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Impact of Climate Change on Insect Pests

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Climate change is defined as "Change in climate over time, either due to natural variability or as a result of human activity". Anthropogenically induced climate change arising from increasing levels of atmospheric greenhouse gases would likely to have a significant effect on agricultural pests. Changes in climate may trigger changes in geographical distribution, increased overwintering, change in population growth rates, increase in the number of generations, extension of the development season, changes in crop-pest synchrony, changes in interspecific interactions, pest biotype, activity and abundance of natural enemies, species extinction, increased risk of invasion by migrant pests and efficiency of crop protection technologies. Global warming will also reduce the effectiveness of host plant resistance, transgenic plants, natural enemies, bio-pesticides and synthetic chemicals for pest management. The global mean surface temperature is predicted to increase by 1.4 to 5.8˚C from 1990 to 2100. Such changes in climate and weather could profoundly affect the population dynamics and status of insect pests of crops. The change in the environment affects the pest population dynamics in two ways either directly or indirectly by altering the host physiology.

Insects and plants are exposed to complex interactions among changes in temperature, precipitation and increased levels of carbon dioxide and variations in nutrient availability. Higher frequency of abiotic disturbance and its gradual changes might affect the population dynamics parameters like development and reproduction, diapauses, winter mortality, flight and dispersal.

Effect of increasing Temperature on insect pests

Increase in temperature might affect any stage of the insect life cycle and therefore limit distribution and abundance through its effects on survival, reproduction and development, diapauses and winter mortality and migration of insects.

(a) **Survival rate of insects:** In case of aphids a 2˚C temperatures increase causes one to five additional life cycles per season. The adult survival of the brown plant hopper, *Nilaparvata lugens* remained almost unchanged between 25 to 35˚C, but was drastically reduced at 40˚C. In another pest species, survival of different stages of the rice leaf folder *Cnaphalocrocis medinalis* was greatly affected at 35˚C.

(b) **Development and reproduction:** In rice ear head bug, *Leptocorisa acuta*, the 0.5 and 2˚C rise in daily average caused no affect on the generation time but 3˚ C rise caused 1 to

3 days increase in generation time. The egg predator (*Cyrtorhinus lividipennis*) had increased instantaneous attack rates and decreased handling times with increasing temperatures until 32˚C. At 35˚C the attack rate and handling time decreased drastically.

(c) **Growth rate of insects:** The rate of development of pests will enable a more rapid response to a change in temperature. The population of *Nephotettix cincticeps* will increase by a ratio of from 3 to 4. The rise in temperature beyond 3˚C, affects the population growth of rice ear head bug.

(d) **Diapauses and winter mortality:** Accelerated metabolic rates at higher temperature shorten the duration of insect diapauses due to faster depletion of stored nutrient resources. Warming in winter may cause delay in onset and early summer may lead to faster termination of diapauses in insects, which can then resume their active growth and development. Winter mortality of adults of *Nezara viridula* and *Halyomorpha halys* is predicted to be reduced by 15 % by each rise of 1˚C and in *C. suppressalis* two generation per year after 2˚C warming.When the average environment temperature has increased , higher mortality has been observed for caterpillars of *Lymantria monacha*, where as the survivability of *L. dispar* larvae has increased.

(e) **Migration and movement:** Temperature thresholds for insect flight vary both among and within species, with season and also with region. In the aphid. *Aphis fabae* , 17˚C is required for take-off, 15˚ C for sustained upward flight, 13˚C for horizontal flight and 6.5˚C for wing beating. Insect emergence and first appearance after hibernation may depend on the combination of day length and temperature thresholds.

