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# Effect of global warming on insect dynamics

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**Abstract**
This topic deals with the effect of global warming on insect dynamics. The ill effects of global warming like change in climate, temperature, rainfall, humidity, level of carbon - di -oxide has been found to have both positive and negative effects on insects, which in turn reduces the effectiveness of crop protection measures. This creates the need for global warming to be taken as an important criterion in Entomology. So, to mitigate the influence of global warming on insect control we have to develop resistant strains of bio-control agents and further research has to be carried out to manipulate the effects with a focus to improve the effectiveness of crop protection practises.

**Keywords:** Global warming, climate change, insect pests, temperature, precipitation, drought

## Introduction
The effects of global warming are increase in global mean annual temperature increased variability of climate, increase in $CO_2$ level, Drought, increase in atmospheric temperature, changes in precipitation pattern, melting of ice glaciers, rise in sea level, increase in ocean heat and changes in humidity. This study indicates about the effect of these factors on insect dynamics.

## Impact of climate change on insects
It leads to increased risk of invasion by migrant pest, extension of geographical range of insect pest, reduced effectiveness of crop protection technologies, changes in synchrony between insect host - plant interactions, introduction of alternate hosts as green bridge, increased over-wintering and rapid population growth, extinction of species and diversity among species. (Sharma, 2010) [7].
Climate also causes extension of the growing season, altering the time of emergence, rapid growth and development rates, shortening generation times, prolonged over-wintering, shorten predation window, altering geographic distribution in relation to insects (Porter *et al*., 1991) [5].

## Case Study
### Spruce Bark Beetle
Developmental rate may change in response to changes in climate especially in multi-voltine insects. Spruce bark beetle has only one generation per year but a second generation has been initiated in southern parts of Sweden. This is because of 2.4 to 3.8$^{o}$ rise in temperature due to climate change resulted in Spatio - temporal changes in the life cycle of bark beetle. It resulted in the formation of viable population leading to heavy damage to crops (Anna Maria Jonsson *et al*., 2009) [2].

## Effect of fluctuating temperature on insects
Temperature influences behaviour, distribution, development, survival and reproduction of insects.

## Temperature Preferendum
Every species has a particular threshold of temperature above which the development occurs and below which the development ceases.

## Effect of fluctuating temperature on insects
Fluctuating temperature leads to increased northward migration, insect development rates, fecundity, invasive pest introduction, insect extinction and decreased parasitism, insect diversity in ecosystem, effectiveness of insect bio-control, reliability of Economic Threshold Level (Das *et al*., 2011) [4].

**Case Study**

***Aedes aegypti***

Insects migrate towards the south when it is winter in south Canada since the north parts are warmer. Now the north parts are also getting warmer. This has added to the increased migration of *Aedes aegypti* which also carries deadly diseases like dengue, malaria with them. From this, it is also evident that fluctuating temperature also contributes to insect migration. (Carrington *et al*., 2013) [3].

Another example is Camille Parmesan, University of Texas at Austin found that "Sooty Copper" butterfly, whose northern range ended in Austria, can now be found in Estonia.

**Effect of elevated $co_2$ on insects**

Increased food consumption by caterpillars, reproduction by aphids, predation by coccinellids, carbon based plant defense, effect of foliar applications and *Bacillus thuringiensis*. Decreased insect development rates, response to alarm pheromones by aphids, parasitism, nitrogen based plant defense, effect on transgenic *Bacillus thuringiensis*.

**Influence of elevated $co_2$ on gram pod borer**

Alteration of food quality of chickpea due to elevated $CO_2$ stimulates the growth of pod borer which leads to increased food consumption, gain in larval weight, more faecal matter production, increased pupal weight and total larval duration. (Abdul Khadar *et al*., 2014) [1].

**Effect of drought on insect dynamics**

Drought increases the insect survival and growth due to changes in the nutrient level of plant, decreases the plant defense mechanism and creates more favourable conditions for pest attack and physiological changes in plant that leads to increased susceptibility and attractiveness to herbivorous insects.

**Case Study**

**Castor Semi - Looper**

Alteration of physiological activities of castor has stimulated the growth parameters of castor semi - looper like longer larval duration, increased larval survival rate, increased pupal weight, increased consumption rate and digestibility (Srinivasa Rao *et al*., 2012) [8].

**Impact of precipitation on insects**

High humidity favours the development of some insects Eg: Aphids. Thrips and White flies are sensitive to heavy precipitation and are removed and killed by heavy rains. Out breaks of *Amsacta moorei* is directly related to heavy and frequent rain (Saini *et al*., 2010) [6].

**Brown Plant Hopper**

The abundance of BPH without precipitation is found to be normal. With an increase in 10% precipitation more than normal it is abundant. But with an increase in 10% precipiation and temperature of 1ºC successively it has been found to multiply enormously.

Global warming has lead to the increased risk and abundance of invasive pest such as *Aceria guerreronis*, *Aleurodicus disperses*, *Paracoccus marginatus*, *Ceratovacuna lanigerum*.

**Conclusion**

Global warming affects the insect dynamics both positively as well as negatively. Hence pest management tactics are to be improved according to the prevailing condition. Productive insects and natural enemies are affected to a greater extent. So, resistant strains are to be developed. Further research has to be carried out to manipulate the effects with a focus to improve the effectiveness of crop protection practises.

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