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Rice Field Agro-Ecosystem's Arthropod Complex In Central India

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Summary

A survey was made on the farmers' rice fields to study the insect pests and their natural enemy complex in rice ecosystem of eastern Vidarbha of Maharashtra, India. In both *kharif* (wet) and *rabi* (dry) seasons a pest complex of 23 insect pests belonging to 7 orders and 14 families was recorded and identified. Of all these, 4 pest species viz., yellow stem borer, *Scirpophaga incertulus* (Walker), leaf folder, *Cnaphalocrocis medinalis* (Guen.), brown planthopper, *Nilaparvata lugens* (Stal.) and whitebacked planthopper, *Sogatela furcifera* (Horvath) were infesting rice crop very commonly and thus representing major pest status. The incidence of *S. incertulus* in the *rabi* season was much higher than that of the *kharif* season. The peak density of *C. medinalis* in the *kharif* season was much higher than that of the *rabi* season. The incidence of *N. lugens* and *S. furcifera* during *rabi* season were much lower as compared to the *kharif* season. The infestation of *S. furcifera* was noticed at an early stage of the crop growth whereas the BPH appeared in appreciable number at the grain filling stage of crop causing heavy loss.

About 11 parasitoids and 23 predatory insects and spiders were active and effectively regulating the populations of all the four major pests. Among the parasitic wasps *Apantales* spp., *Trichomma cnaphalocrosis*, *Ophius* spp. and *Temelucha* spp. appeared frequently in the rice fields and out of 23 predators, dragonflies, damselfly, *Agriocnemis femina*, lady bird beetles, *Micraspis discolor* and *Hormonia octamaculata*, rove beetle, *Paederus fuscipes* and ground beetle, *Ophionia indica* were found to be abundantly predating on immature and mature stages of major and minor pests. Among the 4 species of spiders recorded as non-insect predators, *L. pseudoannulata* was found to be predominant species predating on all types of pests. The abundance of dragonflies, lady bird beetle, *M. discolor* and rove beetle, *P. fuscipes* was more in *rabi* than in *kharif* season whereas spiders and ground beetle, *C. indica* were dominant during *kharif* season. The findings of present study may help in Integrated Pest Management technique to control the major insect pests of rice ecosystem.

Keywords

Eastern Vidarbha, farmers' fields, *kharif*, natural enemies, pests complex, *rabi*.

Introduction

Rice, *Oryza sativa* L. is a staple food for over 55% population of India and is grown in almost all the states. About 300 species of insects have been reported to attack rice crop in India out of which 20 have been found to be the major pests (Pathak, 1977, Arora and Dhaliwal, 1996) causing 21 to 51 percent yield loss (Singh and Dhaliwal, 1994). Although some attempts have been made to study the incidence of rice pests and their natural enemies in Andhra Pradesh (Rao and Ali, 1976), Punjab (Brar *et al*., 1994), Gujarat (Pandya *et al*., 1995), Karnataka (Naganagoud *et al*., 1999), Bihar (Rai *et al*., 2000) and Uttaranchal (Pushpakumari and Tiwari, 2005), we do not have much information for Maharashtra, especially Bhandara district, a rice bowl of state. Keeping in view this fact, the present work was undertaken to update the list of insect pests and their natural enemies of rice ecosystem in the Eastern Vidarbha of Maharashtra, India.

Materials and Methods

The collection of insect pests and their natural enemies was made from farmer's fields of Bhandara and Gondia districts from both *rabi* and *kharif* rice seasons. Regular monitoring of the occurrence and abundance of the pests and their natural enemy complex of rice ecosystem was made visually as well as by hand insect and or by hand in 1x1 quadrate sample from five randomly selected spots. Whenever the predatory species predating pests were noticed, they were collected and were further provided with different pest species to confirm their predatory behaviour.

The pests and their natural enemies collected in this way were killed in ethyl acetate, mounted either on insect pins or paper points depending on size and labeled. They were preserved in boxes using naphthalene as a pest repellent. Some small immature forms were preserved in 70% alcohol. The specimens were identified with the help of available literature.

Results and Discussions

I. Insect Pest Complex of Rice Ecosystem

In the present study during both *rabi* and *kharif* seasons, a pest complex of about 23 insect pests belonging to 7 orders and 14 families was recorded and identified. It consisted of eleven lepidopteran, five homopteran, two each of heteropteran and coleopteran and one each of dipteran, thysanopteran and orthopteran species. The common and scientific names, order, family, and pest status has been given in Table 1.

Of all these, four pest species viz., yellow stemborer (YSB), *Scirpophaga incertulus*, leaf folder (LF), *Cnaphalocrosis medinalis*, brown planthopper (BPH), *Nilaparvata lugens* and whitebacked planthopper (WBPH), *Sogatella furcifera* were infesting rice crop very commonly and thus representing major pest status. Remaining twelve insect species were considered as minor pests, causing moderate to low infestation whereas seven species were of less importance, casing very low damage to the rice crop without much economic loss.

