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Research Article

Studies on Climate Change Impact on Rice Insect Pests under Eastern Uttar Pradesh Conditions

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ABSTRACT

The climate change and global warming have affected the rice insect pests scenario drastically. The impact of climate change on agriculture will be one of the major deciding factors influencing the future food security of the mankind. Rice is one of the most important staple food of the world as well as India. The duration of insect life cycle is altered under increased temperature, elevated carbon dioxide concentrations and decreased precipitation. An increase of 0.4ºC average surface temperature over past century in India[11] has led to rice insect pests losses increase from 10% during the pre green revolution period to 25% during the post green revolution period[5]. The rice plant hoppers (Nilaparvata lugens and Sogatella furcifera) in rice have reported recent outbreaks in relation to climate change in India[15]. The climate change has affected number of major insect pests of rice have increased from 3 to 15 (500 times) since 1965 to 2009 in India[8]. Meanwhile, the rice stem borers (Scirpophaga incertulas and Chilo suppressalis) and rice leaf folder (Cnaphalocrocis medinalis) have been maintaining the major insect pests status[8]. In eastern Uttar Pradesh, the rice hispa, rice cutworm, common termite, rice earhead bug, rice grasshopper and green leaf hoppers were not considered as serious insect pests till 2005, now assumed major insect pests status[8,10]. The changes in rice insect pests losses low to severe has been inference with impact of climate change on rice insect pests under eastern Uttar Pradesh conditions, while increase of 0.7º C to 1º C average surface temperature and rainfall decrease to 737 mm by 2011[6,13]. This paper attempts to analyse the review of impact of climate change on rice insect pests under eastern Uttar Pradesh conditions to reduce the risk of strategy for effective rice insect pest management.

Key words: *Climate change, Rice insect pests, Eastern Uttar Pradesh, India.*

INTRODUCTION

The climate change is long term effects of climate and weather events. The importance of climate and weather events to the distribution of insects and their population dynamics has long been recognized. The Intergovernmental Panel on Climate Change (IPCC) defines climate change as, a change in the state of climate that can be identified by changes in the mean or the variability of its properties and that persists for an extended period, typically decades or longer.

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Insects are likely to be affected by climate change, because they are ectothermic and sensitive to precipitation[2]. The current trend of global warming is the heating of global surface temperature due to emission of green house gases, over a long period of time. The global average surface temperature has increased by approximately 0.6ºC over the past century. Further, the global average surface temperature will increase by 1.4–5.8ºC over the end of 21 century and atmospheric carbon dioxide concentrations by 540–970 ppm over the same period[7]. The climate change and global warming pose significant threat to agriculture. The impact of climate change on agriculture will be one of the major deciding factors influencing the future food security of the mankind. An increase of 1- 4ºC, the grain yield reduced on average by 10% for each degree of temperature increased have been predicted in rice production in India[1]. The principal components of climate change are increased temperature and atmospheric carbon dioxide concentrations. The duration of insect life cycle is altered under increased temperature and elevated carbon dioxide concentrations resulting in variable number of generations per year. Insects are poiklo thermic in nature and are directly under the control of temperature for their growth. The elevated carbon dioxide concentrations are mediated through enhanced photosynthesis in plants for phyto phagous insects growth and development[12]. Several insect pests, that were important in the past or the minor pests are likely to become more devastating with global warming and climate change. Overwintering of insect pests will increase as a result of climate change producing larger spring population as a base for a build up in numbers in the following seasons. Many insect species that will move to newer areas as invasive pests due to climate change. The legume pod borers (*Helecoverpa armigera* and *Maruca vitrata)* presently confined to tropical climates in Asia, Africa and Latin America are most likely to move to northern Europe and North America over the next 50 years as a result of global warming and climate change[14] is now become the classical example. Insect pests cause an estimated annual loss of 13.6% globally[3] and 23.3% in India[4]. Losses due to insect pests are likely to increase as a result of change in crop diversity and climate change[15]. Rice (*Oryza sativa*) is one of the most important staple food of the world (70% of the population) as well as India (65% of the population). Uttar Pradesh shares 15% of the India rice production and occupies second position followed by West Bengal (17%) and first in rice production area. Despite this above proud credentials, Uttar Pradesh is not appearing leading position in this proud scenario. Rice is grown under different agro-climatic zones of India, which are distributed in 15 zones. Among them, Middle-Gangetic Plains Zone is belong to Uttar Pradesh. There are also 8 agro-climatic zones of rice for country and Uttar Pradesh come under, the Sub-humid Sutlez-Ganga Plains Zone. The zones are mostly a warm humid environments conductive to the survival and proliferation of insects. Reduction in damage by insect pests is one of the potential areas for increasing food production, and it is in this context that we should focus our attention on the likely effects of global warming and climate change on the activity and abuudance of insect pests and their implications for crop protection and food security[14].

