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Review Article

Diversity dynamics of insects growth and population around Amrawati district, Maharashtra

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ABSTRACT

According to Intergovernmental Panel on Climate Change, it is defined as Change in climate over time, either due to natural variability or as a result of human activity. Most of the warming observed over the last 50 years is attributable to human activities. The global mean surface temperature is predicted to increase by 1.4 to 5.8°C from 1990 to 2100. If temperatures rise by about 2°C over the next 100 years, negative effects of global warming would begin to extend to most regions of the world. Such changes in climate and weather could profoundly affect the status of insect pests of crops. These may arise not only as a result of direct effects on the distribution and abundance of pest populations but also indirect effects on the pests' host plants, competitors and natural enemies. Some pests which are already present but only occur in small areas, or at low densities may be able to exploit the changing conditions by spreading more widely and reaching damaging population densities. The occurrence of climate changes is evident from increase in global average temperature, changes in the rainfall pattern and extreme climatic events. These seasonal and long term changes would affect the fauna, flora and population dynamics of insect pests. The abiotic parameters are known to have direct impact on insect population dynamics through modulation of developmental rates, survival, fecundity, voltinism and dispersal. Among the climatic factors, temperature is an important factor. Therefore climate change would result in changes in the population dynamics of insect pests. Thus temperature rise plays a pivotal role in insect population dynamics. Keeping these facts the topic on the impact of climate change on insects is discussed here.

1. Introduction

The term global change embraces a range of natural and anthropogenic environmental changes. According to Intergovernmental Panel on Climate Change, it is defined as Change in climate over time, either due to natural variability or as a result of human activity. The most of the warming observed over the last 50 years is attributable to human activities. The global mean surface temperature is predicted to increase by 1.4 to 5.8°C from 1990 to 2100.

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If temperatures rise by about 2°C over the next 100 years, negative effects of global warming would begin to most regions of the world. Such changes in climate and weather could profoundly affect the population dynamics and status of insect pests of crops. These may arise not only as a result of direct effects on distribution and abundance of pest populations but also indirect effects on the pests' host plants, competitors and natural enemies. Some pests which are already present but only occur in small areas, or at low densities may be able to exploit the changing conditions by spreading more widely and reaching damaging population densities. Keeping these facts in view the topic is discussed the impact of climate on the population dynamics of population.

Effects of Climate change on insects

Insects are good indicators of current human driven climate change. They have responded to warming in all predicted ways from changes in phenology and distribution to undergoing evolutionary changes. Insects are among the groups of organism most likely to be affected by climate change because climate has a strong direct influence on their development, reproduction and survival. Moreover, insects have short generation's times and high reproductive rates, so they can more like to respond quicker to climate change than long-lived organisms, such as plants and vertebrates (Menendez, 2007). Increasing climatic variability reduced the level of parasitism of caterpillars, which in turns may increase the frequency and intensity of herbivore outbreaks (Stireman, et al., 2005).

Impact on arthropods diversity and extinction

The current extinction rates are 100 to 1,000 times greater than what has happened earlier and nearly 45 to 275 species are becoming extinct every day. It has been intimated that six degree increase in temperature will lead to the mass extinction of species including humans (Anonymous, 2013).

Impact on geographical distribution and population dynamics of insects

Overwintering of insects will increase as a result of climate change, producing larger spring populations in the following season. These may be vulnerable to parasitoids and predators if the latter also overwinter more readily. There may also be increased dispersal of airborne insects in response to atmospheric disturbances. Many insects such as Helicoverpa sp. are migratory and therefore may be well adapted to exploit new opportunities by moving rapidly into new areas as a result of climate change (Sharma, 2005).

Impact on expression of resistance of plants to insect pests

Global warming may result on breakdown of resistance to certain insect pests. Sorghum varieties exhibiting resistance to sorghum midge, *Stenodiplosissorghicola*(Coq.) in India became susceptible to the pest under high humidity and moderate temperatures near the Equator in Kenya (Sharma, et al., 1999). Lower foliar nitrogen content due to CO2 causes an increase in food consumption by the herbivores up to 40%, while unusually severe drought increases the damage by insect species such as stem borer, *Chilopartellus* (Swinhoe) in sorghum (Sharma, et al., 2005). Global warming may also change the flowering times in temperate regions, leading to ecological consequences such as introduction of new insect pests and attaining of a pest status by non- insect pests (Willis, et al., 2008).

Impact on effectiveness of transgenic crops for pest management

Possible causes for the failure of insect control in transgenic crops may be due to inadequate production of the toxin protein, effect of environment on transgene expression, Btresistant insect populations and development of resistance due to inadequate management (Sharma and Ortiz, 2000). Cry1Ac levels in transgenic plants decrease with the plant age, resulting in greater susceptibility of the crop to insect pests during the latter stage of crop growth (Kranthi, et al., 2005).

