

RESEARCH ARTICLE

Occurrence of insect-pests and natural enemies in rice (*Oryza sativa* L.) agro-ecosystem

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ABSTRACT

The present survey was conducted during *Kharif* 2011 and *Kharif* 2012 in Varanasi district of Uttar Pradesh, India. Twenty six insect-pests and natural enemies of crop plants, belonging to 9 different orders (including Acarina group) were recorded in the rice (*Oryza sativa* L.) agro-ecosystem. The maximum percentage of insect-pests and natural enemies were recorded in the order Coleoptera (23.10%), followed by Lepidoptera (15.40%), Homoptera, Isoptera and Thysanoptera. Insect pests *viz.*, yellow stem borer, green leaf hopper and gundhi bug were highest in proportion, whereas rest others were found to be medium or low in proportion. Among natural enemies and predators, rove beetles, tiger beetles, carabid beetles, damsel flies and dragon flies were recorded from the rice agro-ecosystem.

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INTRODUCTION

Globally, rice is the second most important crop in production as well as consumption. It is the major food crop in Asia and India is the most dominant rice growing country in world. India is the second largest producer of rice in world (after China) contributing 11.4% of the world's production. Rice is primarily used as high energy calorie food in human diet. The major part of rice consists of carbohydrate in the form of starch, which is about 72-75 per cent of the total grain composition. The protein content of rice is around 7 per cent. The protein portion of rice mainly contains glutelin, which is also known as oryzenin. The nutritive value of rice protein (biological value = 80) is much higher than that of wheat (biological value = 60) or maize (biological value = 50) and most of the other cereals. Rice contains most of the

minerals mainly located in the pericarp and germ, and about 4 per cent phosphorus. Rice also contains some enzymes. Rice husk contains 16 - 22% ash, which is high in silica. Rice bran is a mixture of substances like protein, fat, ash and crude fibre. Brewer's rice is often used as ingredient for beer brewing. According to the reports of Gowda and Gubbaiah (2011), insect pests are the major biotic constraints in rice production throughout the country. More than 28 insect species have been reported as pests on rice from Karnataka state only. There is not a single factor responsible to increase the population of insect pests, but all the agronomic as well as environmental factor affect the pest population. Litsinger (1994) found that the insect pest abundance depends on plant geometry. Close plantings alter the microclimate, and crop growth and development, which in turn affect the pests and their natural enemies. Sparse planting encourages weeds and

indirectly has an effect on insect abundance. Low tiller number per unit area can result in a higher percentage of tillers damaged by stem borers, whereas closely spaced plants shade each other, making rice plants more vulnerable to brown plant hopper due to increased humidity, greater plant surface area for oviposition and less crowded feeding conditions. A field with 10 cm x 10 cm hill spacing has greater chances of suffering hopper burn than a field with 20 cm x 20 cm hill spacing. Dense planting increases population of plant hoppers, leafhoppers, leaf folders, gall midges, black bugs and caseworms; but the whorl maggots, root aphids, root weevils and leaf beetles may become less abundant. Therefore, keeping in view the prevailing crop losses in Varanasi, the present investigation was carried out to estimate the relative abundance of various insect pests and natural enemies on rice crop.

MATERIAL AND METHODS

The present investigation was carried out in agriculture research Farm of Banaras Hindu University, Varanasi to study the insect-pests complex of rice (*Oryza sativa* L.) during *Kharif* 2011 and *Kharif* 2012. The crop was transplanted in the second week of July in 2011 and third week of July in 2012 with recommended agronomic practices and the variety, Naati Mansoori was selected for present investigation of insect-pest complex. The data of both the years, recorded on the basis of severity of pest were combined together. The observations were recorded in ten days interval, at the total of five spots and ten plants were selected randomly from each spot. Thus, fifty plants were visited right from transplanting to harvesting of crop. The pest species were collected, pinned, stretched, dried and stored in the laboratory of the Network Project on Insect Biosystematics, Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India.

