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Perspectives of Economically Important Pests and Climatic Changes on Various Agricultural Field Crops: A Review

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Abstract: Survey and evaluation of natural enemies of insect pests were investigated by many researchers. Here, >160 species pests were associated with important field crops of sugarcane, rice, wheat pulses, legumes and cotton were recorded including parasitic and predatory mites and insect pathogens. Among these natural enemies few of them are utilized as a biological control agent for suppress the lepidopteran, caterpillar pests, grampod borer, leafhopper.

Key words: Agro-ecosystem, insect pests, climatic changes, crop field, environmental changes, India

INTRODUCTION

Insects are the most diverse group of organisms in freshwater streams and rivers. In addition to significant ecosystem function, aquatic insects are reliable indicators of human impact on freshwater ecosystem. On the other hand, the present study shows that the distribution and abundance of terrestrial insect pest's family and genera are influenced by the typical economically important crop field. Furthermore, the study examined perceptions and adaptations to climate variability and change in subsistence agriculture. Change in functional groups and habits reflect that human influence in the riparian zone alters the stream insect community structure and could be related to a change in nature of the nutrient input into the streams. The arthropod natural enemies of rice pest insects include a wide range of predators and parasitoids that are important biological control agents. Predators include a variety of spiders and insects such as carabid beetles, aquatic and terrestrial predatory bugs and dragon flies.

Role of insects and its effects on paddy fields: The temporal development of arthropod communities in relation to rice cultivation in Philippine rice fields was studied by Browse and Howe (2008), where they examined the guild structure, successional changes and dynamics of important. Phytophagous and predator arthropod species, providing insights into the arthropod community structure in rice fields. Earlier studies by Subramanian *et al.* (2005) indicated in describing the above-water food web dynamics of arthropod communities exhibiting mainly depends upon the the irrigated rice fields. They determined the trophic links of the cumulative food webs in Philippine rice fields. Very recently, Carmona *et al.* (2011) documented 36 families of insect and arachnid arthropods in rice fields of the Muda irrigation scheme in Malaysia. The greater number of insect families and individuals were collected from field plots using recycled water than from non-recycled plots. Whereas, they tended to remain in the fields long enough for pupation with the recycled system. Earlier studies on other pests in agricultural field such as oil seeds, legumes, pulses, rice and other economically important crop (Subramanian *et al.*, 2005). The majority of the insect species belonged to order Hymenoptera (81 sp.) followed by Lepidoptera (58 sp.). Apart from these key studies, there is a wealth of rapidly growing information on the rice field insect pests and their arthropod natural enemies viewed from a biological control perspective (Marc *et al.*, 1999). The green revolution initiated in the mid 1960's and characterized by the successful breeding and widespread adoption of new high yield varieties pesticides and fertilizers has doubled the production of many crops such as rice, wheat and maize (Lu *et al.*, 2007). Meanwhile, the continuous and excessive inputs of pesticides and fertilizers have resulted in some negative effects unwelcome harvest on environment and resources as well as the considerable disturbances to plant and animal communities.

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Insect pests of rice: According to Erb *et al.* (2008) who has given a comprehensive account of the biology and ecology of insect pests of rice, >800 species of insect damage on rice plants in several ways, although the majority of them cause minor damage. The number of insect species that cause economic damage to rice varies from 20. The insect pests of rice are either monophagous feeding only on the rice plant or polyphagous where they move in and out of adjacent vegetation including largely rice field weeds. Karban and Agrawal (2002) had been documented various forces that determine the presence and abundance of insect pests in rice agro-ecosystems, including their adaptations to the rice environment, the influence of the cropping system and the dynamics of the pest populations in relation to the cultural environment.

Potential impacts of climate change on agriculture and food supply: Several uncertainties limit the accuracy of current projections. One relates to the degree of temperature increase and its geographic distribution (Bhar and Fahrig, 1998). Understanding the potential impacts of global environmental change on this sequence of interlocking elements is a 1st step in modeling what will happen when any one of them is changed as a result of possible global warming and a prerequisite for defining appropriate societal responses (Wilf *et al*., 2001). Very recently, Chukwukere *et al.* (2011) predicted the following criteria might be interrupted the growth and augmentation of the plant species such as climate variability, perceptions and adaptations in subsistence. Agriculture possible biophysical responses of agro-ecosystems to the specific environmental changes that are anticipated as a result of the build up of global greenhouse gases and then at the range of adaptive actions that might be taken to ameliorate their effects (IPCC, 1990). In successive sections draw on other modeling studies to show examples of regional and global assessments that have so far been made, including discussions of the effects of uncertainty, thresholds and surprises and the possible consequences of global warming on agricultural sustainability and food security (Rosenzweig and Hillel, 1993).

