

# Non-Judicious pesticide utilization causing decline in butterfly population

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## Abstract

India is a developing country either in matters of urbanization or over- population. This has greatly affected the precious biodiversity around us. Amongst them are pollinators like bees and butterflies that play very crucial role in maintaining the healthy environment. Such environmental growth is on the verge of decline due to some of the anthropogenic activities including the urban ideas and the constant use of chemicals in agricultural fields. The concept of targeting only the insect pests by the use of excessive pesticides goes array as it cause a greater decline in the bio-control agents and pollinators. The lethal and sub-lethal effects of pesticides like synthetic insecticides affected different stages of butterfly life cycle. Recent scenario speaks that farmers exercise multiple spraying of chemicals non- judiciously for achieving quick marking results of killing targeted organisms, thereby losing the visible diversity of non-targeted butterflies. Butterflies form an essential link in the food web so conservation of such marvellous creatures now becomes a prime responsibility. The concept of Integrated Pest Management (IPM) today is a must for sustaining the natural properties around us. Day fliers are under big threat so conservation is the final destination!

## Keywords

Butterflies, Conservation, IPM, Pesticides

## Introduction

India has undergone remarkable progress since the last decade, either it would be the matter of global infrastructure or be it the most popular concept of the population explosion. Today, the country has inclined from the rural theory to the urban practices. But, is this heap of visible gold strong enough? Who is responsible for the loss of nature's belongings and its products which has been lost behind this outer sparkling world?

Such an imperfection has lead to world problems of habitat destruction and fragmentation, diversity crisis and pollution troubles. Today, the urban luxury has almost completely taken over the natural habitats of living organisms. Habitat destruction and pesticide applications have accelerated the deterioration of the major biotic components around us along with the drastic climate change. With the decrease in the natural habitat cover, pollinators are gradually vanishing. Pollinators are more vulnerable to the habitat loss and climate variations like increase in temperature. Amongst pollinators, butterflies are biological indicators and thus, experience multiple pressures that further incline its population to decline. And an exposure to harmful pesticides gives its decline a further thrust. Recently, first attempt was made in Florida to estimate insect exposure as chemical mass per unit body

weight for pesticides applied by ultralow-volume sprays for the purpose of evaluating risk to adult butterflies (Bargar , 2012). Worldwide, many analysts carried out studies showing the distribution of various organisms to different habitat spatially and temporally. In Britain, Hickman *et al*, 2006 studied distributional changes across a wide range of animal groups to investigate the qualitative similarity in responses of less well studied groups to climate warming to better studied groups.

The ever increasing population has also led to the increase in the food demands; and this has boost up agricultural economy. However, what's the nutritive quotient of the final agricultural product obtained from the fields?

This is due to the non judicious pesticide usage not only in India but all over the world. Pesticides are known to have a wide range of activity either in agricultural fields or estates or in maintaining the vector control agents. This chemical consumption in the agricultural fields has not only harmed the crop yield but also the residing pollinators are affected that contribute in enhancing the survival of the surrounding environment. Bee pollinators top the list as insect pollinators; so much of the detailed work is carried out on them, leaving the butterfly pollinators scant. (Kunte, 2000) Why only the pollinators, there are cases

where in the pesticide usage has created alarming mortality in humans too which is due to pesticide poisoning. Pesticide poisoning is a major clinical problem in the Warangal district of Andhra Pradesh in South India, with thousands of poisoning and hundreds of deaths every year where during 1997-2002, 8040 patients were admitted to the hospital with pesticide poisoning and 1819 of those died (Srinivas Rao *et al*, 2005).

Pollinators like butterflies are considered as the indicators of good environment health. They are the most common, colourful and visible identified creature known around the globe. Different parts of the world harbours great diversity of butterflies namely birdwings, peacocks, brimstones, albatross, sulphurs, blues and skippers which are a matter of interest to all nature lovers and photographers. These flying creatures form an excellent subject of study either be spatially, temporally or altitudinal gradient. Aizen *et al*, 2009 determined that cultivation of pollinator-dependent crops has, on average, been expanding faster than that of non-dependent crops in both developed and developing countries over the period 1961-2000, so the demand for pollination service is rising at the same time that pollinator abundance and diversity are declining.

About 1502 species have been described in India, which includes nearly 100 endemics (Singh, 2011). Out of the 12 major biodiversity hot-spots is 'Western Ghats' which harbours 334 butterfly species (Jafer *et.al*, 2012) of which 19 species belong to family- Papilionidae, 35 species belong to family- Pieridae, 97 species belong to family- Nymphalidae, 103 species belonging to family- Lycaenidae and 80 species belong to family- Hesperidae.

Today, situations have gone beyond the critical boundaries as anthropogenic world is dominant over such environment friendly organisms.

Butterflies prefer almost all types of terrestrial habitats except that of the extreme arid and polar regions. And amongst all such habitats, what we find in our surroundings are the common urban habitats and the agricultural fields. But it is said farmlands support a relatively impoverished butterfly fauna and where it exists it is largely restricted to field boundaries and other non-cultivated areas (Sparks and Parish, 1995).

### Pesticide Exposure to Organisms

Today worldwide, pesticides are been consumed in the fields as well as in urban estates to have so called secured life without pests. But, to look on to other side of it, it is one of the major factors causing alarming decline to beneficial pollinators like *Apis mellifera* and butterflies like *Eurema brigitta* and *Tarucus nara* and other non targeting organisms.