RESULTS AND DISCUSSION

The categorization of different insect-pests was carried out and it was observed that 26 insect-pests were recorded which can bring about losses and beneficial effect on the rice crop (Table 1). Among these, some were found in very large and others in very small numbers, which lead to their classification as major and minor pests, respectively. Some of them were found to be medium in proportion. The insect-pests which were recorded belonged to 9 orders *i.e.*, Orthoptera, Coleoptera, Diptera, Lepidoptera, Isoptera, Homoptera, Odonata, Thysanoptera and Acarina (Table 1). Out of these, the maximum number of insects *i.e.*, 23.1% was recorded for order Coleopteran, followed by Lepidoptera (15.4%); whereas minimum number of insect-pests (3.8%) was observed for orders Thysanoptera and Isoptera. The orders Orthoptera, Homoptera, Diptera, Odonata and Acarina

recorded 11.6%, 15.4%, 7.7%, 7.7%, and 11.5% of the insect-pests, respectively (Fig.1).

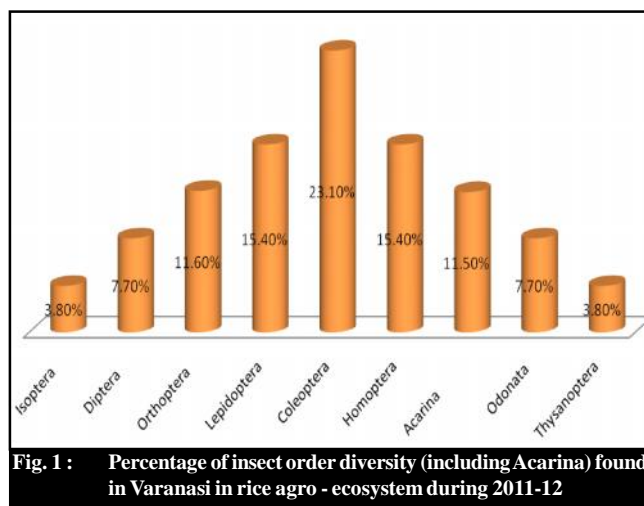


Fig. 1 : Percentage of insect order diversity (including Acarina) found in Varanasi in rice agro-ecosystem during 2011-12

The rice crop is being infected by these insect pests at different growth stages (Table 2) and the insect infestation was found to occur both in the nursery as well as in the main field conditions. The pests infecting only at nursery stage involves rice thrips (*Stenchaetothrips biformis*), rice short horned grass hopper (*Oxya nitidula*) and short horned grasshopper (*Acrida* sp.), whereas the pests infecting at all the vegetative stages involve rice short horned grasshopper (*Oxya nitidula*), short horned grasshopper (*Acrida* sp.) and termite (*Odontotermes obesus*). Among the pests found to be most problematic were leaf defoliators and folders, which include rice hispa (*Diadisa armigera*), rice leaf folder (*Cnaphalocrosis medinalis*), and climbing cutworm (*Mythmina seprata*). The pests found to be most damaging at flag leaf stage and panicle formation stage were yellow stem borer (*Scirpophaga incertulas*), rice mite (*Steneotarsonemus spinki*) and spider mite (*Oligonychus oryzae*), where as the rice bug was most severe at the milking stage. Rice short horned grass hopper (*Oxya nitidula*), short horned grasshopper (*Acrida* sp.), surface grasshopper (*Chrotogonus trachypterus*), rove beetle (*Paederus* sp.) and termite (*Odontotermes obesus*) were found to be problematic at all the stages right from vegetative to harvesting stage of the crop. On the basis of pest status, the yellow stem borer (*Scirpophaga incertulas*), green leaf hopper (*Nephotettix nigropictus/virescence*) and rice ear headbug (gundhi bug) (*Leptocoriza acuta/varicornies/oratorious*) were found to be highest in number; whereas short horned grasshopper (*Acrida* sp.), rice leaf folder (*Cnaphalocrosis medinalis*), rice thrips (*Stenchaetothrips biformis*), gall fly/gall midge (*Orseolia oryzae*), brown plant hopper (*Nilaparvata lugens*) and rice mite (*Steneotarsonemus spinki*) were found to be

