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Integrated Pest Management Under Changing Climate

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Abstract:

Global climatic changes, due to natural and anthropogenic actions, have resulted in transformed environmental conditions which are conducive for influencing the abundance and diversity of insect pests and their natural enemies. Insects, by being poikilothermic in nature, are readily responding to the changes in climatic variables.

They are developing and progressing with geographical shifts under global warming. Their threat to food security is enhanced because global climatic changes like raised temperatures and CO_2 *levels have reduced the efficiency of host–plant resistance, effectiveness of transgenic plants, natural enemies, bio pesticides, and synthetic chemicals for insect pest management.*

The extent of these changes is expected to be elevated with upcoming climatic changes in future. In addition to biological control methods, the efficacy of chemical control would also be questionable in the future IPM programs under such abrupt weather and climatic changes.

Therefore, it is time to evaluate the plausible effects of climatic changes on insect pests, natural enemies, and control tactics to develop vigorous and effective technologies which should be effective and inexpensive in the upcoming IPM scenario under climate change.

Keywords:

Climate change, IPM, Insect pests, Insecticides, Global warming.

5.1 Introduction:

Climate change is occurring (Houghton *et al*. 1996, 2001). During the past 100 years global-average surface temperatures have increased by approximately 0.6 °C (the largest increase of any century during the past 1000 years), with the 1990s the warmest decade and 1998 the warmest year since instrumental records began (Houghton *et al*. 2001).

The Third IPCC report predicts that global-average surface temperature will increase further by 1.4±5.8 °C by 2100 with atmospheric carbon dioxide (CO2) concentrations expected to rise to between 540 and 970 p.p.m. over the same period. It is predicted that the British Isles will experience temperature and CO2 elevations of this magnitude (CCIRG 1991, 1996; Hulme & Jenkins 1998; Houghton *et al.* 2001). Precipitation, ultra-violet B (UVB) penetration and extreme events are also predicted to increase, but there is less certainty about the magnitude of these changes. The consequence of such changes for natural ecosystems presents a major challenge for biologists.

A clearer understanding of how a changing climate affects species, populations, communities and ecosystems, and of the mechanisms involved, will enable better prediction of its overall impact. Models of climate change impacts frequently fail to consider these effects; for example, the effects of herbivores, central to ecosystem structure and function (e.g. Crawley 1983; Mulder *et al*. 1999), are often either treated as constant (i.e. a black box), included as a disturbance factor, or ignored (e.g. Adams & Woodward 1992).

Insect responses to environmental change are crucial for understanding how agro-ecosystems will respond to climate change. Many insect species are pests of crops, but they also play crucial roles as parasitoids and predators of key pest species. Changes in an insect population's physiology, biochemistry, biogeography and population dynamics may occur among populations across their distribution, among the growing seasons, and among crop types. An insect population's response to a rapidly changing climate may also be variable when insects interact with different competitors, predators and parasitoids and impose costs at different life stages. This also can influence the overall food production systems that can be at critical risk from the impacts of climate change (IPCC 2014).

One of the major biotic factors are pests, which are also impacted by climate change and weather disruptions. Temperature rise directly affects pest's reproduction, survival, spread and population dynamics as well as the relationships between pests, the environment, and natural enemies. As such, it is very important to monitor pest's appearance and abundance as the conditions of their occurrence can change at a high pace. This paper will review the impact of some of the predicted climate changes, especially the rise of atmospheric carbon dioxide concentrations and temperatures along with changeable precipitation pattern effects on the biology and ecology of harmful insects, especially invasive pest species, which can be a major problem in crop production. Potential solutions for the current issues in plant production will be presented, mostly in the form of modified integrated pest management (IPM) strategies, which include IPM and the production of healthy food in an environmentally friendly way as well the monitoring techniques and modelling prediction tools.

5.2 Climate Under Change:

The climate is a crucial element that determines various characteristics and distributions of managed and natural systems, including hydrology and water resources, cry ology, marine and freshwater ecosystems, terrestrial ecosystems, forestry and agriculture. It can be explained as the phenomenon that involves changes in environmental factors such as temperature, humidity and precipitation over many years. As a result of increased temperatures, climate extremes, increased CO2 and other greenhouse gases (GHGs) as well as altered precipitation patterns, global food production is under severe threat. Global warming is a serious problem facing the world today. It has reached record breaking levels as evidenced by unprecedented rates of increase in atmospheric temperature and sea level. According to the World Meteorological Organization (WMO), the world is now about one degree warmer than before widespread industrialization. The Intergovernmental Panel on Climate Change (IPCC) also reported that each of the last three decades has been increasingly warmer, with the decade of the 2000s being the warmest. Based on a range of global climate models and development scenarios, it is expected that the Earth could experience global warming of 1.4 to 5.8 ◦C over the next century. The main cause of global warming is increased concentrations of greenhouse gases in the atmosphere. The most prevalent atmospheric gases are carbon dioxide (CO2), methane (CH4), and nitrous oxide