In India insect pest scenario is known to vary considerably in different states. Thakur (1984 CAB abstract) reported about 24 species of insects on rice in the Sikkim hills but the high infestation was recorded only by *S. incertulus*, C. *suppressalis, Sesamia inferens*, *Leptocorisa* spp., and *Oxya chinensis*. In Karnataka and Punjab, the dominant pests of rice are *S. incertulus*, *N. lugens* and *S. furcifera* while *C. medinalis* is of minor importance (Sharma *et al.,* 1996; Vijay Kumar and Patil, 2004). On the contrary *C. medinalis* causes severe damage to rice in Bihar and Haryana (Kushwaha, 1988 and Rai *et al*., 2000). In Gujarat the major insect pests during summer and wet-season crop were *S. incertulus* and *C. medinalis* while *Pelopidas mathias* and *D. armigera* were minor pests (Pandya *et al.,* 1995).

Yellow stem borer (YSB), *S. incertulus*

Among the five species of rice stemborers identified in the present study, *S. incertulus* was very common and found to be the major pest of rice. The stemborer damage was started from the early stage and observed throughout the crop growth; however, much damage was noticed in the later stage of the crop. The stemborers caused 'deadhearts' (DHs) during vegetative stage and 'white earhead' (WHs) during the reproductive phase of the crop. The incidence of *S. incertulus* was found to be very high in the *rabi* than that of *kharif* season.

According to Satishkumar *et al*. (1997), among different rice stem borer species, *S. incertulus*, *S. innotata* and *Sesamia inferens* are the predominant species recorded in the rice ecosystem in the Kangra Valley of Himachal Pradesh. Abrol and Gadgil (1999 CAB abstract) reviewed the status of stem borer incidence in 21 states of India and reported that the level of pest was 'severe' in 7 states, 'moderate' in 8 states and 'low' in 6 states. *S. incertulus* was found to be the most predominant pest species (95.2%) of rice in Punjab followed by *S. innotata* (3.5%) and *Sesamia inferens* (1.3%), (Sharma *et al*., 1996). Van Vreden and Abdul Latif (1986) reported that the insect fauna in *rabi* and *kharif* seasons differs from each other in Peninsular Malaysia due to factor involved undoubtly the absence or presence of water in the rice field. They further stated that the adaptations of *S. incertulus* to wet environment (*rabi* season) is due to the fact that the larvae are very capable of dispersing themselves under aquatic conditions and their populations were often high in areas with poor drainage and stagnant water.

Leaf folder (LF), *C. medinalis*

Among the defoliators, *C. medinalis* was found to be the major pests causing considerable damage to rice crop as a leaf folder. The caterpillars fold the leaves and scrape the green tissues of the leaves from within and cause scorching and leaf drying. Each caterpillar larva is capable of destroying several leaves by its feeding. Under heavy infestation, each rice plant has several rolled leaves, which severely restricts the photosynthetic activity. The overall population growth rate and peak density of *C. medinalis* in the *kharif* season were much higher than that of the *rabi* season. The damage was severe in the later stage of the crop growth, particularly in shady areas. Misuse of insecticides and excessive use of nitrogenous fertilizers have been cited as the cause for high leaffolder populations (Dhaliwal *et al*., 1979). The report revealed that the rice crops transplanted early

(upto third week of July) showed significantly low incidence of leaf folder in comparison to late (August first week) planting (Anonymous, 1996).

Plant hoppers, *N. lugens* and *S. furcifera*

Among the 5 species of sap feeders belonging to order Homoptera identified in the present study, *N. lugens* and *S. furcifera* populations were always high during *kharif* season as compared to the other 3 species of leafhoppers, *Nephotettix* spp., *Recilia dorsalis* and *Pyrilla perpusilla* hence considered them as major pests. Although *N. lugens* and *S. furcifera* populations were high during *kharif* seasons, their incidence was comparatively low in *rabi* season. Low populations of leafhoppers and planthoppers during *rabi* season with occasional increase in location where agro-chemicals were abundantly used, have been reported by Van Vreden and Abdul Latif, (1986). Recently Joshi *et al.* (2003) stated that the most abundant rice herbivores were sap feeder such as *Nephotettix* spp., *S. furcifera* and *N. lugens* comprising 39, 24 and 34 %, respectively of the total rice arthropod compositions.