Table 1 : Occurrence of Insect-pests and natural enemies (including Acarina) in rice agro-ecosystem in Varanasi during 2011-12

Sr. No.	Common name	Zoological name	Family
1.	Orthoptera		
	Rice short horned grasshopper	<i>Oxya nitidula</i> Walker	Acrididae
	Short horned grasshopper	<i>Acrida</i> sp.	Acrididae
2.	Coleoptera		
	Rove beetle	<i>Paederus</i> sp.	Staphylinidae
	Rice hispa	<i>Dicladispa armigera</i> Olivier	chrysomellidae
	Blue beetle/Leaf beetle	<i>Lyphgma pygmoea</i>	Chrysomelidae
	White grub	<i>Holotrichia consanguinea</i> Blanch	Scarabaeidae
	Tiger beetle	<i>Cicindela ocellata rectilatera</i> Chaudoir	Cicindelidae
	Carabid beetle	<i>Cicindela</i> spp	Carabidae
3.	Diptera		
	Whorl maggot/ rice leafminer	<i>Hydrellia</i> sp.	Ephyridae
4.	Gall fly (gall midge)	<i>Orseolia oryzae</i> Wood-Mason	Cecidomyidae
	Lepidoptera		
	Yellow stem borer	<i>Scirpophaga incertulas</i> (Walker)	Pyrellidae
	Rice leaf folder	<i>Cnaphalocrocis medinalis</i> Guenee	Pyrellidae
5.	Rice caseworm	<i>Nymphula depunctalis</i> Guenee	Pyrellidae
	Climbing cutworm	<i>Mythmina seprata</i> Walker	Noctuidae
	Isoptera		
	Termite	<i>Odontotermes obesus</i> Rambur	Termitidae
	8.	Thysanoptera	
Rice thrips		<i>Stenchaetothrips biformis</i> Bagnall	Thripidae
9.	Homoptera		
	Green leaf hopper	<i>Nephotettix nigropictus/virescence</i>	Cicadellidae
	Brown plant hopper	<i>Nilaparvata lugens</i> Stål.	Delphacidae
	White backed plant hopper	<i>Sogatella furcifera</i> Hovarth	Delphacidae
10.	Rice ear headbug (gundhi bug)	<i>Leptocoriza acuta/varicornies/oratorious</i>	Coreidae
	Odonata		
	Damsel fly, Bog dancer	<i>Agriocnemis femina femina</i> Brauer	Calypterygidae
11.	Dragon fly	Many species	-
	Acarina		
	Panicle rice mite/ spinki mite	<i>Steneotarsonemus spinki</i> Smiley	Tarsonemidae
	Rice spider mite	<i>Oligonychus oryzae</i> Hirst.	Tetranychidae
	Wolf spiders	<i>Lycosa pseudoannulata</i>	Araneae

medium in pest status. The rest were found to be lesser in number and thus low in pest status. Some beneficial insects like damsel flies, dragon flies, spiders, tiger beetles etc. were also found in the field, but the populations of these insects were low as compared to insect pests. The present investigation is supported by different works on insect pests in the rice agro-ecosystem. Jena *et al.* (2012) reported some of the major insect pests causing severe losses in rice production, which included yellow stem borer (*Scirpophaga incertulas*), leaf folder (*Cnaphalocrocis medinalis*), whorl maggot

(*Hydrellia philippina*), hispa (*Dicladispa armigera*), brown plant hopper (*Nilaparvata lugens*), white-backed plant hopper (*Sogatella furcifera*) and gundhi bug (*Leptocorisa acuta*). Kaur *et al.* (2012) also recorded the similar results from Punjab, where insect pest damaged samples received at Plant Clinic were found to be infected by various pests. The maximum severity of damage was recorded in case of plant hopper (44%) followed by leaf folder (30%) and stem borer (29%). Verma *et al.* (2010) conducted a trail at 10 different locations to investigate the influence of fertilizer applications at

Table 2 : Status and time of occurrence of insect-pest and natural enemies (including Acarina) in rice agro-ecosystem in Varanasi during 2011-2012