(N2O), which are caused by many anthropogenic activities including burning off the fossil fuels and land-use change. Among the greenhouse gases, CO2 is the most important and the most abundant. The increase in atmospheric CO2 is one of the most recorded global changes in the atmosphere in the last half century. Its concentration in the atmosphere has increased dramatically to 416 ppm, against 280 ppm reported from pre-industrial period, and is likely to double in 2100. CO2 is considered a greenhouse gas due to its high absorbance in certain wavelengths of thermal infrared radiation emitted from the Earth's surface. The greater the number of atmospheric gases that absorb thermal infrared radiation from the Earth's surface, the greater the proportion of radiation emitted from the atmosphere toward the Earth's surface. As a result, the long-wave balance of the Earth's surface becomes less negative, while more energy is available for sensible and latent heat flux at the Earth's surface. As more energy is available for heat flux, this leads to an increase in air temperature. Changes in extreme weather and climate events have been observed since the mid-20th century. Many of these changes, which have been linked to anthropogenic influences, include a reduction in cold temperature extremes, an increased occurrence of warm temperature extremes, enhanced rates of sea level rise, and an increase in the frequency of heavy precipitation events in numerous regions. Heat waves are expected to become more frequent and last longer, and extreme precipitation events are expected to be more intense and frequent in certain areas. It is very likely that the precipitation pattern will change and not be uniform. In the higher latitudes and equatorial Pacific, there appears to be an increase in mean annual precipitation. In the dry mid-latitude and subtropical regions, mean precipitation is likely to decrease, while in the wet mid-latitude regions, mean precipitation is likely to increase. Extreme precipitation events in most mid-latitude areas and humid tropical regions are likely to become more frequent and intense. The United Nations (UN) and the IPCC have made numerous decisions to reduce GHGs emissions, provide financial assistance to developing countries, and improve adaptive capacity to meet the challenges posed by the harmful effects of climate change.

5.2.1 Impact of Climate Change on Crop Pests:

Climate change is causing global shifts in temperature, precipitation patterns and CO2 and non-CO2 greenhouse gas (GHG) levels, and an increase in unpredictable, extreme weather. As a result, it is having a significant impact on global crop yields and food security

(Beddington *et al.* 2012, Challinor *et al*., 2014). Climate change is also directly and indirectly influencing the distribution and severity of crop pest, including invasive species, which is further effecting crop production (Juroszek *et al.* 2011, Lamichhane *et al*. 2015, Macfadyen *et al*. 2016).

Although the effects of climate change can be beneficial, evidence suggests that pest problems overall are likely to become more unpredictable and larger in amplitude (Gregory *et al.* 2009). Predicting the direct effects of climate change on pests is complicated by the interacting influences of increasing atmospheric CO2 concentrations, changing climatic regimes and altered frequency/intensity of extreme weather events (Gregory et al. 2009, Bebber *et al*. 2013). Projections are further challenged by the fact that climate change can exert its effects on pests indirectly.

For example, the differing responses of host crops and pest natural enemies, as well as changes in efficacy of pest control strategies (e.g. biological control, synthetic pesticides), also affect pest responses (Barzman *et al.* 2015, Lamichhane *et al*. 2015). The influence that climate change has on human activities, such as land-use changes and crop management practices, should also not be ignored, as these can have an even greater effect on pest pressure than the direct effects of climate change alone (Hoffmann *et al.* 2008, Cock *et al.* 2013).

If changing climatic factors are examined in isolation, the following impacts on pests are just a few examples of what can transpire:

- Changing precipitation (excessive or insufficient) can have substantial effects on crop–pest interactions. For example, warm and humid conditions favour many species, including plant pathogens (Hatfield *et al*, 2011), while crops suffering from water stress are more vulnerable to damage by pests (Rosenzweig *et al*. 2001).
- Increases in temperature can augment the severity of diseases caused by pathogens, and can also reduce the effectiveness of pesticides (Lamichhane *et al.* 2015). Pest populations often increase as temperatures rise, which can lead to increased applications of pesticides and fungicides, with negative external effects on the environment and human health.