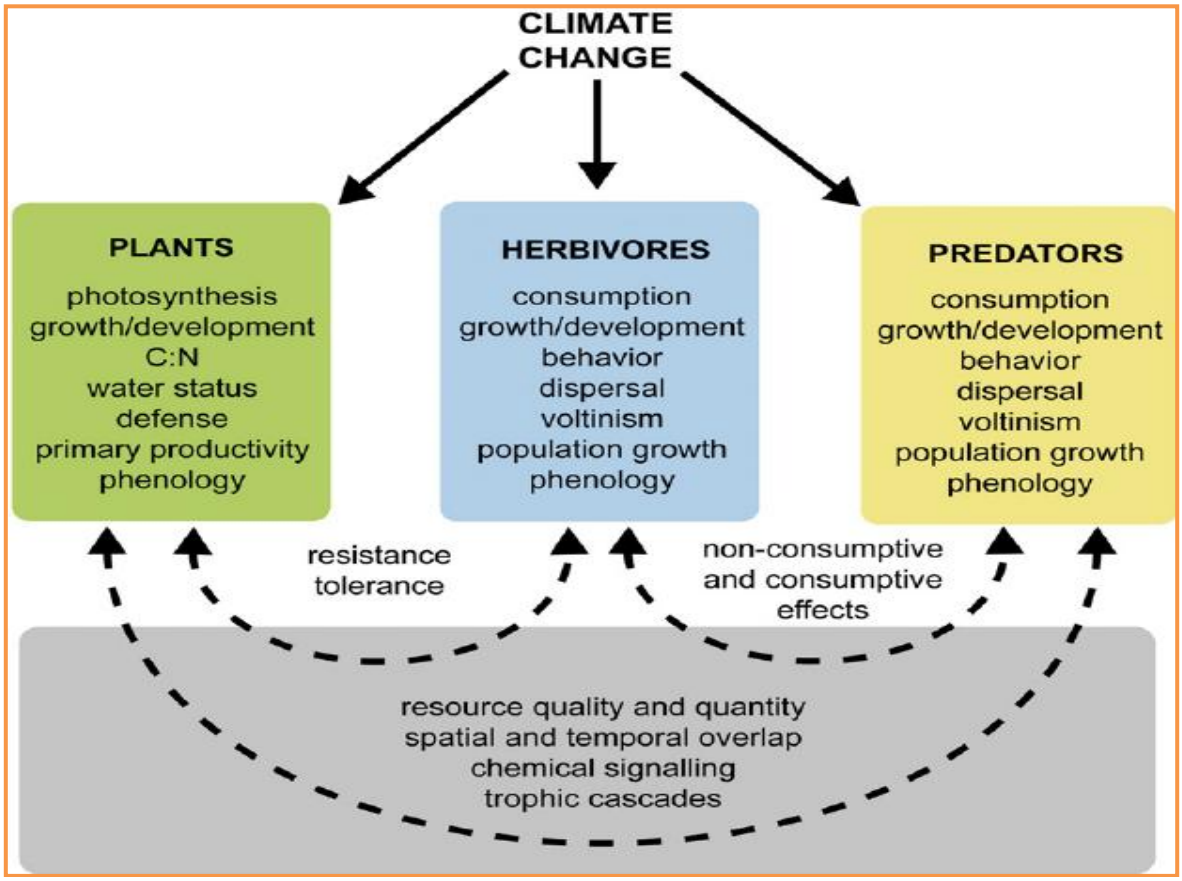

Fig. Impact of climate change on Herbivores, predators and plants

Effect of Precipitation and Drought on insect pests: Abnormally cool wet conditions can also bring on severe insect infestations, although excessive soil moisture may drown out soil-residing insects. Some insects are sensitive to precipitation and are killed or removed from crops by heavy rains. Enhanced summer rainfall and drought conditions on soil dwelling *Agriotes lineatus* (wireworms) promote rapid increase in the population of wireworms in upper soil. The deviation of rainfall during monsoon affects level of *Helicoverpa armigera* damage severity showed higher, November rainfall favoured higher infestation. Drought

conditions severely affected egg viability of *Scopelosaurus Lepidus* eggs and did not hatch at under very dry conditions. In some cases drought stress brings increased insect pest out breaks.

Indirect effects of Climate change on insect pests via Host plant: The nutritional quality of plant tissue for insect herbivores generally increases with nitrogen content and decreases with lower water content and rising concentrations of secondary metabolites. Increased carbon to nitrogen rations in plant tissues resulting from increased carbon dioxide levels may slow insect development and increased the length of life stages vulnerable to attack by parasitoids. The atmospheric carbon dioxide is likely to stimulate plant defense and resistance to the colonization of phytophagous insects.

Effects of Climate change on insect pests via Natural enemies: Shifts in climate can differentially affect the development rates of pest and predator species. The parasitoid *Campoleties chlorideae* developed successfully over the temperature range of 12-37˚C. The percentage pupal mortality of *C. chlorideae* increased above and below 22˚C, with the highest mortality rate occurring at 37˚C.

Conclusion

Temperature causes the direct effects like survival, growth and development, voltinism and dispersal. Drought and precipitation play vital role in soil insect's abundance. The carbon dioxide is causing indirect effect through host nutrient alternation and it has both positive and negative effects. There is a need to studying evolutionary changes under modified environment would be useful to face the challenge in near future.

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