

Natural enemies of rice insect pests in rice-wheat cropping system of northern Indo-gangetic plains

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ABSTRACT

Roving field surveys were conducted during wet seasons of 2000-2005 to assess natural enemy diversity prevalent on rice in rice-wheat cropping system (RWCS) of ten districts of Uttar Pradesh, Haryana and Uttarakhand. The results revealed that as many as 31 species of predators belonging to 22 genera under 16 families of 7 orders were recorded in traditional and basmati rice growing belt under RWCS. Damselflies, long horned grasshopper, bugs, wolf and lynx spiders were recorded in high numbers, whereas lady bird beetles, ground beetles, crickets, ripple bugs, orb spiders and long jawed spiders were recorded in moderate numbers. Sac spiders, crab spiders, earwigs and rove beetles were recorded in low numbers. Among parasitoids, 31 species including 6 unidentified species belonging to 19 genera under 11 families of Hymenoptera were recorded. Genus *Xanthopimpla*, *Trichogramma* and *Telenomus* were recorded in high numbers, whereas *Bracon*, *Cotesia*, *Stenobracon*, *Amuromorpha*, *Temelucha*, *Anagrus*, *Tetrastichus* and *Anastatus* were recorded in moderate numbers. Genus *Isotima*, *Oligosita*, *Brachymeria*, *Elasmus*, *Goniozus* and *Aphanogmus* were recorded in low numbers.

Key words: rice-wheat system, survey, pests, natural enemy diversity

In India, rice accounts for more than 40% of foodgrain production, providing direct employment to 70% people in rural areas (ICAR, 2011). Rice-wheat systems occupy 24 million hectares of cultivated land in Asia. Of this, 13.5 million hectares are in South Asia extending from the Indo-Gangetic Plains to the Himalayan foothills. Rice-wheat systems cover about 32% of the total rice area and 42% of the total wheat area in India, Pakistan, Bangladesh and Nepal. Rice-wheat cropping system (RWCS) is a major cropping system in the Indo-Gangetic Plains that covers about 11 m ha area in India, and as high as 12 tonnes ha⁻¹ productivity of rice and wheat grains has been achieved (Garg and Pathak, 2002). During the last two decades, the wide adoption of high-yielding, semi-dwarf varieties, increased use of chemical fertilizers and improved package of cultural practices in rice and wheat has considerably increased the pest problems (Atwal and Dhaliwal, 2009). Insect

pests and diseases are the major production constraints in increasing productivity of rice in rice-wheat cropping system in Uttar Pradesh, Haryana and Uttarakhand (Garg *et al.*, 2004). Farmers of this region grow basmati rice which fetches high price in domestic and export markets therefore; farmers do not hesitate to apply high quantity inputs including pesticides for managing these pests. The excessive use of pesticides in these rice growing areas has resulted in reduction of biodiversity of natural enemies, outbreak of secondary pests (Garg *et al.*, 2002). Keeping in view the above facts, roving field surveys were conducted during wet seasons of 2000-2005 to identify natural enemy diversity in rice crop in RWCS of ten districts of Uttar Pradesh, Haryana and Uttarakhand falling under Indo-gangetic plains of India.

Collection of natural enemies was done from paddy fields of 5 districts of Uttar Pradesh (Ghaziabad,

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Meerut, Muzaffar Nagar, Baghpat and Saharanpur); 2 districts of Haryana (Sonapat and Panipat) and 3 districts of Uttarakhand (Haridwar, Rishikesh and Dehradun) coming under Indo-Gangetic plains of India. Mostly the sampling was done by sweep net taking a 50 successive double stroke sweeps at 15 days interval. Immature stages and damaged hills were also collected from different fields and reared in Biocontrol laboratory of National Centre for Integrated Pest Management,

collected specimens were identified up to species level by the Division of Entomology, Indian Agricultural research institute, New Delhi, Department of Zoology, Aligarh Muslim University, Aligarh and Division of Crop Protection, Central Rice Research Institute, Cuttack. Based on the relative abundance of predators and parasitoids recorded in paddy fields they were classified into three main categories i.e. high, moderate and low (Garg *et al.*, 2008).

Table 1. Predators collected in rice ecosystem of northern Indo-gangetic plains of India (Wet season 2000 to 2005).