- Increasing CO2 levels can lead to crop yield increases. However, any gains in yield may be offset partly or entirely by losses caused by pests (Coakley *et al.* 1999) because higher CO2 levels also stimulate pest incidence.
- Extreme weather events can influence the interactions between crops and pests in an unpredictable way, potentially resulting in the failure of some crop protection strategies (Rosenzweig *et al.* 2001, Chakraborty *et al*. 2011). Droughts can reduce populations of beneficial insects, with knock-on effects on pollination and pest infestations, while strong air currents in storms can transport disease agents (and insect pests) from overwintering areas to areas where they can cause further problems. For example, Hurricane Wilma in Florida spread citrus canker widely, destroying 170,000 acres of commercially-grown fruit trees (Sutherst *et al*. 2011). Ecosystems that have been disturbed following extreme climatic events are also more susceptible/vulnerable to invasions of alien and native species (Masters *et al*. 2010).

With all of this taken into consideration, it has been concluded that a global pattern of increasing latitudinal and altitudinal range of crop pests is anticipated, either through direct effects of climate change on the pests themselves, or on the availability of host crops (Gregory *et al.* 2009, Barzman *et al.* 2015).

Up to 40% of the world's food supply is already being lost to pests (Oerke 2006), and, as climatic environments continue to change, and further intensify and/or create new pest threats, farmers across the globe need to start adapting their farm and landscape management practices immediately. Action should not be restricted to just farm level though. The impact of enhanced pest pressure and crop losses extends beyond the farm, to local and national food security, the economy and employment, and migration. Immediate action is needed on multiple levels and geographical scales to protect food and farmers, as well as economy and welfare on national and international scales, because pestrelated yield losses due to climate change have so far gained little attention compared to human or animal health and its interaction with climate change. While science has directly addressed the issue of pest management in a changing climate, and the need to consider and revisit existing preventive agricultural practices and integrated pest management (IPM) strategies, information is often specific to a particular type of pest or geographic region.

What is lacking is a clear concept that brings all of these recommendations and tools together under one umbrella with a strong focus on adapting to climate change and recognizing the potential of pest management for climate mitigation. This approach needs to be embedded within a favorable enabling environment. Without the effective coordination of multiple stakeholders, the large-scale development and uptake of new and adaptive pest management approaches will be unsuccessful at worst and inefficient at best.

5.3 Climate Change and IPM Approaches:

With CO2 levels and temperatures increasing, precipitation becoming more variable and non-native insect species moving into new ranges, changes in insect–plant interactions and IPM regimes will be substantive and less predictable (Trumble and Butler 2009).

It is generally expected that insect chewing herbivores will consume more leaf tissue as plant nutrition is reduced (more carbon per unit of nitrogen), many insect pest species will develop quicker as they are ectotherms (or regional heterotherms) and as their internal temperature varies considerably and they respond quickly to increased temperatures.

It is generally anticipated that a changing climate and more variable weather patterns will make pests (and pathogen) attacks more unpredictable and their amplitude larger. Combined with the uncertainty of how climate change will directly impact on crop yields, the insect–plant interactions in this system remain unclear along with what effect this will have on crop productivity (Gregory *et al.* 2009). One key ecosystem change may be that glasshouse pests could become more problematic in open pastures and fields.

It is also thought that population growth and longevity of short-lived species, including insect pests, may be enhanced (Morris *et al*. 2008). Relaxed cold limitation could be one of the key drivers for exacerbating the expansion of insect pests into new regions, and a longer growing season in current regions (Diffenbaugh *et al.* 2008).

5.4 Cultural:

Changing farming and adaptive management strategies will be required to reduce the impact that agricultural pests have on crops (Thomson *et al.* 2010). This may include: (1) planting different plant varieties, (2) planting at different times of the year to minimize exposure to pest outbreaks, and (3) increasing the diversity of habitat on edges to promote natural enemy numbers. All of these strategies are used to minimize pest impact at the farm scale. Other relatively simple strategies include mulching, raised beds and shelters to conserve soil moisture, protecting crops from heavy rains, high temperatures and flooding, and preventing soil degradation. At the farm level and the microclimate level, changing farming strategies is most critical.

