C. Chattopadhyay and D. Prasad (eds),
Dynamics of Crop Protection and Climate Change

Impact of Climate Change on Insect Pests Management in Fruit Crops

2

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Most organisms, including humans, depend upon renewable resource species for their survival; and weather in the short run and climate in the long run are highly important determinants of the distributions and abundance of all species (Andrewartha and Birch 1954). In natural and agro-ecosystems, weather determines much of the within season phenology and dynamics of species. In agriculture, weather affects crop yield and quality as well as the dynamics of pests and their regulation by natural enemies; regulation that largely goes unnoticed by humans (De Bach 1964).

Climate change is already widely considered a reality (IPCC 2007). The last assessment report from the Intergovernmental Panel on Climate Change (IPCC) predicts an increment in mean temperature from 1.1 to 5.4°C toward the year 2100 (Meehl *et al.* 2007). An increment of this magnitude is expected to affect global agriculture significantly. In addition, such changes in climatic conditions could profoundly affect the population dynamics and the status of insect pests of crops. Climate change influences on insect pests are mainly plant mediated. These effects could either be direct, through the influence that weather may have on the insects physiology and behavior, or may be mediated by host plants, competitors or natural enemies. A review was carried out of 1700 species range shifts, showing an average 6.1 km movement per decade towards the poles, and spring events advancing by 2.3 days per decade (Parmesan 2006).

Climate warming could influence crop production in at least three ways:

- Direct effect of changes in temperature, precipitation, and carbon dioxide (CO_2) levels on plant growth and health.
- Indirect effect on plant health via climate-induced changes in herbivore and competitor distribution and abundance.
- Indirect effect on plant health via changes in higher trophic level interactions of

predation, parasitism, and competition on herbivore and/or competitor distribution and abundance.

These changes have drastic impacts on the economy of agriculture based, biodiversity rich countries like India. Global warming is predicted to have a dramatic impact on many species (Table 2.1). For insects, in particular, evidence of a response to long-term environmental trends, directly or indirectly linked to recent climate warming, are accumulating quickly. This includes northern and altitudinal shifts in geographical range, increased number of generations for multivoltine species, increased winter survival and prolonged diapauses. Anticipated patterns of climate change will have multiple interactive direct effects on the physiology of both plants and herbivores. The climate change appeared to have impacted environmental factors influencing crop phenology aspects, viz. flower bud differentiation, intensity of flowering, maturity period, fruit yield along with quality, physiological disorders and pests and diseases incidence, that could render either decimation of traditional areas or ensure additional areas becoming feasible for production of these crops. Climate change can influence interactions between plant and herbivores in many ways. For example, expected environmental changes in carbon dioxide levels, temperature, cloud cover, and water and nutrient availability will affect plant susceptibility to herbivores (Johnson and Lincoln 1991). Climate change will also directly affect herbivores nutritional requirements, development time and overwinter survival (Solbreck 1991). In addition, herbivores will experience the indirect effect of changes in food quality. This global change will alter the nature and strength of many plant herbivore interactions and will sometimes yield dramatic consequences at the level of populations, communities and ecosystem. This development may compromise the ability of many growers of temperate fruits and nuts to successfully produce the same array of crops as in the past.

Table 2.1 Impact of Climate Change on Insect Pests

Variable	Mode of Action	Effect (+/-)	Impact
Increased CO_2	Increased C:N ratio resulting increased plant size and canopy density	-	Increase feeding of herbivore to derive more amino acids
		-	Greater fungal spore production, favours pathogens
	Lower decomposition rate could increases the crop residue	-	Pest can overwinter, resulting in higher inoculum levels at the beginning of the growing season

Contd.

Few Pages are not available

Conclusion

Insect pests had a tremendous impact on fruit crops. The change in climatic conditions is a concede warning or hot line for fruit trees. Projected warming may also result in increases in the number of generations per season of a primary insect pest and the number of necessary pesticide applications. The current pace of environmental change demands new approaches to accelerate the adoption of new pest management technology. Crop and pest managers will have to become more 'nimble' in order to cope with the accelerating dynamism of global change. There is a need for decision makers in government, industry and other policy makers to understand the wider issues in maintaining effective pest management systems in the face of change and recognition given to the type of information needed. When predicting direct effects of climate change, phenotypic and genotypic flexibility of herbivores and parasitoids and interactions between species need to be considered. Enhanced evaluation of available genetic resources to identify promising accessions for such pests is an option for mitigating damage by such changes in intensity of specific pests. There is a need to focus on standardization of pest management practices for use in case of changed climatic conditions. Similarly, pest identification, pest management methods, of currently less serious pests, should be available for ready use in case of changed conditions of their infestation and infection. Facilities for speedy research on any new pests should be considered. Given the scale of the challenges we face to mitigate the impacts of climate change, the time is right to intensify goal-oriented interdisciplinary research in order to provide the urgently needed, and cost-effective technical solutions for sustainable insect management worldwide. Once enough is known about the effects of climate change on the different interacting components of tri-trophic networks and ultimately crop yield, useful predictions for future planning might become possible about climate change effects.

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