Common Name	Scientific Name	Order	Family	Host	Peak period of activity	Relative abundance
Dragon flies	<i>Crocothemis servilia</i>	Odonata	Libullulidae	SB, LF, PH	Aug-Sept.	High
	<i>Orthetrum sabina</i>	Odonata	Libullulidae	SB, LF, PH	Aug-Sept.	High
Damsel flies	<i>Ischnura senegalensis</i>	Odonata	Agrionidae	SB, LF, PH	Aug-Sept.	High
	<i>Agriocnemis pygmaea</i>	Odonata	Agrionidae	SB, LF, PH	Aug-Sept.	High
Lady bird beetles	<i>Harmonia octomaculata</i>	Coleoptera	Coccinellidae	LH, PH, LF	Aug-Sept.	Moderate
	<i>Micraspis discolor</i>	Coleoptera	Coccinellidae	LH, PH, LF	Aug-Sept.	Moderate
	<i>Micraspis inops</i>	Coleoptera	Coccinellidae	LH, PH, LF	Aug-Sept.	Moderate
Ground beetles	<i>Ophionea nigrofasciata</i>	Coleoptera	Carabidae	LH, PH, LF	Aug-Sept.	Moderate
	<i>Casnoidea ishii ishii</i>	Coleoptera	Carabidae	LH, PH, LF	July end-Sept	Moderate
	<i>Casnoidea indica</i>	Coleoptera	Carabidae	LH, PH, LF	July end- mid Oct	Moderate
Long horned grasshopper	<i>Conocephalus longipennis</i>	Orthoptera	Tettigonidae	LH, PH, LF	July end- mid Oct	High
Sword bearing crickets	<i>Anaxipha longipennis</i>	Orthoptera	Trigoniidae	LH, PH, LF	July end- mid Oct	Moderate
	<i>Metioche vittaticollis</i>	Orthoptera	Trigoniidae	LH, PH, SB, LF	July end- mid Oct	Moderate
Ripple bug	<i>Microvelia douglasi</i>	Hemiptera	Veliidae	LH, PH, LF	Aug-Sept.	Moderate
	<i>Mesovelia vittigera</i>	Hemiptera	Veliidae	LH, PH, LF	Aug-Sept.	Moderate
Plant and leaf bugs	<i>Cyrtorhinus lividipennis</i>	Hemiptera	Miridae	LH, PH, LF	Aug-Sept.	High
Wolf spider	<i>Lycosa pseudoannulata</i>	Araneida	Lycosidae	SB, LF, LH,PH	July end- mid Oct	High
Lynx spider	<i>Oxyopes javanus</i>	Araneida	Oxyopidae	SB, LF, LH,PH	July end- mid Oct	High
	<i>O. lineatipes</i>	Araneida	Oxyopidae	SB, LF, LH,PH	July end- mid Oct	High
	<i>O. assamensis</i>	Araneida	Oxyopidae	SB, LF, LH,PH	July end- mid Oct	High
Orb spider	<i>Argiope catenulata</i>	Araneida	Araneidae	SB, LF, LH,PH	July end- mid Oct	Moderate
Long jawed spider	<i>Tetragnatha mandibulata</i>	Araneida	Tetragnathidae	SB, LF, LH,PH	July end- mid Oct	Moderate
	<i>T. japonica</i>	Araneida	Tetragnathidae	SB, LF, LH,PH	July end- mid Oct	Moderate
	<i>T. javana</i>	Araneida	Tetragnathidae	SB, LF, LH,PH	July end- mid Oct	Moderate
	<i>T. virescens</i>	Araneida	Tetragnathidae	SB, LF, LH,PH	July end- mid Oct	Moderate
	<i>T. maxillosa</i>	Araneida	Tetragnathidae	SB, LF, LH,PH	July end- mid Oct	Moderate
Sac spider	<i>Clubiona japonicola</i>	Araneida	Clubionidae	SB, LF, LH,PH	July end- mid Oct	Low
	<i>C. lena</i>	Araneida	Clubionidae	SB, LF, LH,PH	July end- mid Oct	Low
Crab spider	<i>Thomisus</i> sp.	Araneida	Thomisidae	SB, LF, LH,PH	July end- mid Oct	Low
Earwig	<i>Euborellia stali</i>	Dermaptera	Carcinophoridae	SB, LF, LH,PH	July end- mid Oct	Low
Rove beetles	<i>Paederus fuscipes</i>	Coleoptera	Staphylinidae	SB, LF, LH,PH	July end- mid Oct	Low