Impact on effectiveness of insecticides

Bio pesticides and synthetic insecticides are highly sensitive to environment. Increase in temperature and UV radiation and decrease in relative humidity may render many of these control tactics to be less effective and such an effect will be more pronounced on natural plant products and bio pesticides (Isman, 1997).

Impact of different parameters of climate change on insects

Temperature

Climate change resulting in increased temperature could impact crop pest populations in several ways. Most researchers seems to agree that warmer temperatures in temperate climates will results in more types and higher populations of insects. Researchers have shown that increased temperature can potentially affects insect survival, development, geographic range and population size. The potato tuber worm incidence under climate changes showed that the population of the pest at Ismalia gave the highest number of generations as compared with EL Beheira location under current climate. Generation numbers of tuber worm under climate change conditions increased especially in Ismailia location. However, the expected generation numbers of the tuber worm in 2050 and 2100 are expected to be 9 to 11 and 10 to 12 generations per year, respectively. This concluds that higher temperature in the future may thus increase the damage on crops, by increasing the number of generations of the pest (Abolmaaty, et al., 2011). The data of the study are essential for developing prediction models about the distribution range of this tramp species based on its physiological needs in relation to temperature (Abril, et al., 2008). Elevated temperature decreased final plant biomass while leaf nitrogen concentration increased. Aphid, MyzuspersicaeSulz.abundance was enhanced by both CO2 and temperature treatment. Parasitism rated remained unchanged in elevated CO2, but showed an increasing trend in conditions of elevated temperature. It shows that M. persicae might increase its abundance under changing climatic conditions (Bezemer, et al., 1998).Many insects are contributors to global warming because of the CO2 they emit. Bug and termites is major contributor of global warming. With every degree the global temperature rise, the life cycle of each bug will be shorter. The quicker the life cycle, the higher will be the population of pests (Deka, et al., 2012).

Carbon dioxide (CO2)

Generally CO2 impacts on insects are thought to be indirect-impact on damage results from changes in the host crop. It is thought that measured increase in the levels of simple sugars in the soyabean leaves may have stimulated the additional insect feeding (Hamilton, et al., 2005). Larval life-span of *Helicoverpaarmigera* (Hubner) increased by 5.49, 7.02 and 10.26 % and larval survival rate decreased by 7.35, 9.52 and 11.48 % in first, second and third generations, respectively under elevated CO2 compared with ambient CO2. Consumption and frass per larva of bollworm fed on cotton bolls showed significant increase for the first, second and third generations under elevated CO2. Significantly lower relative growth rate was observed in the first, second and third generations (Gang, et al., 2007). Brachypterous females laid more eggs on rice plants exposed to elevated than ambient CO2. Elevated CO2 exhibited positive effect on BPH multiplication and resulted in more than a doubling of its population at peak incidence compared to ambient CO2 (Prasannakumar, et al., 2012). The lifespan of H. armigera was delayed and larvae fed more artificial diet and produced more frass under elevated CO2 compared with those under ambient CO2. Furthermore, elevated CO2 marginally influenced the artificial diet-utilization effciency of H. armigera larvae that decreased in relative growth rate (RGR), relative consumption rate (RCR), effciency of conversion of ingested food (Wu, et al., 2006a). Gossypii was mainly indirect, even though the host plants growing under elevated CO2 levels were directly affected (Chen, et al., 2005). Longer larval life-span for the third generation and lower pupal weight for all generations were observed in H. armigera fed on milky grains of spring wheat grown in elevated CO2. Moreover, the consumption, frass per H. armigera larva and RCR significantly increased under elevated CO2 compared to ambient CO2 (Wu, et al., 2006b).

Drought and Rainfall

Large scale changes in rainfall will have a major effect on the abundance and diversity of arthropods. Analysis of precipitation data over the past 100 years showed that the total precipitation did not change, but the frequency of light rain decreased and the frequency of heavy rainfall increased (Das et al., 2011). Some insects e.g. onion thrips are sensitive to precipitation and are killed or removed from crops by heavy rains (Reiners and Petzoldt, 2005). For some insects that overwinter in soil, flooding the soil has been used as a control measures (Vincent et al., 2003). Decreasing snowfall promotes the expansion of pine moth, Thaumetopoeapityocampa into high elevation stands of mountain pine. More than 50 species of butterflies showed northward range expansions and 10 species of previously migrant butterflies have been established on Nansei Islands during 1966 to 1987.

Conclusion:

Effect of climate change is more in temperate insects, it permits range expansion in growth and population of insects. Among the various abiotic factors, temperature is an important force to drive the population. Temperature causes the direct effects like survival, growth and development, voltinism dispersal. Drought and precipitation play vital role in soil insect’s abundance. The CO is causing indirect effect through host nutrient alteration and it has both positive and negative effects. Change in voltinism is more profit to multivoltine species than univoltine species. There may possibility of evolutionary adaption in insects for changing environment. Therefore climate change change population dynamics and growth of insect pests differently in different agro- ecosystem and ecological zones, need greater attention to understand and address these issues through more research. If the climate study collaboratly study with the insect growth it give great opportunity for less uses of chemicals like pesticides and insecticides which resulted to maintain the balance of Nature.