Predictable rejoinder of agro-ecosystems: Plants grow through the well-known process of photosynthesis, utilizing the energy of sunlight to convert water from the soil and carbon dioxide from the air into sugar, starches and cellulose; the carbohydrates that are the foundations of the entire food chain (Koji, 1978). Wheat, rice and soybeans belong to physiological classes (C3 plants) that respond readily to increased CO_2 levels. Corn, sorghum, sugarcane and millet are C4 plants that follow a different pathway (Peiffer and Felton, 2005). Thus far, these effects have been demonstrated mainly in controlled environments such as growth chambers, greenhouses and plastic enclosures.

The dual effect of the plants behaviour, higher levels of atmospheric CO_2 also tempt plants to close the small leaf openings known as stomates through which CO_2 is absorbed and water vapor is released (Rosenzweig and Hillel, 1993). According to IPPC (1990), the associated climatic effects such as higher temperatures, changes in rainfall and soil moisture and increased frequencies of extreme meteorological events could be either superior or negate potentially beneficial effects of enhanced atmospheric CO_2 on crop physiology.

Applicability of IPM: IPM is being practiced for a wide range of crops in all regions of the world. IPM is about an approach and not a set of techniques. The approach is universally applicable. IPM does not necessarily involve sophisticated information gathering and decision making. The IPM approach can be introduced at any level of agricultural development. For example, improvement of basic crop management practices such as planting time and crop spacing can often be effective in reducing pest attack (Van Emden, 1999). IPM is a dynamic process. A useful beginning can be made with relatively limited specialized information or management input. Later, additional information, technologies and mechanisms can be developed to enhance the effectiveness of the system (Allmann and Baldwin, 2010). In addition to crop production, IPM also calls for non-chemical alternatives to post harvest loss prevention. This is particularly important as losses due to post harvest damage can be significant and use of chemicals on stored produce is a common cause of poisoning people.

Interactions in agricultural background: In order to prevent significant losses of agricultural crops to herbivory, both in the field and following harvest, some of them of an insect population control is often required; some crops may require protection from >1 insect herbivore (Jander and Howe, 2008). They have been further discussed under conventional farming methods in the industrialized world, insecticides are applied to agricultural fields to control insect pests. Often, >1 type of insecticide and/or >1 treatment will be applied in a single crop cycle. For instance, recent research examining the effects of moth larvae feeding on corn has demonstrated that after herbivore damage, corn plants release a new complex of odorants into the air and that some of these molecules are attractive to parasitic wasps (Arimura *et al*., 2008). The parasitic wasps then seek out and parasitize the larvae feeding on the corn plants. These odorants have the potential to be used to help control moth damage on corn.

In exceedingly, IPCC (1990) found out a very different view of insect-plant interaction focuses on the use of insects as biological control agents for weeds and takes advantage of the fact that insects can feed destructively on plants. Information of this nature is needed to assess potentialities for coping with more drastic climate change depicted by Rosenzweig and Hillel (1993). Additionally, Ruttan (1994) success in adapting to possible future climate change will depend on a better definition of what changes will occur where and on prudent investments, made in timely fashion, in adaptation strategies.

Plant interactions between arthropod and herbivores: Plant-herbivore interaction research is arguably one of the most multidisciplinary endeavors in plant biology (Fernandez, 1994). Like all research concerned with inter species relationships, numerous disciplines are required to accurately describe the range of chemical and ecological processes that influence the outcome of plant herbivore interactions (Rhoades, 1979). The merging of molecular and ecological disciplines offers a powerful approach to understand gene function and evolution in an ecological context (Coley *et al*., 1985).

Much of contemporary plant herbivore interaction research is focused on understanding the molecular mechanisms and ecological consequences of induced plant responses to herbivory. Mithofer and Boland (2008) discussed the early signaling events at the plant herbivore interface. Previously, Frost *et al*. (2008) described the molecular and ecological aspects of defense priming which has become an important area of research. Again, Dicke and van Loon (2000) describes various mechanisms by which insects evade host defense responses, thereby highlighting the co-evolutionary nature of plant-herbivore relations (Table 1).