Common name	Zoological name	Status	Time of occurrence
Rice short horned grasshopper	<i>Oxya nitidula</i> Walker	+	All crop growth stage
Short horned grasshopper	<i>Acrida</i> sp.	++	All Crop growth stage
Surface grasshopper	<i>Chrotogonus trachypterus</i> Blanchard	+	All Crop growth stage
Rove beetle	<i>Paederus</i> sp.	+	Whole crop growth time
Termite	<i>Odontotermes obesus</i> Rambur.	+	Whole time in water stress
Yellow stem borer	<i>Scirpophaga incertulas</i> Walker	+++	Flag leaf, Panicle emergence
Rice hispa	<i>Di cladispa armigera</i> Olivier	+	Vegetative stage, Defoliators
Rice leaf folder	<i>Cnaphalocrocis medinalis</i> Guenee	++	Vegetative stage
Rice thrips	<i>Stenchaetothrips biformis</i> Bagnall	++	Nursery and vegetative stage
Gall fly (gall midge)	<i>Orseolia oryzae</i>	++	Early Vegetative
Rice caseworm	<i>Nymphula depunctalis</i> Guenee	+	Early Vegetative
Green leaf hopper	<i>Nephotettix nigropictus/virescence</i>	+++	Vegetative stage
Brown plant hopper	<i>Nilaparvata lugens</i> Stål.	++	Vegetative stage
White backed plant hopper	<i>Sogatella furcifera</i> Hovarth	+	Vegetative stage
Rice ear headbug (gundhi bug)	<i>Leptocoriza acuta/varicornies/oratorious</i>	+++	Milking stage
Blue beetle/Leaf beetle	<i>Lyphgma pygmoea</i>	+	Vegetative stage
White grub	<i>Holotrichia consanguinea</i> Blanch	+	All vegetative stages
Climbing cutworm	<i>Mythmina seprata</i> Walker	+	Vegetative stage, Defoliators
Whorl maggot	<i>Hydrellia</i> sp.	+	Early Vegetative
Rice panicle mite	<i>Steneotarsonemus spinki</i> Smiley	++	Panicle stage
Spider mite	<i>Oligonychus oryzae</i> Hirst	+	Vegetative and panicle
Tiger beetle	<i>Cicindela ocellata rectilatera</i>	+	All vegetative stages
Carabid beetle	<i>Cicindela</i> sp.	+	All vegetative stages
Damsel fly	<i>Agriocnemis femina femina</i> Brauer	+	All vegetative stages
Dragon fly	Many species	++	All vegetative stages
Wolf spiders	<i>Lycosa pseudoannulata</i>	++	All vegetative stages

Note ; +++ = High, ++ = Medium and + = low

Table 3 : Insect species in individual order including Acarina group and insect order diversity percentage in rice (*Oryza sativa* L.) agro-ecosystem in Varanasi during 2011-12

Sr. No.	Insect order including Acarina	No. of insect species was found in individual order	% of insect order diversity
1.	Orthoptera	3	11.53
2.	Coleoptera	6	23.07
3.	Isoptera	1	3.84
4.	Lepidoptera	4	15.38
5.	Thysanoptera	1	3.84
6.	Homoptera	4	15.38
7.	Diptera	2	7.69
8.	Acarina	3	11.53
9.	Odonata	2	7.69

differential rates on rice pest fauna, like the stem borer (*Scirpophaga incertulas*), leaf-folder (*Cnaphalocrocis medinalis*) and white-backed plant-hopper (*Sogatella furcifera*). The major insect pests were recorded respectively from lowland, foothill and upland rice

ecosystems by Zhimomi and Ao (2011). The maximum abundance of the major insect pests was recorded from the months of May to November, while minimum was recorded mostly during the months of January to March. The eighteen insect pests including their natural enemies were recorded

from the rice fields by Khan and Alam (2007). Among these insect pest species, abundance of short horned grasshopper, long horned grasshopper, green leafhopper, leaf roller, yellow stem borer, rice bug and gall midge differed significantly with combined effect of different management practices and growth stages. Phytophagous mites infecting the rice crop is also supported by the studies of Hummel *et al.* (2009).

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