Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 03, Issue: 04 (JULY-AUGUST, 2023)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Climate Change and Agricultural Insect Pests

(*Geeta Devi, Lomash Kumar and Rahul Saini)
Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India
*Corresponding Author's email: geetbishnoi0029@hau.ac.in

The term "climate change" refers to a gradual increase in the average temperature of the Earth's atmosphere and oceans, which is assumed to be permanently changing the planet's climate. The average world temperature has been steadily increasing since 1900, rising by 1°C on average. Although India has experienced a 0.2°C to 1°C rise in temperature, while North western or North America has experienced the greatest increase. The pace of global warming is also quickening; over the past 50 years, temperatures have risen twice as quickly as they did over the previous 100. It is expected that by 2070, the average temperature in India will increase by up to 1.7°C in the kharif (July to October) and up to 3.2°C in the rabi (November to March) seasons, while the average rainfall will rise by 10% (Gupta, 2011). Climate change and global warming are two of the most debated issues in today's society and have a significant impact on agriculture. The effects of changing patterns of precipitation, increasing atmospheric CO_2 concentrations, and hotter temperatures on agricultural production and agricultural insect pests are all considerable. Climate change can affect pest insects in a number of ways. They may also lead to changes in the number of generations produced, the overwintering survival rate, the synchrony between plants and pests, the interaction between species, the risk of migratory pest invasion, the frequency of insect-transmitted plant diseases, and the biological control, particularly natural enemies, which may become less effective. As a result, both the safety of humans and the likelihood of significant crop economic losses are at risk. Adaptive control strategies will be required since climate change significantly influences the dynamics of insect population. Prioritisation of future research on the effects of climatic changes on agricultural insect pests can be done using a variety of criteria. Some of the tactics include modified integrated pest management techniques, monitoring of the climate and pest population, and the use of modelling prediction tools.

Effect of different weather parameters on insect pests

Rainfall pattern: Planting season timing is less predictable as a result of climate change. *Helicoverpa armigera* can injure pigeonpea plants, which were delayed by 45 days in 2009's wet season and sustained substantial damage (Sharma, 2010). Similar to how temperature changes affect illnesses and parasites, fluctuations in precipitation can have an impact on pest insect predators. Since fungi that cause bacterial infections in insects thrive in high humidity, environmental changes that lengthen high humidity periods and reduce them when they result in drier conditions would both enhance and decrease their prevalence. It is important to keep in mind that some insects are sensitive to precipitation and are killed or removed from crops by heavy rainfall when choosing management options like onion thrips (Reiners and Petzoldt, 2005).

Temperature: Many consequences of rising temperatures on insect performance can be attributed to the direct effects of temperature on insects. Because they are exothermic, insects usually become more active in warmer weather. High temperatures can result in increased intake rates and a shortened pupation period. In some circumstances, this raises the potential number of generations per season and reduces the organisms' visibility to natural predators. A 2^{o} C temperature increase is thought to cause insects to experience one to five extra life cycles every season (Yamamura and Kiritani, 1998). Higher temperatures enhance gipsy moth performance by reducing their growth time and increasing their survival rate (Williams et al., 2003). When temperatures rise, the nun moth, another species in its genus, has a significantly different survival rate. If gipsy moth populations adapt to new habitats better than competing species, outbreaks may become more common. Elevated temperatures (on the scale of anticipated global warming) can also have an impact on plant phenotypes directly, but typically not to the same extent as elevated CO_2, and those factors (such as total non-structural carbohydrates, starches, and sugars) typically have less of an impact on insect herbivores than host-plant traits affected by elevated CO_2.

Carbon di-oxide (CO_2): Host plants growing in high CO_2 conditions often provide less nutrition for insect herbivores, which might affect how they behave and how effectively they feed. The nutritional content of the leaf material utilised by insects is typically decreased by phenotypic host-plant changes. As a result, insects have more difficulty in converting the food they eat into biomass. To counteract the effects of food that is less nutrient-dense, insect herbivores frequently consume more. Leaf nitrogen level is positively correlated with insect herbivore performance. Zvereva and Kozlov (2010) found that mustard and collard grown in high CO_2 settings have reduced leaf nitrogen content. The water content of the leaf has a favourable correlation with the performance of insect herbivores that consume on leaves. When collard & mustard plants exposed to elevated CO_2, the water content of the leaves decreased.

