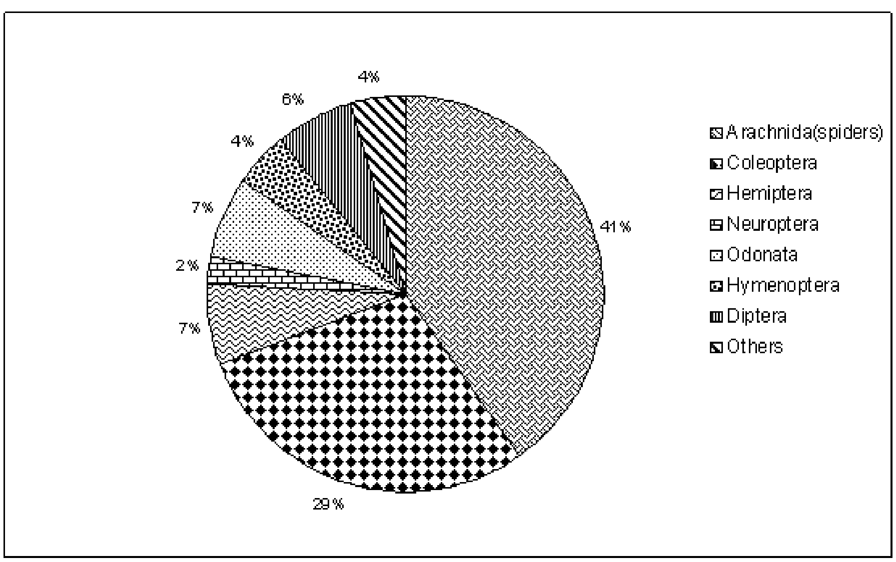

Figure 2: Relative abundance of different groups of arthropods among the natural enemies collected.

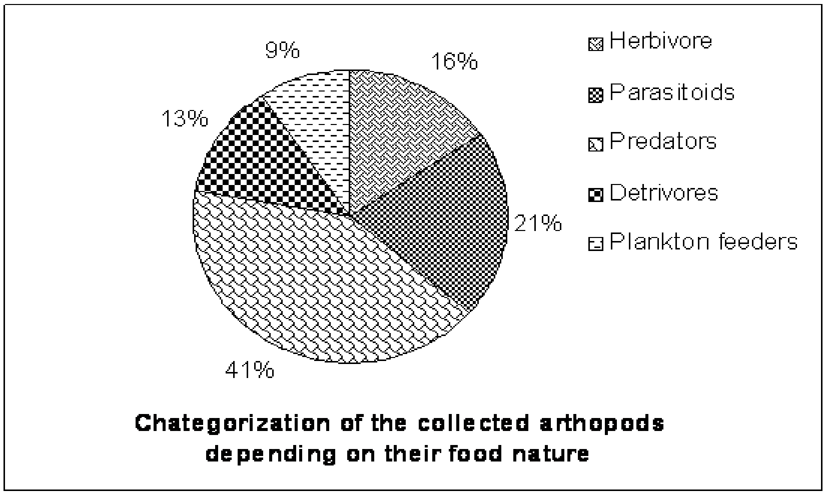

Figure 3: Categorization of the collected arthropods depending on their food nature.

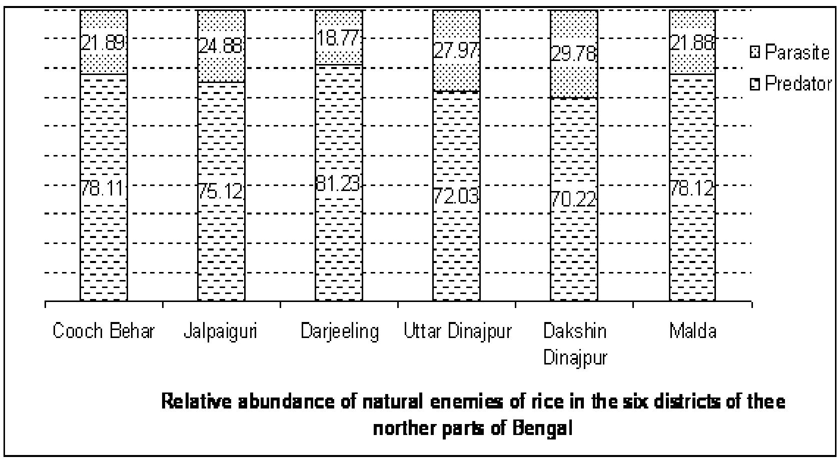

Figure 4: Relative abundance of natural enemies of rice in the six districts of the northern parts of Bengal.

Table 1. Natural enemies of the paddy at ecosystems of northern parts of Bengal.