Considerable knowledge is available on the effects of climate and weather events on rice insect pests in India. But concerned to the climate change, studies are in lag phase. A major portion of the cultivated areas of eastern India, especially eastern Uttar Pradesh covered under rain fed rice. Majority of the farmers in this region depend on mono crop and have poor economic background to bear any risk of the crop failure. Therefore detailed study of the climate change scenario on the basis of long term historic weather data, forecast of future scenario, its impact on yield and formulation of coping strategy are of paramount importance to reduce the risk of crop failure. This paper was attempted to analyse the reported studies on the impact of climate change on rice insect pests under eastern Utter Pradesh conditions to reduce the

risk of strategy for effective rice insect pest management.

MATERIAL AND METHODS

An extensive analysis was carried out on reported studies on the impact of climate change on rice insect pests under eastern Uttar Pradesh conditions. The eastern Uttar Pradesh is the part of eastern India comprises mainly the 10 districts of 3 administrative divisions i.e. Gorakhpur (Gorakhpur, Deoria, Kushinagar and Maharajganj), Basti (Basti, Santkabirnagar and Siddharthnagar) and Azamgarh (Azamgarh, Mau and Balia). Uttar Pradesh lies between 23º 52' and 30º 16' N latitude and 77º 48' and 84º 38' E longitude. The average minimum temperature during winter varies from 15º C to 25º C in eastern part of state. The maximum temperature during summer varies from 32º C to 46º C in south western part of the state. Annual relative humidity ranges from 60 to 70% in north eastern Tarai regions to 30- 40% in south western regions. The normal annual rainfall of the state is 947 mm[13]. Analysis was reviewed to the reported studies, Rice Knowledge Management Portal (RKMP) and Subject experts respectively.

RESULTS AND DISCUSSION

The climate change has affected the incidence of major insect pest species of rice increased from 3 to 15 (500 times) during 1965 to 2009. Meanwhile, the rice stem borers (*Scirpophaga incertulas and Chilo suppressalis*) and rice leaf folder (*Cnaphalocrocis medinalis*) have been maintaining the major insect pests status[8] (Table 1.). In eastern Uttar Pradesh, the rice hispa (*Dicladispa armigera*), rice cutworm (*Spodoptera mauritia*), common termite (*Odontotermes obesus*), rice earhead bug (*Leptocorisa acuta*), rice grasshopper *(Hieroglyphus banian*) and green leaf hoppers (*Nephotettix virescens* and *N. nigropictus*) were not considered as serious insect pests till 2005 assumed major insect pest status, Whereas the rice leaf folder (*Cnaphalocrocis medinalis),* rice stem borers (*Scirpophaga incertulas and Chilo suppressalis*) and rice plant hoppers (*Nilaparvata lugens* and *Sogatella furcifera*) have been maintaining the major insect pests status[8,9] (Table 2.). An increase of 0.4º C average surface temperature over past century in India[11] has led to rice insect pests losses increase from 10% during the pre green revolution period to 20% during the post green revolution period[5] (Table 3.). The brown plant hopper (*Nilaparvata lugens)* and white backed plant hoper (*Sogatella furcifera)* in rice have reported recent outbreaks in relation to climate change in India[15] (Table 4.).