5.5 Crop Rotation and Diversification:

Crop rotation and diversification can build a higher level of resilience into agricultural production by reducing pest outbreaks and pathogen transmission, and buffering crop production from more frequent extreme climatic events as well as higher levels of climatic variability (Lin 2011). Increased diversity within agro- ecosystems will increase the functional ecosystem diversity of the landscape as well as increasing redundancy if species do become locally extinct. This is critical under a rapidly changing climate as biotic (e.g. pest, pathogens) and abiotic (e.g. solar radiation, temperature and precipitation) pressures are likely to change (Lin 2011; Vandermeer *et al.* 1998).

Crop rotation can assist in suppressing diseases, which are predicted to increase in prevalence under a changing climate. For example, planting oilseed, pulse and forage crops within a cereal cropping system disrupts disease cycles (Krupinsky *et al.* 2002). Increasing genetic diversity can also suppress diseases, such as fungal blast occurrence among different rice varieties. Disease-susceptible rice varieties exhibited a 89% yield increase in the Yunnan Province of China when planted in mixtures with resistant varieties, and rice blast (the major disease of rice) was reduced by 94% (Zhu *et al*. 2000).

Structural diversity can also suppress pests. Unharvested Lucerne refuge strips provide habitat for natural enemies of Helicoverpa (Noctuidae: Lepidoptera), and the unharvested refuge strips are ideally placed 30m apart to allow natural enemies to work as effective biological controls in the harvested strips (Hossain *et al*. 2002). Non-crop vegetation can be used to develop ‘beetle banks’ at field margins that can be used as overwintering habitat for natural enemies (Collins *et al.* 2002; Thomas *et al.* 1991). With a warmer and drier climate, these refuges can also increase the microclimate diversity of a farm, providing opportunities for climatic respite associated with extreme temperatures in a relatively homogenous production landscape.

Having a polyculture can assist with climate change buffering. In dealing with local variability and disturbance, small holder farmers in varying cropping regions (e.g. north-east Tanzania and east-central Sweden) use wild varieties and a diversity of crops, spatially and temporally, to enhance their capacity to deal with agro-ecosystem changes.

5.6 Biological Factors:

Methodologically, most assessments of parasitoids and predators have been done at constant temperatures. Bahar *et al*. (2012) found that fluctuating temperatures in laboratory conditions (particularly lower temperatures) can substantially change the developmental period of pest herbivores (in their case the diamondback moth) and its parasitoid.

Short-term temperature fluctuations can cause substantial stress on both pest species and their natural enemies, which can then have substantive influences on their interactions (Chidawanyika *et al.* 2012). Insect biology of both pests and natural enemies in agro-ecosystems, including generation times, sex ratio, lifespan, fecundity, activity, distribution and survival, are all affected by temperature extremes and fluctuations (Duale 2005; Hance *et al*. 2007; Kalyebi *et al.* 2005; Liu *et al.* 1995; Sorribas *et al*. 2012).

There may also be spatial and temporal mismatches between pests and their natural enemies which will reduce the efficacy of biocontrol agents, and predicting these impacts will be difficult without a thorough understanding of the tritrophic interactions among species (Thomson *et al.* 2010)

5.7 Pesticides:

With a doubling of maize, wheat and rice production worldwide since the 1960s, there has been a 15–20-fold increase in pesticide use (Oerke 2006). Additionally, as crop yield has increased, due to the use of high-yielding varieties, soil and water management, fertilization and cultivation methods, there has been an increase in crop loss due to pests. Many new varieties of crops are more reliant on pesticides as they have lower tolerance to competitors and herbivory, as much of the inbuilt resilience is bred out (Oerke 2006). With the expectation of more insect pest outbreaks and that global food production needs to increase by 50% to meet the 2050 global population needs, it is assumed that food security using a range of pesticides will be one of the more sought-after tools of management (Chakraborty and Newton 2011).

Pesticide applications are the primary method of managing pests in the industrialized world (Ziska 2014). The application of pesticides is correlated with temperature at sites and site minimum temperature can serve as a proxy for pesticide application. For example, Ziska (2014) assessed pesticide applications on soybean along a 2100km latitudinal gradient in the USA and found that soybean yields did not vary over the gradient, while total pesticide application increased from 4.3 kgha−1 active ingredient in Minnesota (having a minimum daily temperature of –28.6°C) to 6.5kgha−1 active ingredient in Louisiana (–5.1 °C minimum daily temperature).

