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

Pest Scenario, Plant Protection Approaches in the Current Context of Changing Climate

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Climate change is possibly the most significant global change event that has attracted the attention of scientific community all over the globe (Firake *et al.* 2013). Climate change refers to any significant change in measures of climate such as temperature, precipitation or wind lasting for an extended period of time. The main cause of climate change is global warming. Global warming is an average increase in temperature of atmosphere near the earths' surface and in troposphere which can contribute to changes in global climate patterns. Global warming occurs mainly by an alarming increase in the concentration of greenhouse gases (GHGs) like carbon dioxide (CO_2), methane (NH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs) in the atmosphere due to natural processes or human activities like deforestation, urbanisation, burning fuels and desertification etc. These greenhouse gases trap the outgoing infra-red radiations from the earth's surface and thus raise the temperature of atmosphere. During the last 100 years global-average surface temperature has increased by approximately 0.6°C (Houghton *et al*. 2001). The expected rate of increase is now 0.1°C per decade (Kerr 1998). The third Intergovernmental Panel on Climate Change (IPCC) report predicts that, global average surface temperature will increase by 1.4-5.8°C by 2100 with atmosphere CO_2 concentrations expected to rise between 540 and 970 ppm over the same period. Mahlman (1997) predicted that a doubling of atmosphere CO_2 (from a current concentration of 360 ppm) would result in a warming between 1.5°C and 4.5°C. The rate of evaporation would increase in a warmer climate, which would lead to an increase in global precipitation of 2±0.5% per 1°C warming. Decrease in soil moisture because of increased temperature has also been predicted, although this could be offset by simultaneous increase in precipitation. Ultra-violet B (UVB) penetration and extreme events (e.g., flooding, storming and drought) are also predicted to increase, but there is less certainty about the magnitude of these changes.

By the end of this century, the global average sea level will rise between 0.18 and 0.59 meters above the 1980-1999 average.

In developing countries like India, climate change could represent an additional stress on ecological and socioeconomic systems that are already facing tremendous pressures due to huge growing population, rapid urbanization, industrialization, and economic development. The various studies conducted in India have shown that the surface air temperatures in our country are going up at the rate of 0.4°C per hundred years, particularly during the post-monsoon and winter season. Using models, they predict that mean winter temperatures will increase by as much as 3.2°C in the 2050s and 4.5°C by 2080s, due to greenhouse gases. Summer temperatures will increase by 2.2°C in the 2050s and 3.2°C in the 2080s. Extreme temperatures and heat spells have already become common over northern India, often causing loss of human life. In 1998 alone, 650 deaths occurred in Orissa due to heat waves. Climate change has had an effect on the monsoons too. Subtle changes have already been noted in the monsoon rain patterns by scientists at IIT, Delhi. They also warn that India will experience a decline in summer rainfall by 2050. A trend of sea level rise of 1 cm per decade has been recorded along the Indian coast. Sea level rise is expected to be about 25-40 cm by 2050. This could inundate low lying areas, erode beaches, cause flooding and increase the salinity of rivers.

With the signs of climate change becoming more and more concrete with each passing year, concerns about its possible implications for various sectors of life on the Earth are also escalating. On account of its close association with climatic variables such as temperature and precipitation, agriculture is definitely the most climate-sensitive sector. Thus, the possible impact of climate change on agriculture has been the most important research topic and intensively debated in recent times. Insects are the most diverse group of animals on Earth. There are over a million described species of insects, and an estimated 6-10 million species of total (Anonymous 2013a). Worldwide, an estimated 570,000 species may go extinct by year 2100 (Stein and Flack 1997). Many of insects are the pest of crops, animals, household and stored products and in terms of monetary value, the Indian agriculture currently suffers an annual loss of about Rs 8,63,884 million due to insect pests (Dhaliwal *et al*. 2010) Climate change is possibly the most significant global change event that has attracted the attention of scientific community all over the globe. The possible effects of changing climate on insects could result in their outbreaks, migration, change in biodiversity, species extinction, change in host shift, and emergence of new pests or biotypes (Firke *et al.* 2013).

Effect of Rising Temperature on Insects

Growth and development of insects are dependent on several environmental factors including temperature, light and humidity. Insects are cold-blooded (poikilothermic) organisms – the temperature of their bodies is approximately the same as that of the

Few Pages are not available

Durability of resistance may be threatened, however, if the number of infection cycles within a growing season increases (Coakley *et al*. 1999).

Increasingly, plant breeders will need to combine pest resistance with tolerance to factors such as heat and drought when they develop new varieties. The search for such tolerance has made good progress in a few dryland cereals, such as pearl millet, sorghum and durum wheat, but has been less successful or hardly attempted at all in most other crops. Flexible global arrangements will be needed to facilitate the speedy exchange of germplasm with the necessary resistance characteristics (Bambawale *et al.* 2009).

With the changing climate, there has been decline in pollinator population. Increased temperatures results in early flowering thus depriving the crop from pollination due to lack of pollinator population as happened during 2007 in mango crop in Andhra, which flowered three months early. During 2000, almond flowered three months early, thus, causing total loss. Under such situations, bee colonies need to be erected. Moreover, a different set of pollinator assembalage with different traits and responses to ambient conditions will be one of the best ways to minimise risks due to climate change.

During the *National Conference on Climate Change and Indian Agriculture* organized by ICAR in October 2007, emphasize was laid on developmental projects for adoption to strengthen surveillance of pest and diseases and to establish a science based 'Agricultural Intelligence System' to facilitate understanding of impact of real time weather and other inputs on production of important commodities (Bambawale *et al.* 2009).

There is a need to predict and map potential changes in geographical distribution of various pests and study how climatic changes will affect incidence and population dynamics of these pests. An understanding of how climate change and shifts in agro ecosystems will influence the natural enemies is also very important. We need to understand effect of climate change on the effectiveness of transgenic crops in pest management and assess the efficacy of various pest management technologies under diverse environmental conditions (Sharma 2009). Identification and utilisation of stable sources for developing crop varieties with greater resistance is another important step to reduce the impact of climate change on crop damage. There is a need to develop integrated pest management strategies for minimizing the damage by pests to mitigate the impacts of climate change to reduce crop losses and improve food security.

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