LF - Leaf folder, LH - Leafhopper, PH - Planthopper, SB - Stem Borer

New Delhi for emergence of adults. Collected specimens were kept temporarily in 70% alcohol and preserved in Outman's fluid. Specimens were also preserved using paper envelopes, setting board, relaxing container and pins for dragon and damsel flies. The

During the study, the insect pests recorded attacking the rice crop at different developmental stages were leaf folder *Cnaphalocrosis medinalis* (Guen.), stem borer *Scirpophaga incertulas* (Wlk.), white backed plant hopper *Sogatella furcifera* (Horvath),

Table 2. Parasitoids recorded /collected in rice ecosystem during survey of northern Indo-gangetic plains of India (Wet season-2000-2005).

Parasitoid	Order	Family	Host	Stage Parasitized	Peak Period of activity	Relative abundance
<i>Cotesia angustibasis</i> (Gahan)	Hymenoptera	Braconidae	<i>Chaphalacroasis medinalis</i> (Guen.)	Larvae	July-Oct	High
<i>Bracon chinensis</i> (Szepligeti)	Hymenoptera	Braconidae	<i>Scirpophaga incertulas</i> (Wlk.)	Larvae	Aug-Sept	Moderate
<i>Cotesia ruficornis</i> (Halday)	Hymenoptera	Braconidae	<i>S. incertulas</i>	Larvae	Aug-Sept	Moderate
<i>C. flavipes</i> Cameron	Hymenoptera	Braconidae	<i>S. incertulas</i>	Larvae	Aug-Sept	Moderate
<i>Stenobracon oculatus</i> Szepligeti	Hymenoptera	Braconidae	<i>S. incertulas</i>	Eggs, Larvae	Aug-Sept	Moderate
<i>Amuromorpha accepta</i> (Tosquinet)	Hymenoptera	Ichneumonidae	<i>S. incertulas</i>	Eggs, Larvae	Aug-Sept	Moderate
<i>Isotima dammermani</i> (Rohwer)	Hymenoptera	Ichneumonidae	<i>S. incertulas</i>	Eggs, Larvae	Aug-Sept	Low
<i>Isotima</i> sp.	Hymenoptera	Ichneumonidae	<i>S. incertulas</i>	Eggs, Larvae	Aug-Sept	Low
<i>Temelucha philippinensis</i> Ashmead	Hymenoptera	Ichneumonidae	<i>C. medinalis</i>	Eggs, Larvae	Aug-Sept	Moderate
<i>T. stangli</i> (Ashmead)	Hymenoptera	Ichneumonidae	<i>C. medinalis</i>	Eggs, Larvae	Aug-Sept	Moderate
<i>Xanthopimpla punctata</i> (Fabr.)	Hymenoptera	Ichneumonidae	<i>C. medinalis</i>	Eggs, Larvae	Aug-Sept	High
<i>X. flavolineata</i> Cameron	Hymenoptera	Ichneumonidae	<i>S. incertulas, C. medinalis</i>	Eggs, Larvae	Aug-Sept	High
<i>Anagrus optabilis</i> (Perkins)	Hymenoptera	Mymaridae	<i>Sogatella furcifera</i> (Horvath)			
			<i>Nilaparvata lugens</i> (Stal.)	Nymph and adults	Aug-Sept	Moderate
<i>Gonatocerus</i> sp.	Hymenoptera	Mymaridae	<i>S. incertulas, N. lugens</i>	Nymph and adults	Aug-Sept	Low
<i>Oligosita yasumatsui</i> Vigi. & Subba Rao	Hymenoptera	Trichogrammatidae	<i>N. lugens, S. furcifera</i>	Nymph and adults	Aug-Sept	Low
<i>Trichogramma chilonis</i> Ishii	Hymenoptera	Trichogrammatidae	<i>S. incertulas, C. medinalis</i>	Nymph and adults	Aug-Sept	High
<i>T. japonicum</i> Ashmead	Hymenoptera	Trichogrammatidae	<i>S. incertulas, C. medinalis</i>	Eggs	Aug-Sept	High
<i>Tetrastichus formosanus</i> (Timbet.)	Hymenoptera	Eulophidae	<i>N. lugens</i>	Nymph and adults	Aug-Sept	Moderate
<i>T. schoenobii</i> Ferr.	Hymenoptera	Eulophidae	<i>S. incertulas</i>	Eggs	Aug-Sept	Moderate
<i>Brachymeria excarinata</i> Gahan	Hymenoptera	Chalcididae	<i>C. medinalis</i>	Eggs, Larvae	Aug-Sept	Low
<i>B. lasus</i> (Wlk.)	Hymenoptera	Chalcididae	<i>C. medinalis</i>	Eggs, Larvae	Aug-Sept	Low
<i>Brachimeria</i> sp.	Hymenoptera	Chalcididae	<i>C. medinalis</i>	Eggs, Larvae	Aug-Sept	Low
<i>Anastatus</i> sp.	Hymenoptera	Eupelmidae	Bugs and Grasshoppers	Eggs	Aug-Sept	Moderate
<i>Elasmus philippinensis</i> Ashmead	Hymenoptera	Elasmidae	<i>C. medinalis</i>	Larvae	Aug-Sept	Low
<i>Goniozus</i> sp.	Hymenoptera	Bethylidae	<i>C. medinalis</i>	Larvae	Aug-Sept	Low
<i>Aphanogmus</i> sp.	Hymenoptera	Ceraphronidae	<i>C. medinalis</i>	Larvae, Pupae	Aug-Sept	Low
<i>Telenomus dignus</i> (Gahan)	Hymenoptera	Scelionidae	<i>S. incertulas</i>	Eggs	Aug-Sept	High
<i>T. remus</i> Nixon	Hymenoptera	Scelionidae	<i>S. incertulas</i>	Eggs	Aug-Sept	High
<i>T. triptus</i> Nixon	Hymenoptera	Scelionidae	<i>S. incertulas</i>	Eggs	Aug-Sept	High
<i>T. rowani</i> Gahan	Hymenoptera	Scelionidae	<i>S. incertulas</i>	Eggs	Aug-Sept	High