The authors of this study suggest that, with a changing climate, herbicide use will increase in the more temperate regions, whereas there will be a greater increase in insecticide and fungicide use closer to the tropics (Ziska 2014). This is due to the fact that, in temperate regions, warming enhances growth and insect reproductive output, as well as survival (Patterson *et al*. 1999). In some cases, exposure to sublethal concentrations of pesticide could lead to cross- tolerance of temperature and the insecticide. An example of this is the brown planthopper (Nilaparvata lugens) which attacks rice crops in Asia (Ge *et al*. 2013).

When brown plant hoppers were exposed to sub lethal concentrations of the commonly used insecticide triazophos (40ppm) at 40°C, mortality was reduced from 94% to 50% and lethal mean time (LT50 based on a Gompertz model) was increased by over 17 hours, compared to a control (tap water and the non-active substances dimethyl sulfoxide and emulsifier). The authors found that, when insecticide usage increased, Hsp70 and arginine kinase were upregulated, both being critical for the brown plant hopper’s survival and thermotolerance. This indicates that a sub lethal stress induced by an insecticide can initiate cross-tolerance to temperature. From the agricultural perspective, this indicates that the brown plant hopper population that is exposed to sub lethal concentrations of triazophos will increase cross-tolerance and reproductive potential. If pesticides become a trigger for induced thermotolerance, then pests may be able to survive hotter temperatures and cause more damage to sensitive crops.

5.8 Semi Chemicals:

The signaling chemicals (semi chemicals) which cause changes in the behaviour of other living organisms (Dicke and Sabelis 1988) play a critical role in IPM. The use of pheromones (which act between individuals of the same species) and allele chemicals (acting between species, including kairomones which benefit the receiver, alimonies Effect of Climate Change on Insect Pest Management 213 which benefit the emitter and synomones which benefit both) is a key method that insects use to sense their environment. Their use in monitoring, trapping, mating disruption, push-pull strategies and biological controls makes them ideal for a range of IPM techniques (Heuskin *et al.* 2011; Wajnberg and Colazza 2013).

Temperature, humidity and air speed can have critical impacts on the effectiveness of semi chemicals (Heuskin *et al.* 2011). For example, Cork *et al*. (2008) used PVC-resin controlled-release formulations to deliver sex pheromones to the yellow rice stem borer at a range of temperatures (from 22°C to 34°C). The temperature used highly influenced pheromone rates, with half-lives of the sex pheromone decreasing with an increase in temperature.

Temperature has also been shown as the critical environmental variable influencing volatile release rates in moth sex pheromones (van der Kraan and Ebbers 1990), light brown apple moth pheromones (Bradley *et al*. 1995), tsetse fly kairomones (Torr *et al.* 1997) and waterbuck odors to control tsetse fly (Shem *et al.* 2009), oriental fruit moth pheromone (Atterholt *et al.* 1999) and sawfly sex pheromones (Johansson *et al*. 2001).

As the annual climate warms across agricultural landscapes, and as microclimates become more variable, it would be anticipated that the use of these volatiles in their current forms may become less effective and may require a synergist or other compounds to reduce their volatility under high temperature regimes.

5.9 Reproductive Control:

The sterile insect technique (SIT) is a critical method used to control insects (Knipling 1959) which releases radiation-induced sterile males into wild populations to reduce the number of offspring after mating with wild females. It is a key method used to control Ceratitis capitate (Tephritidae: Diptera) worldwide (Robinson 2002). One of the strains of C. capitata has a temperature sensitivity gene, tsl, which makes the homozygous female embryos sensitive to high temperature mortality (compared to males) after 24 hours of development (Fisher 1998; Robinson 2002). Females remain sensitive to temperature throughout their lifetime, but the impact of the tsl gene mutation or the effect of irradiation on released males in the field are currently unknown (Nyamukondiwa *et al*. 2013). In South Africa, populations increase once sufficient degree days have accumulated, and they decrease as temperatures fall below minimum critical temperatures. Individuals expressing the tsl mutation exhibit a higher critical thermal maximum and greater longevity in the field compared to wild-type individuals, indicating that the sterile insect technique may be more effective in a warming climate (Nyamukondiwa *et al.* 2013). This advantage of lab-reared sterile males could enhance their usefulness as a pest management tool under a warming climate.