Table 1: Impact of climate change on rice insect pests in India during 1965- 2009

Insect pests	Before 1965	1965	1970	1975	1980	1985	1990	1995	2000	2005	2009
Mites	-	-	-	-	-	-	-	*	*	**	*
Thrips	-	-	-	-	-	-	*	*	*	*	*
GLH	*	*	*	**	**	*	*	*	*	*	**
BPH	-	-	-	*	*	**	**	***	***	***	***
WBPH	-	-	-	*	*	*	*	*	**	**	**
Rice hispa	-	-	-	-	*	*	*	*	*	**	**
Leaf folder	-	-	-	-	-	**	**	***	***	***	***
Gall midge	*	*	*	*	*	**	**	**	**	*	*
Army worm	-	-	-	-	*	*	*	*	*	**	**
Gundhi bug	-	-	-	-	*	*	*	*	**	**	**
Black bug	-	-	-	-	-	-	-	*	*	*	*
Root weevil	-	-	-	-	-	-	-	*	*	*	*
Stem borers	*	*	*	**	***	***	***	***	***	***	***
Grasshoppers	-	-	*	-	-	-	-	-	-	**	**
Whorl maggot	-	-	-	-	-	-	-	-	-	**	**
No. of insect pest species	3	3	4	5	8	9	11	13	13	15	15
% increase over 1965	-	-	133	167	267	300	367	433	433	500	500

* - Low, ** - Moderate, *** - Severe

Table 2: Impact of climate change on rice insect pests in eastern Uttar Pradesh during 1995-2000

Regions / Insect pests	Uttar Pradesh			Eastern Uttar Pradesh		
	1995-2000	2001-2005	2006-2009	1995-2000	2001-2005	2006-2009
Rice hispa	-	-	**	-	-	**
Rice cutworm	-	**	*	-	**	**
Rice leaf folder	**	*	**	**	**	**
Common Termite	-	-	*	-	-	*
Rice earhead bug	-	**	**	-	**	**
Rice grasshopper	-	**	-	-	**	**
Rice stem borers	***	***	**	***	***	***
Green leaf hoppers	-	*	*	-	*	*
Rice plant hoppers	***	-	-	***	***	***

* - Low, ** - Moderate, *** - Severe

Table 3: Impact of climate change on crop insect pests losses in India

Crops	Pre-green revolution (early 1960s) %	Post-green revolution (early 2000s) %	Changes in insect pests losses %
Rice	10.0	25.0	+ 15.0
Wheat	3.0	5.0	+ 2.0
Maize	5.0	25.0	+ 20.0
Pulses	5.0	15.0	+ 10.0
Cotton	18.0	50.0	+ 32.0
Sugarcane	10.0	20.0	+ 10.0
Groundnut	5.0	15.0	+ 10.0
Other oilseeds	5.0	25.0	+ 20.0
Sorghum & millets	3.5	30.0	+ 26.5
Average	7.2	23.3	+ 16.1

Table 4: Recent out breaks of crop insect pests due to climate change in India

Insect pests	Host plants	Locations	Impacts
Sugarcane wooly aphid (*Ceratovacuna lanigera*)	Sugarcane	Karnataka & Maharastra	30% yield losses
Plant hoppers (*Nilaparvata lugens* & *Sogatella furcifera*)	Rice	Northern India	Crop falure on more than 33,000 Ha
Cotton mealy bug (*Phenacoccus solenopsis*)	Catton	Punjab & Haryana	30-40% yield losses
Papaya mealy bug (*Paracoccus marginatus*)	Papaya	Tamil Nadu, Karnataka & Maharastra	Significant yield losses

It has been concluded that, temperature has always been found to be important as a determinant for insect pests survival, growth, development, fecundity and reproduction. Insects are found to be active in a temperature range, within which their development rate increases with increases in ambient temperature. The changes in rice insect pests losses low to severe has been inference with impact of climate change on rice insect pests scenario under eastern Uttar Pradesh conditions, while increase of 0.7º C to 1º C average surface temperature and rainfall decrease to 737 mm by 2011[6,13].

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