Plant eminence and insect conflict to pathogens: From an evolutionary perspective, a fascinating recent finding is that the costs of resistance to *B. thuringiensis* in the cabbage looper moth Trichoplusiani vary with host plant species and the size of these costs increase as the suitability of the plant as a food source declines (Johnson and Felton, 2001). If the costs and even development of resistance are context dependent, this has wide allegations for the use of entomopathogens as bioinsecticides and for the interplay between host resistance and pathogen virulence in natural populations (Mithofer and Boland, 2008). Preliminary evidence also suggests that entomopathogenic populations become

Table 1: Lists of the affected pests on various economic crops

Name of the pests (Local name)	Scientific name
Important pestsof rice	
Thrips	*Stenchaetothrips biformis*
Green leafhopper	*Nephotettix virescens*
Rice case worm	*Nymphula depunctalis*
Paddy stemborer	*Scirpophaga incertulas*
Swarming caterpillar	*Spodoptera mauritia*
Main field pests	
Paddy stem borer	*Scirpophaga incertulas*
Gall midge	*Orseolia oryzae*
Swarming caterpillar	*Spodoptera mauritia*
Rice skipper	*Pelopidas mathias*
Leaf folder (or) leaf roller	*Cnaphalocrocis mainsails*
Rice horned caterpillar	*Melanitis ismene*
Yellow hairy caterpillar	*Psalis pennatula*
Grasshopper	*Hieroglyphus banian*
Spiny beetle/Rice hispa	*Dicladispa armigera*
Whorl maggot	*Hydrellia sasakii*
Green leafhopper	*Nephotettix virescens*
Brown plant leafhopper	*Nilaparvata lugens*
White backed plant hopper	*Sogatella furcifera*
Mealy bug	*Brevennia rehi*
Rice ear head bug	*Leptocorisa acuta*
Pests on sorghum I. Borer	
Thrips	*Stenchaetothrips biformis*
Shootfly	*Atherigona varia soccata*
Stem borer	*Chilo partellus*
Pink stem borer	*Sesamia inferens*
Earhead feeders	
Ear head caterpillar	*Helicoverpa armigera*
Earhead bug	*Calocoris angustatus*
Sorghum midge	*Contarinia sorghicola*
Sap feeders	
Shoot bug	*Peregrinus maidis*
Plant lice	*Rhopalosiphum maidis*
Pests on maize I. Borer	
Stem fly	*Atherigona orientalis*
Stem borer	*Chilo partellus*
Pink stem borer	*Sesamia inferens*
Earhead feeders	
Corn worm	*Helicoverpa armigera*
Ear head bug	*Calocoris angustatus*
Leaf feeders	
Web worm	*Cryptoblabes gnidiella*
Ash weevil	*Myllocerus* sp.
Sap feeders	
Leafhopper	*Pyrilla perpusilla*
Aphid or plant lice	*Rhopalosiphum maidis*
Shoot bug	*Peregrinus maidis*
Pests of Ragi	
Pink stem borer	*Sesamia inferens*
Earhead bug	*Calocoris angustatus*
Aphids	*Rhopalosiphum maidis*
Root aphid	*Tetraneura nigriabdominalis*
Pests of bengal gram	
Gram pod borer	*Helicoverpa armigera*
Semilooper	*Autographa nigrisigna*
Cut worm	*Agrotis ipsilon*
Termites	*Odontotermes obesus*
Pests of black and green gram (I. Borers)	
Spotted pod borer	*Maruca vitrata*
Spiny pod borer	*Etiella zinckenella*
Blue butterfly	*Lampides boeticus*
Grass blue butterfly	*Euchrysops cnejus*
Sap feeders	
Bean aphids	*Aphis craccivora*
Leaf hopper	*Empoasca kerri*
Pod bugs	*Riptortus pedestris*
Lab lab bug	*Coptosoma cribraria*

