Effect of Climate Change on Insect Pollinator: A Review

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Abstract: A review was done to know the effect of climate change on insect pollinators. Pollinated by insects produced higher quality and quantity of crop. Of the total pollination activities, over 80 percent is performed by insects. Many experiments proved that increased temperature has effect on plants, pollinators and their interactions. Changing climates may cause changes in the time of growth, flowering and maturation of crops, with consequent impacts on crop-associated biodiversity, particularly on pollinators. Key biological events such as insect emergence, their foraging behaviour and date of onset of flowering need to occur in synchrony for successful pollination interactions. On a larger scale, changes in temperature, disturbances on rainfall pattern and other many environmental changes over the entire season may alter the abundance, diversity and foraging behaviour of pollinators. Hence climate change causes very serious impact on insect pollinators and flowering plants.
[Pudasaini R, Chalise M, Poudel PR, Pudasaini K, Aryal P. **Effect of Climate Change on Insect Pollinator: A Review.** *N Y Sci J* 2015;8(3):39-42]. (ISSN: 1554-0200). http://www.sciencepub.net/newyork. 7

Keywords: Climate change; Flowering Plants; Insect pollinators

1. Introduction

Pollination is a process of transfer of pollen grains from the anther of a flower to the stigma of same flower of the same pants or another plant of same species. The process of pollination is believed to be basic to the evolutionary history of flowering plants, spanning at least 100 million years. Pollination is a necessary step in the reproduction of flowering plants and the development of fruit and seeds; without pollination, flowering plants unable to produce seeds. Pollination is a prerequisite to pollen tube development and subsequent fertilization of ovules, leading to seed and fruit setting in flowering plants and insect pollinators play crucial role in this process (Dhakal, 2003). Scientific evidence confirms that pollination improves the yield and quality of crops, such as fruits, vegetable seeds, spices, oilseeds and forage crops (Partap and Partap, 1997; Thapa, 2006; Pudasaini, 2014). Losey and Vaughan (2006) emphasized that insect pollinators provide an important ecosystem function to global crop production through their pollination services. Although the roles of insect pollinators are very important, they are negatively impacted by different factors. Different scientists notice that we may be in the middle of global pollination crisis (Steffan-Dewenter *et al*., 2005; Biesmeijer *et al*., 2006). Among them, effect of climate is a major issue nowadays which is negatively harming the insect pollinators. Climate change may be a further threat to pollination services (Memmott *et al*., 2007; Schweiger *et al*., 2010; Hegland *et al.,* 2009). But the knowledge of the effects of climate change on mutulistic interactions is still limited (Walther *et al*., 2002; Visser and Both, 2005). Hence regarding such context this paper reviews about the impact of climate change on insect pollinators.

2. Material and Methods

The effect of climate change on insect pollinators is reviewed in this paper. It is prepared by reviewing secondary source of information. The secondary source of information was gathered from review the journal papers, proceedings papers, internet sources, concerning books, study / research paper etc. The paper summarizes various literatures explaining the negative effect of climate change on insect pollinators and its causes on food insecurity.

3. Results and Discussion

IPCC (1996), predict that, the earth would warm by 1.4 to 5.8 0C by the year 2100. It is estimated that average global surface temperature will further increase by between 1.1°C (low emission scenario) and 6.4 °C (high emission scenario) during the 21st century, and that the increases in temperature will be greatest at higher latitudes (IPCC, 2007). Many observational evidences showed that many ecosystems are affected by regional and global climate changes, particularly temperature increases (IPCC, 2007).

Different studies suggest that climate change maybe one of the biggest anthropogenic disturbance factors imposed on ecosystems today (Walther *et al*., 2002; Parmesan, 2006). Speculations on the disruptions of plant-pollinator interactions due to climate change are often brought forward (Visser and Both, 2005; Parmesan, 2006). The impacts of climate change depend upon the physiological sensitivity of organisms to change on different environmental factors. Studies have shown that both the distribution and phenology of many plants and animals are biased in the directions predicted from global warming in the last few decades (Parmesan, 2006), indicated by a global advancement of spring events by 2.3 days per decade and a species range shift of 6.1 km per decade towards the poles (Parmesan and Yohe, 2003). Several studies noticed as alteration in trophic relationships and energy-flows in both predator-prey and plant-herbivore interactions as a consequence of rising temperatures (Stenseth and Mysterud, 2002; Visser and Both, 2005; Durant *et al*., 2007). Kudo *et al.,* (2004) reported that from few years plants have been flowering much earlier in alpine environments while the time of emergence of pollinators may not changed resulted in disturbance. Insect-pollinated plants generally react more strongly to increased warming than wind-pollinated plants, and species flowering early in the season appear to be most sensitive (Fitter and Fitter, 2002; Miller-Rushing *et al*., 2007), an indication that these species have thermal-sensitive phenologies. There is clear evidence for prolonged growing seasons in many plant communities in Europe during the last decades (Menzel and Fabian, 1999).

Climate change is altering the phenological response of plants and pollinators may be unable to alter their life cycles in synchronization with altered pollination timing. In general, the onset of flowering appears to be correlated with the mean temperature in the month of flowering or the months prior to flowering (Sparks *et al*., 2000; Menzel *et al.,* 2006). The responses of flowering onset to increasing temperatures were linear in most cases (Sparks *et al.,* 2000; Fitter and Fitter, 2002; Gordo and Sanz, 2005; Menzel *et al*., 2006), which could be important for plant interactions with pollinators. Also, other potential cues for flowering initiation include photoperiodicity, precipitation, soil humidity and snow melt (Inouye *et al*., 2003; Price and Waser, 1998) as well as a particular combinations of cues (Lambercht *et al*., 2007). Some species are more mobile or adaptable to change and so the composition of plant and pollinator assemblages is likely to change in many locations as species in the tropics appear to be living at or near their thermal optimum and further warming may cause some species to migrate to cooler areas, or die out (Deutsch *et al*., 2008). With respect to the potential effects of future global warming, pollinator behavioural responses to avoid extreme temperatures have the potential to significantly reduce pollination services (Corbet *et al*., 1993). Most pollinators are insects, because insects are small and poikilothermic, it is likely that temperature will be critical for their life cycle development and activity pattern. For example in a study of butterfly reported that close positive relationship between first appearance date and temperature (Roy and Sparks, 2000; Forister and Shapiro, 2003). The timing of pollination is determined by climatic cues such as temperature and water availability (Cleland *et al*., 2007). Similarly, the foraging behaviour of insect pollinators such as commencement and cessation, number of plants and flowers visits by insect pollinators, number of pollinators per meter square area is environmental dependant factors (Pudasaini, 2014) which is directly disturbs by increase on temperature, irregular in rainfall pattern and other different environmental factors.

Hence, pollination activities, out of total over 80% is performed by insects (Robinson and Morse 1989), is negatively impacted by climate change which result on lower production of crop may lead to serious global food security problem.

4. Conclusion

It is concluded that climate change effects on plants, pollinators and their interactions by increased temperatures, disturbances on rainfall pattern and other many environmental changes. It is also reported that the native biodiversity and trophic relationship also altered which result on lower the production of crops.

Acknowledgements:

It is our heartfelt gratitude to respected Prof. Resham Bahadur Thapa, Ph.D., Department of Entomology, Institute of Agriculture and Animal Science (IAAS), for providing support, guidance and help for writing this review paper.

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3/3/2015