brown plant hopper *Nilaparvata lugens* (Stal.), Leaf hoppers *Recilia dorsalis* (Motsch.) and *Nephotettix virescens* (Distant) and rice hispa *Dicladispa armigera* (Oliv.). During the survey 31 species of predators belonging to 22 genera under 16 families of 7 orders were recorded in traditional and basmati rice growing belt under RWCS of Uttar Pradesh, Haryana and Uttarakhand (Table 1). Dragonflies *Crocothemis servilia* (Drury) and *Orthetrum sabina* (Drury), damselflies *Ischnura senegalensis* (Rambur) and *Agriocnemis pygmaea* (Rambur), long horned grasshopper *Conocephalus longipennis* (Haan), mirid bug *Cyrtorhinus lividipennis* Reuter, wolf *Lycosa pseudoannulata* and lynx spiders were recorded in high numbers, whereas Lady bird beetles, Ground beetles, Crickets (*Anaxipha longipennis* and *Metioche vittaticollis*), ripple bugs (*Microvelia douglasi* and *Mesovelia vittigera*), orb spiders and long jawed spiders were recorded in moderate numbers. Sac spiders, crab spiders (*Thomisus* sp.), earwigs and rove beetles (*Paederus fuscipes*) were recorded in low numbers. Garg *et al.* (2002) recorded 14 species of predators belonging to 13 genera under 13 families in rice fields in Baghpat district of Uttar Pradesh.

Among parasitoids, 25 species (identified) and 6 unidentified species belonging to 19 genera under 11 families of Hymenoptera order were recorded (Table 2). *Cotesia angustibasis* Gahan, *Xanthopimpla punctata* (Fabr.), *X. flavolineatta* Cameron, *Trichogramma chilonis* Ishii, *T. japonicum* Ashmead, *Telenomus dignus* (Gahan), *T. remus* Nixon, *T. triptus* Nixon and *T. rowani* Gahan were recorded in high numbers, whereas *Bracon chinensis* (Szepliget), *Cotesia ruficrus* (Haliday), *C. flavipes* Cameron, *Stenobracon oculatus* Szepliget, *Amuromorpha accepta* (Tosq.), *Temelucha philippinensis* Ashmed, *T. stangli* (Ashmed), *Anagrus optabilis* (Perkins), *Tetrastichus formosanus* (Timb.), *T. schoenobii* Ferr. and *Anastatus* sp. were recorded in moderate numbers and other parasitoids were recorded in low numbers.

The abundance and diversity of predator and parasitoids showed a gradual increase with the growth of rice plants and gradually decreased towards ripening of the crop. Similar reports were also made by Garg *et al.* (2004 and 2008) and Pathak *et al.* (2002 and 2009).

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