Plants can also defend themselves mechanically by growing tough leaves or by acquiring traits like leaf trichomes. Mechanical defence levels are adversely correlated with herbivore performance. Increased CO_2 caused a rise in radish trichome density. Increased CO_2 has also been linked to improvements in mechanical defence, with the majority of these studies concentrating on leaf toughness, leaf thickness, and specific leaf weight. Hamilton et al. (2005) found that cabbage white butterflies fed mustard or collard grown in high CO_2 levels resulted in a greater percentage of leaf damage or consumption. Leaf miners have generated similar outcomes on a number of woody plants. Zvereva and Kozlov (2010) found that elevated CO_2 has a considerable negative impact on the performance of insect herbivores. They found that herbivore populations were smaller on plants cultivated in elevated CO_2 than on plants grown in ambient CO_2. A major element to this is undoubtedly the higher mortality rates caused by parasitoids and other natural enemies. Due to the improved visibility of their prey at higher CO_2 concentrations, natural enemies are believed to be more successful. Insects typically take longer to mature, which allows their natural predators to catch them earlier. Higher consumption rates serve as indications for natural enemies in addition to increased leaf damage and frass production.

Climate change has an impact on the diversity, incidence, reproduction, growth, development, voltinism, and phenology of insect pests. Increases in population and activity of insect pests can be attributed to factors such as rising global temperatures, disrupted rainfall patterns, altered gaseous composition, etc. The more recent problems this situation has raised for food security have had an influence on the quality and quantity of agricultural products. Despite the fact that species-specific effects of climate change differ, the overall trend seems to be an increase in pest activity and population as well as harm to agriculture. The global food output is already significantly harmed by such an abundance of insect pests. The pest population is moving longitudinally and latitudinally in order to survive and adapt. Pest species are now primarily found in more recent places where they were previously absent. Environmental changes have led to a rise in the spread and population of insect pests. Numerous animals have evolved defence mechanisms and the ability to adapt to different environments. Pest outbreaks, a resurgence of pests, and an increase in insect adaptability brought on by an increase in agricultural pests limit the production of food crops in the required quality and quantity. As a result of growing population and increased food demand, global agriculture will face a crisis in the potential production of agricultural commodities, endangering human food security.

References

1. Gupta, H.S. (2011). Climate change and Indian Agriculture: Impacts, mitigation and adaptation. In: *Proceedings of Xth Agricultural Science Congress on Soil, Plant and Animal Health for Enhanced and Sustained Agricultural Productivity*, 10-12th February 2011, ICAR-NBFGR, Lucknow, India, pp.73-81.
2. Hamilton, J.G., Orla, D., Mihai, A., Arthur, R.Z., Alistair, R., May, R.B. and Evan, H.D. (2005). Anthropogenic changes in tropospheric composition increase susceptibility of soybean to insect herbivory. *Environmental Entomology*, 34(2): 479-485.
3. Reiners, S. and Petzoldt, C. (2005). Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production. Cornell Cooperative Extension Publication #124VG
4. Sharma, H.C. (2010). Effect of climate change on IPM in grain legumes. In: *5th International Food Legumes Research Conference (IFLRC V), and the 7th European Conference on Grain Legumes (AEP VII)*, 26-30th April 2010, Anatalaya, Turkey.
5. Williams, R.S., Lincoln, D.E. and Norby, R.J. (2003). Development of gypsy moth larvae feeding on red maple samplings at elevated CO_2 and temperature. *Oecologia*, 137: 114-122.
6. Yamamura, K. and Kiritani, K. (1998). A simple method to estimate the potential increase in the number of generations under global warming in temperate zones. *Applied Entomology and Zoology*, 33: 289-298.
7. Zvereva, E.L. and Kozlov, M.V. (2010). Responses of terrestrial arthropods to air pollution: a meta-analysis. *Environmental Science Pollution Research International*, 17: 297-311.