Table 1: Continue

Name of the pests (Local name)	Scientific name
White fly	*Bemisia tabacci*
Flower feeder	
Blister beetle	*Mylabris phalerata*
Pests on cowpea (I. Borer)	
Gram pod borer	*Helicoverpa armigera*
Spotted pod borer	*Maruca vitrata*
Spiny pod borer	*Etiella zinckenella*
Blue butterfly	*Lampides boeticus*
Sap feeders	
Bean aphids	*Aphis craccivora*
Leaf hopper	*Empoasca kerri*
Pod bugs	*Riptortus pedestris*
White fly	*Bemisia tabacci*
Flower feeder	
Blister beetle	*Mylabris phalerata*
Pests on lab lab	
Gram pod Borer	*Helicoverpa armigera*
Spotted pod borer	*Maruca vitrata*
Spiny pod borer	*Etiella zinckenella*
Blue butterfly	*Lampides boeticus*
Sap feeder	
Bean aphids	*Aphis craccivora*
Leaf hopper	*Empoasca kerri*
Pod bugs	*Riptortus pedestris*
White fly	*Bemisia tabaci*
Flower feeder	
Blister beetle	*Mylabris phalerata*
Pest on red gram (I. Borers)	
Gram pod borer	*Helicoverpa armigera*
Blue butterfly	*Lampides boeticus*
Gram blue butterfly	*Euchrysops cnejus*
Plume moth	*Exelastis atomosa*
Spotted pod borer	*Maruca vitrata*
Spiny pod borer	*Etiella zinckenella*
Field bean pod borer	*Adisura atkinsoni*
Tur pod fly	*Melanagromyza obtusa*
Stem fly	*Ophiomyia phaseoli*
Sap Feeders	
Pod bugs	*Riptortus pedestris*
Lab lab bug	*Coptosoma cribraria*
Bean aphids	*Aphis craccivora*
Leaf hopper	*Empoasca kerri*
White fly	*Bemisia tabaci*
Eriyophid mite	*Aceria cajani*
Pests of cash crops	
American boll worm	*Helicoverpa armigera*
Pink bollworm	*Pectinophora gossypiella*
Spotted bollworms	*Earias vittella*
Spiny bollworm	*Earias insulana*
Cotton stem weevil	*Pempheres affinis* (*Pempherulus*)
Shoot weevil	*Alcidodes affaber*
Stem borer	*Sphenoptera gossypii*
Leaf roller	*Sylepta derogata*
Tobacco cutworm	*Spodoptera litura*
Ash weevils	*Mylloecerus undecimpustulatus*
Leafhopper	*Amrasca* (*biguttula biguttula*) *devastans*
Cotton aphid	*Aphis gossypii*
Thrips	*Thrips tabaci*
Red cotton bug	*Dysdercus cingulatus*
Dusky cotton bug	*Oxycarenus hyalinipennis*
Mealy bugs	*Phenacoccus* sp., *Ferrisa* sp. and *Maconellicoccus* sp.

specialized on different host plants. Herbivorous insects can also become specialized on different host plant species (Mopper, 1998). At first, this might seem unlikely because most entomopathogens cannot infect plants. However, many pathogens are ingested with plant material and persistence on the plant surface is often a major component in the entomopathogens life cycle. Insect pathogens, particularly baculoviruses, also exhibit high levels of genotypic and phenotypic variation (Johnson and Felton, 2001). Infection of the pine beauty moth *Panolis flammea* with two NPV genotypes revealed that mortality varied depending on the host plant genotype combination (Cory and Myers, 2004).

Though, the mechanisms behind these findings are as yet unknown, they could relate to changes in the virus that reduce the binding of phytochemicals to either the occlusion body or the virus particles (Listinger *et al*., 1980). Complexity and future challenges thus far, only the tip of the pyramid of complex multitrophic interactions has been exposed. The biggest challenge is to address if and how host plants mediate entomopathogen infection in field populations at the individual and population levels (Erb *et al*., 2008). From a plant-centred viewpoint, it is now apparent that there are several mechanisms by which plants could enhance the effectiveness of pathogen populations for their benefit but this concept needs to be tested directly through the determination of whether plant-mediated changes in pathogen efficacy can increase plant fitness by protecting plants against insects. It is not difficult to envisage more complex, naturally occurring interactions such as plant pathogens indirectly influencing entomopathogen-induced mortality (Duffey and Stout, 1996; Allmann and Baldwin, 2010). Interactions between more mobile natural enemies possibly modulated by plant volatiles are also likely to influence the distribution of pathogen propagules and pathogen encounter rates (Williams and Gilbert, 1981). However, this also raises the issue of how enhancing entomopathogens efficacy might interact with the effectiveness of other natural enemies and the net effect on plant and herbivore populations. Although, entomopathogens with their difficulties of detection and identification, present new challenges to the tritrophic paradigm, they also cannot be overlooked as an important player (Dicke and van Loon, 2000). Only through a consideration of these interactions will it be possible to understand the impacts of entomopathogens in the complex web of plant herbivore natural enemy relationships.

CONCLUSION

This study concluded that these promising economically important insect pests were causing remarkable impacts based upon the climatic changes also according to the nature of field crops. Crop growing possible biophysical responses of agro-ecosystems to the specific environmental changes that are anticipated as a result of the build up of global greenhouse gases and then at the range of adaptive actions that might be taken to ameliorate their effects.

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