5.10 Long-term Monitoring:

One of the key requirements to determine if climate change is changing the population dynamics of pest species is having access to long-term data (Yamamura *et al*. 2006). Without this key baseline data, it is extremely difficult to fully assess changes in pest and beneficial populations with changing climate regimes and predict future population dynamics. However, data covering population dynamics of populations over 50 years are very sparse, with only a few examples, such as annual light trap catches in Japanese rice paddy fields for 50 years (Yamamura *et al.* 2006), aphid suction trap 214 Environmental Pest Management catches at Rothamsted, UK, also for 50 years (Bell *et al*. 2015), and a 1910-year record of locust outbreaks in China based on a reconstructed time and abundance series (Tian *et al*. 2011). A lack of long-term data makes predicting pest outbreaks extremely difficult across most agro-ecological regions, and makes modelling population dynamics tenuous when attempting to align with changing climate regimes in different regions. In addition, any long-term assessment of parasitoid/predator–host/prey interactions and changes in trophic level interactions is not available, making predictions of community assemblage changes in agro-ecosystems with climate change even more difficult.

5.11 Directions for Future Research:

Agricultural impact assessment based on changing yields due to increased pressures from pests due to climate change is still in its infancy (Gregory *et al.* 2009; Scherm 2004). However, it is clear that human-induced climate change will have impacts on all aspects of IPM systems, pest outbreaks, pollinator synchrony with flowers, efficiency of crop protection technologies, and parasitoid and predator effectiveness (Sharma 2014). Biological responses to climate change, particularly changes in temperature, can be based on threshold-level responses rather than linear responses, and when interactions occur with other climatic changes and biological adaptation, responses at all levels will be complex (Benedetti-Cecchi et al. 2006; Gutschick and BassiriRad 2003; Thompson *et al.* 2013b).

There is a critical need for continued assessment of biological responses to climate change within and among species (Andrew 2013; Andrew and Terblanche 2013), particularly in the field and at critical life history stages which are vulnerable to the abiotic and biotic impacts of climate change. For many crops, pesticides are still the main form of pest control (Nash and Hoffmann 2012). Under a changing climate, insect pests are likely to become more damaging, especially if the current worldwide broad-spectrum spraying regimes continue. For IPM to be adopted more fully within cropping systems, regimes that increase management strategy flexibility, such as those outlined by Nash and Hoffmann (2012), need to be implemented. This requires a greater understanding of pest population dynamics, thermal physiology, ecology, behaviour and core IPM priorities of host plant resistance, area-wide management, emergency chemical control when required, and predictive modelling tools when controlling pests in a more variable climate (Nguyen *et al.* 2014; Sutherst *et al.* 2011).

A more holistic inclusion of different management regimes including resistant cultivars, preservation of natural enemy activity, utilizing thresholds, use of pheromones, use of selective insecticides in preference to broad-spectrum usage, landscape manipulation, tillage management, crop rotation, biological control (naturally occurring and safely introduced, classic, mass-reared natural enemies) within an adaptive management context will be critical for managing insect pests in agro-ecosystems within a rapidly changing climate. To address this challenge, climate-smart pest management (CSPM) approach has been developed. It provides more focus on management of various plant pests in the context of climate change, and involves all key actors in the production chain: farmers, research institutes, advisory services, and governmental bodies.

5.12 Conclusion:

Climate change now a day is globally acknowledged fact. It has serious impacts on diversity, distribution, incidence, reproduction, growth, development, voltisim and phenology of insect pests. Climate changes also affect the activity of plant defense and resistance, bio pesticides, synthetic chemicals, invasive insect species, expression of Bt toxins in transgenic crops. Considering such declining production efficiency due to depleting natural resource base, serious consequences of climate change on diversity and abundance of insect-pests and the extent of crop losses, food security for 21st century is the major challenge for human kind in years to come. Being a tropical country, India is more challenged with impacts of looming climate change. In India, pest damage varies in different agro-climatic regions across the country mainly due to differential impacts of abiotic factors such as temperature, humidity and rainfall. This entails the intensification of yield losses due to potential changes in crop diversity and increased incidence of insect-pests due to changing climate. It will have serious environmental and socio-economic impacts on rural farmers whose livelihoods depend directly on the agriculture and other climate sensitive sectors. Dealing with the climate change is really tedious task owing to its complexity, uncertainty, unpredictability and differential impacts over time and place. Understanding abiotic stress responses in crop plants, insect-pests and their natural enemies is an important and challenge ahead in agricultural research. Impacts of climate change on crop production mediated through changes in populations of serious insect-pests need to be given careful attention for planning and devising adaptation and mitigation strategies for future pest management programmes. Therefore, there is a need to have a concerted look at the likely effects of climate change on crop protection, and devise appropriate measures to mitigate the effects of climate change on food security.