The nature and symptoms of damage are different in case of *S. furcifera* and *N. lugens. N. lugens* infests the rice crop at all stages of plant growth. It inhibits the plant growth and destroys the crop by sucking the sap and by damaging the plant by its exploratory feeding behavior and oviposition. In addition, *N. lugens* is a vector of ragged-stunt; grassy-stunt and wilted stunt virus diseases. As a result of feeding by both nymphs and adults at the base of the tillers, plants turn yellow and dry up rapidly. At an early infestation, round yellow patches appear which soon turn brownish due to drying up of the plants. This condition (dried-out plants) is called 'hopper. The patches of infestation then spread out and cover the entire field. Heavy infestation in some fields destroyed the crop completely causing heavy loss.

S. furcifera prefers a young crop and both, adults and nymphs suck sap primarily at the base of the rice plants which leads to yellowing of the lower leaves (the symptoms start from the leaf-tips backwards) reducing vigour and plant growth, and ultimately reduction in tillers and panicles. Because seedlings are attacked in the nursery, infestation is often carried through eggs into transplanted crop. The rice plants affected by *S. furcifera* appeared uniformly in large areas throughout the field rather than as localized 'hopper burn' as in the damage by *N. lugens.* This may be due to the difference in the distribution patterns of the two plant hopper species. Under favorable conditions, the insect produces several generations and inflicts heavy damage on the rice crop. This pest confined mostly to the leaf sheaths under the thick canopy, thereby its presence is left unnoticed until the plants wither out due to continuous desapping by its nymphs and adults. However, by the time symptoms of damage appear, crop protection measures become futile and the farmer has to sustain the losses in the yield sometimes even up to 100 per cent.

II. Natural Enemy Complex of Rice Fields

Walker (1962) recorded about 100 species of natural enemies, including predators, parasites as well as diseases on the rice stem borers in Asia. Ooi and Shepard (1987) concluded that predators and parasitoids in the rice fields of tropical south and Southeast Asia are essential for maintaining insect pest populations at low levels. In the Kangra valley of Himachal Pradesh, Satishkumar *et al*. (1997) recorded seven species of

parasitoids and five species of predators in rice eco-system with *Apanteles* spp. being the most abundant parasitoids and *Argiope* spp. the most dominant predators. About fifteen species of predators and parasitoids of rice pests in the Kollam district of Kerala were identified between July and October 1997 (Nandkumar and Pramod, 1998). Anis Joseph (2006) observed large number of predators in the rice ecosystem in Kerala, which are dragonflies and damselflies, lady bird beetles, rove beetles, ground beetles, water striders, *Microvelia,* water treader, grass hoppers, mirid bug and spiders like *Tetragnatha* spp; *Lycosa* spp; *Pirata* spp; orb spiders, etc. Kaur and Singh (2003) recorded spiders, lady bird beetles, carabid beetles, water bugs, plant bugs, damsel flies, ear wigs, etc. as the most common predators in Indian rice fields. Among these, the spiders are the most important. Behera and Prakash (2004) observed the dragon and damselflies; *Andrallus spinidens, Cyrtorhinus lividipennis, Microvellia spp; Tylthus parviceps* and *Vernaia discolor (Micraspis discolor*) as the potential predators of rice insect pests in India.

In the present study in both *rabi* and *kharif* seasons a total of about 23 predators including insects and spiders were prominently recorded in the field predating on various stages of insect pests. Among the parasitic wasps *Apantales* spp., *Trichomma cnaphalocrosis*, *Ophius* spp., and *Temelucha* spp. and were observed frequently parasitizing larval stages of *S. incertulus* and *C. medinalis*. In addition to this, 7 more parasitic wasps were also existed in the field which we could not identify.

Of these 23 species of predators 7 were found to be abundant, 10 were common and 6 were less common in rice ecosystem. The most abundantly found predators were dragonflies, damselfly, *Agriocnemis femina,* lady bird beetles, *Micraspis discolor* and *Hormonia octamaculata,* rove beetle, *Paederus fuscipes* and ground beetle, *Ophionia indica* predating on immature and mature stages of major and minor pests. Among the 4 species of spiders recorded as non-insect predators, *L. pseudoannulata* was found to be predominant species predating on all types of pests. They are listed with their common and scientific names, order, family and relative abundance in Table 2.

The result shows that the abundance of dragonflies, lady bird beetle, *M. discolor* and rove beetle, *P. fuscipes* was more in *rabi* than in *kharif* season whereas spiders and ground beetle, *C. indica* were dominant during *kharif* season. The natural enemy fauna of *kharif* season is generally different from those found in *rabi* season (Van Verden and Abdul Latif, 1986).