Arthropod groups	**Scientific name**
Class:Arachnida	
Tetragnathidae	1. *Tetragnatha javanus*
	2. *Tetragnatha bengalensis*
	3. *Tetragnatha maxillosa*
	4. *Tetragnatha* sp.
Lycosidae	5. *Lycosa pseudoannulata*
	6. *Lycosa* sp.
	7. *Marpissa bengalensis*
Oxyopidae	8. *Oxyopes shweata*
	9. *Oxyopes javanus*
	10. *Oxyopes* sp.
Araneidae	11. *Cyclosa insulate*
	12. *Argiope pulchella*
	13. *Argiope catenulata*
	14. *Araneus* sp.
	15. *Neoscona bengalensis*
	16. *Neoscona* sp.
Salticidae	17. *Pardosa sumatra*
	18. *Phidippus indicus*
Attidae	19 *Plexippus* sp
Linyphidae	*20.Atypena(=calitricha) formosana*

Class : Insecta	
Order:Orthoptera	
Tettigonnidae	21. *Conocephalus longipennis*
Gryllidae	22. *Anaxipha longipennis*
Coenagrionidae	23. Agrionemis *femina*
	24. *Agrionemis pygmaea*
	25. *Ischnura aurora aurora*
	26. Ischnura *senegalensis*
	27. *Ceriagrion* sp.
Order: Coleoptera	
Carabidae	28. *Ophionea nigrofasciata*
	29. *Ophionea ishii ishii*
	30. *Ophionea indica*
	31.*Casnoidea indica*
Anthicidae	32. *Micrapsis crocea*
	33. *Harmonia* sp.
	34. *Menochilus sexmaculatus*
Cicindellidae	35. *Cicindela undulate*
	36. *Cicindela melancholia*
Order: Hemiptera	
Miridae	37. *Cyrtorhinus lividipennis*
Reduviidae	38. *Scipinia horrida*
Gerridae	39. *Limnogonus* sp.
Order:Hemiptera	
Vellidae	40. *Mesovelia* sp.
Corridae	41. *Vellidae* sp.
	42. *Limnogonus fossarum*
Order:Diptera	
Tachinidae	43. *Argyrophylax nigrotibialis*
Pipunculidae	44. *Pipunculus* sp.
Order:Hymenoptera	
Bracoinidae	45. *Macrocentrus philippinensis*
	46. *Cotesia* (*Apanteles*) *angustibasis*
	47. *Stenobracon* sp.
Eulophidae	48. *Tetrastichus schoenbii*
Chalcidae	49. *Brachymeria* sp.
Ichneumonidae	50. *Temelucha* sp.
	51. *Isotima* sp.
Scelionidae	52. *Telenomus rowani*
Trichogrammatidae	53. *Trichogramma japonicum*
	54. *Trichogramma chilonis*
	55. *Trichogramma* sp.
Order:Dermaptera	
Carcinophoridae	56. *Euborella stali*

CONCLUSION

Evidences from present field study are overwhelmly indicating that predation and parasitization by natural enemies suppress the pest population considerably.

The present results support a management strategy that promotes the conservation of existing natural biological control through a major reduction in insecticide use and the corresponding increase in habitat heterogeneity. No such field observation even of preliminary in nature was carried out in the northern districts of West Bengal. In such contemplation such work can be recognized as the bench mark in understanding the diversity of the natural enemy population.

REFERENCES

[1] Heong K L, Aquino G B and Barrion A T. 1991. Arthropod community structures of rice ecosystems in the Philippines. Bulletin of Entomological Research. 81: 407-416.
[2] Barrion A T and Litsinger J A. 1995. Rice land spiders of South and South-East Asia. CAB International, UK and IRRI, Philippines. 700pp.
[3] Bhardwaj, D and Panwar A D. 1987. Predator of rice insect pests in Chhattishgarh region, Madhya Pradesh, India. International Rice Research Notes. 12(4):35.
[4] Barrion A and Litsinger J. 1984. The spider fauna of Philippine rice agroecosystems. II. Wetland. Philippine Entomologist. 6: 11-37.
[5] Chatterjee S, Isaia M and Venturino E. 2009. Spiders as biological controllers in the agro ecosystem. Journal of Theoretical Biology. 258: 352–362.
[6] Gould E G, Kennedy G and Johnson M T. 1991. Effects of natural enemies on the rate of herbivore adaptation to resistant host plants. Entomologia experimentalis et Applicata. 58: 1-4.
[7] Way M J and Heong K L. 1994. The role of biodiversity in the dynamics and management of insect pests of tropical irrigated rice- a review. Bulletin of Entomological Research. 84: 567-587.
[8] Moran V C and Southwood T R E. 1982. The guild composition of arthropod communities in trees. Journal of Animal Ecology. 51:289-306.

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