References

Abolmaaty, S. M.; Khalil, A. A. and Amna, M. H. 2011.Using degree- day unit accumulation to predict potato tubeworm incidence under climate change conditions in Egypt. Nat. Sci., 9 (4): 156-160.
Abril, A, Oliveras, J and Gomez, C 2008.Effect of temperature on the development and survival of the Argentine ant, Linepithemahumile.Journal of Insect science 10: 97.
Bale, J.; Masters, G. and Hodkinson, I. 2002.Herbivory in global climate change research: direct effects of rising temperature on insect herbivores. J. Global Change Biol., 8: 1-16.
Bezemer, M. T.; Jones, H. T. and Knight, K. J 1998.Longterm effects of elevated CO2 and temperatire on populations of the peach potato aphid, Myzuspersicae and its parasitoid Aphidiusmatricariae.Oecologia. 116 (1-2): 128-135.
Chen, F. J.; Wu, G. and Ge, F. 2005. Study on the function mode of elevated CO2 on the growth and development of cotton aphid Aphis gossypii (Glover) sucking on transgenic Bt cotton and non-transgenic cotton[J]. ActaEcol Sin, 25 (10): 2601–2607.
Das, D. K.; Singh, J. and Vennila, S. 2011. Emerging crop pest scenario under the impact of climate change – a brief review. J. Agric. Phy., 11: 13-20.
Deka, S.; Byjesh, K.; Kumar, U. and Choudhary, R. 2012.Climate change and impacts on crop pests—a critique. ISPRS Archives, 38: 8.
Gang, W.; Chen, F.; Sun, C. and Feng, G. 2007. Response of successive three generations of cotton bollworm, Helicoverpaarmigera (Hubner), fed on cotton bolls under elevated CO2. J. Environ. Sci., 19: 1318-1325.
Hamilton, J. G.; Dermody, O.; Aldea, M. and Zangerl, A. R. 2005. Anthropogenic changes in tropospheric composition increase susceptibility of soyabean to insect herbivory. Environ. Entomol. 34 (2): 479-485.
IPCC, 2001. Climate change 2001: scientific basis, Contribution of working group I to the third assessment report of the intergovernmental panel climate change (IPCC). Cambridge University Press, Cambridge http:/ /www.grida.no/climate/ipcc_tar/
Isman, M. B. 1997. Neem and other botanical pesticides: Barriers to commercialization. Phytoparasitica, 25: 339-344.
Karnti K.R.; Naidu S. and Kranthi, S. 2005. Temporal and intra-plant variability of Cry1Ac expression in Btcotton and its influence on the survival of the cotton bollworm, Helicoverpaarmigera (Hubner) (Noctuidae: Lepidoptera). Curr. Sci., 89: 291-298.
Menendez, R. 2007. How are insects responding to global warming.TijdschriftvoorEntomologie 150: 355-365.
Porter, J. H.; Parry, M. L. and Carter, T. R. 1991.The potential effects of climatic change on agricultural insect pests.Agril and Forest Meteorol, 57: 221-240.
Prasannakumar, N. R.; Chander, S. and Pal, M. 2012. Assessment of impact of climate change with reference to elevated CO2 on rice brown planthopper, Nilaparvatalugens (Stal.) and crop yield. Curr. Sci., 103: 10.
Reiners, S and Petzoldt, C. 2005. Integrated Crop Pest Management Guidelines for Commercial Vegetables Production.Cornell Cooperative Extension Publication.
Sharma, H. C. 2005. Heliothis/Helicoverpa Management: Emerging Trends and Strategies for Future Research. Oxford and IBH Science Publishers, USA. Pp. 469.
Sharma, H. C. and Ortiz, R. 2000.Transgenics, pest management, and the environment.Curr. Sci.,79: 421-437.
Sharma, H. C.; Dhillon, M. K.; Kibuka, J. and Mukuru, S. Z. 2005. Plant defense responses to sorghum spotted stem borer, Chilopartellus under irrigated and drought conditions. International Sorghum and Millets Newsletter. 46: 49-52.
Sharma, H. C.; Mukuru, S. Z.; Manyasa, E. and Were, J. 1999.Breakdown of resistance to sorghum midge, Stenodiplosissorghicola.Euphytica, 109: 131-140.
Stireman, J. O.; Dyer, L. A.; Janzen, D. H. and Singer, M. S. 2005. Climatic unpredictability and parasitism of caterpillars: implications of global warming. Proceedings of the National Academy of Science. 102: 17384-17387.