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Table 1. A Pest complex of rice ecosystem

Common names	Scientific names	Order: Family	Status
Yellow stem borer (YSB)	*Scirpophaga incertulus* (Walker)	Lepidoptera: Pyralidae	1
White stem borer	*Scirpophaga innotata* (W.)	Lepidoptera: Pyralidae	3
Striped stem borer	*Chilo supresalis* (W.)	Lepidoptera: Pyralidae	2
Pink stem borer	*Sesamia inferens* (W.)	Lepidoptera: Noctuidae	2
Leaf folder (LF)	*Cnaphalocrosis medinalis* (Guenee)	Lepidoptera: Pyralidae	1
Case worm	*Nymphula depunctalis* (Guenee)	Lepidoptera: Pyralidae	2
Case worm	*Parapoynx flutuosalis* (Zeel)	Lepidoptera: Pyralidae	3
Paddy swarming caterpillar	*Spodoptera mauritia* (Boisd)	Lepidoptera: Noctuidae	2
Rice butterfly	*Melanitis leda* (Fabricius)	Lepidoptera: Nymphalidae	2
Rice skipper	*Pelopidas mathias* (Fb.)	Lepidoptera: Hesperidae	2
Rice hairy caterpillar	*Nisaja simplex* (W.)	Lepidoptera: Eupterotidae	3
Brown planthopper (BPH)	*Nilaparvata lugens* (Stal.)	Homoptera: Delphacidae	1
Whitebacked planthopper (WBPH)	*Sogatella furcifera* (Horvath)	Homoptera: Delphacidae	1
Green leaf hopper	*Nephotettix* spp.	Homoptera: Cicadellidae	2
Zig-zag leaf hopper	*Recilia dorsalis* (Motschulsky)	Homoptera: Cicadellidae	3
Leaf hopper	*Pyrilla perpusilla* (W.)	Homoptera: Fulgoridae	3
Rice hispa	*Dicladispa armigera* (Olivier)	Coleoptera: Chrysomelidae	3
Rice blue beetle	*Leptispa pygmaea* (Baly.)	Coleoptera: Chrysomelidae	3
Gundhi bug	*Leptocorisa acuta (*Th*)*	Heteroptera: Alydidae	2
Black rice bug	*Scotinophara spp.*	Heteroptera: Pentatomidae	2
Rice grasshopper	*Hieroglyphus banian*	Orthoptera: Acridiidae	2
Paddy gall fly	*Orseolia oryzae* (Wood-mason)	Diptera: Cicidomyidae	2
Paddy thrip	*Baliothrips biformis* (Bagnall)	Thysanoptera: Thripidae	2

1-Major, **2**- Minor and **3**- Stray.

Table 2. Predatory natural enemy complex of rice fields

Common names	Scientific names	Order: Family	Status
Dragonfly	*Crocothemis servilia* (Drury)	Odonata: Libellulidae	1
Dragonfly	*Orthetrum sabina* (Drury)	Odonata: Libellulidae	1
Dragonfly	*Diplocodes trivialis* (Rambur)	Odonata: Libellulidae	3
Dragonfly	*Neurothemis tullia* (Drury)	Odonata: Libellulidae	2
Damselfly	*Agriocnemis femina* (Brauer)	Odonata: Coenagrionidae	1
Wolf spider	*Lycosa pseudoannulata* (Boes.et)	Araneida: Lycosidae	1
Long jawed spider	*Tetragnatha maxillosa* (Thorell)	Araneida: Tetragnathidae	2
Orb spider	*Argiope catennulata* (Doleshall)	Araneida: Argiopidae	3
Lynx spider	*Oxyopes javanus* (Thorell)	Araneida: Oxyopidae	2
Lady bird beetle	*Verania (=Micraspis) discolor* (Fb.)	Coleoptera: Coccinellidae	1
Lady bird beetl	*Hormonia octamaculata* (Fb.)	Coleoptera: Coccinellidae	2
Rove beetle	*Paederus fuscipes* (Curtis)	Coleoptera: Staphylinidae	1
Ground beetles	*Ophionia indica* (Thum.)	Coleoptera: Carabidae	1
Long horned grasshopper	*Conocephalus longipennis* (de Haan)	Orthoptera: Tettigonidae	2
Sword tailed cricket	*Metioche vittaticollis* (Stal)	Orthoptera: Gryllidae	2
Sword tailed cricket	*Anaxipha longipennis* (Seville)	Orthoptera: Gryllidae	2
Green mired bug	*Cytorhinus lividipennis* (Reuter)	Hemiptera: Miridae	2
Ripple bug	*Microvellia douglasi* (Berg.)	Hemiptera: Velidae	3
Shield bug	*Andrallus spinidens* (Fb.)	Hemiptera: Pentatomidae	3
Assassian-bugs	*Polytoxus selangorensis* (Miller)	Hemiptera: Reduviidae	2
Water strider	*Limnogonus fossarum* (Fb.)	Hemiptera: Gerridae	2
Earwigs	*Eurobellia stali* (Dohrn)	Dermaptera: Chelisochidae	3
Red ant	*Solenopsis geminata* (Fb.)	Hymenoptera: Formicidae	3

1 -abundant, **2** -common and **3** -Less common.