Pesticides are been used since the early 1950s when chemicals like DDT and BHC were considered to be boon for the agricultural crops as it would kill the target pests. Until the introduction of the synthetic pyrethroids in 1982, compounds belonging to organophosphate and carbamate groups were amongst the most widely used insecticides on cotton in India (Kranthi *et al*, 2001). But later on, it was brought to notice that such chemicals also harm the non target organisms. Moreover, this surprised with the resurgence of the target pests in the fields and with the higher degree of resistance. In the early 1990s, reports came up of pesticide toxicity in wild animals, aquatic organisms, birds, beneficial insects and human beings. Organochlorines were later on banned due to their persistence in nature. Mitra *et al*, 2011 carried out toxicological studies of synthetic chemicals on birds, stating that organophosphorous like chlorpyrifos and carbamates cause severe damage to the bird brain, as they inhibit the acetylcholinesterase enzyme activity in them. Also, they said that sub lethal effects of these pesticides include endocrine disruption, alteration in feeding behaviour and immune system which affect the avian reproduction. Soon, the concept of pesticide spraying in the agricultural fields and estates gave shocking results of organotoxicity and genotoxicity in humans.

### Effect of Pesticides on Butterflies

Bees and butterflies are the most affected with the exposure of pesticides. Differences in the life history of bees and butterflies mean they may not be affected by pesticides in the same way (Brittain *et al*, 2009)

Multiple studies are carried upon in concern to the effect of pesticides on pollinators in farmland landscapes and cultivated lands. In the late 1990s, insecticide survey was carried out in agricultural fields in and around Vadodara, which states the domination of the organophosphorous compounds over organochlorines where farmers intended to have immediate results and were not aware of the insecticidal properties including the dilution factors, mode of application, biodegradability, toxicity and residual effect (Kumar and Sachdeva, 1999). Studies were done in agricultural fields like Chhani, situated in Northern Vadodara, agricultural crop fields at Por, situated in Southern Vadodara and Padra, situated in South-west Vadodara in Gujarat state for a period of 2 years i.e. 2009-2011 utilizing different grades of pesticides namely the Ekalux, Biospray, Lannate, Dursban and Cyperin. These market consumables comprise of quinalphos and methomyl compounds, chlorpyrifos and cypermethrin. Different types of agricultural and vegetable fields occur in such crop fields like spinach, coriander, crucifers, banana fields, cotton, okra, papaya and radish. The application of pesticides in such fields

has drifted out the actual butterfly population of *Zizeeria otis*, *Hypolimnas misippus*, *Charaxes solon* to the complementary plantations like that of *Lantana camara*, *Tamarindus indicus*, *Azadirachta indica*, *Ficus religiosa* and *Nerium oleander* which are proved to be the host plants for butterflies. Different butterflies like that belonging to family Pieridae occur in here like *Eurema brigitta*, *Eurema hecabe*, *Catopsilia pomona* and *Catopsilia pyranthe*. Moreover, *Charaxes solon*, belonging to family Nymphalidae, was observed on the over-ripened bananas amongst the banana plantations.

Authors observed various agricultural farms mainly in and around Vadodara and observed a marked decline in the butterfly population due to pesticides spraying. Density of butterflies like *Delias eucharis*, *Hypolimnas missippus* and *Danaus chrysippus* were greatly affected.

Pesticide use has negative impact on the different stages of butterfly life cycle like hormonal disturbances, the delay in process of ecdysis and the difference in the egg size, the emergence of adults from pupae. Previous studies have proved that the use of synthetic chemicals has caused negative effects during the developmental stages of butterfly life cycle. Singh and Kumar, 2011 carried out laboratory experiments regarding the effect of pyriproxyfen on the developmental stages of citrus swallowtail *Papilio demoleus*, which states that the fourth and fifth larvae failed to undergo pupation and all the treated larvae died as larvae due to the ecdysial failure. Moreover, when untreated larvae pupate, they were treated with pyriproxyfen, the larval exuviae remained attached to the abdominal portion of the pupae and development of head, antennae, wings and legs was adversely affected. Strong research in the field of entomology is required so as to minimise such developmental damages in butterflies and other pollinator insects.

## Conclusion

The drifting of the butterfly species *Cepora nerissa*, *Delias eucharis* and species of *Zizeeria* and *Hypolimnas* from the pesticide treated fields to the non-treated complementary plantations surrounding the fields clearly indicates the disturbance in the completion of the life cycle of butterflies. In previous years, researchers brought significant plans that were experimented under laboratory conditions but lost its practicality when implemented in the fields. To avoid such circumstances, authors have suggested the significance of small scale laboratory experiments, in between the laboratory experiments and field trials, which helps to investigate the effects at a population level while maintaining control over plant containment, environmental conditions, insect populations and adequate replication; and thus allow non-target insects a

choice and encompass behavioural responses to transgenic plants (Schuler *et al*, 2001). To dilute this burning issue of pesticide application, the strong and impactful IPM strategy is the need of the hour. Presently, researchers and biotechnologists are working out to find alternatives to these pesticides and other synthetic insecticides, thereby bringing down the number of decline in pollinators and non-target organisms. Today, people are more turning to the use of phytochemicals like carotenoids, flavonoids, monoterpenes and biopesticides like *Bacillus thuringiensis* (Bt Cry F1) minimizing the use of other fungicides and weedicides because of its eco-friendly and degradation properties. Along with these plants based eco-products, bio-control agents like the lady bird beetle *Coccinella septempunctata*, *Coccinella transversalis*, spiders like *Oxyopes birmanicus*, *Oxyopes shweta* and green lacewing *Chrysoperla carnea* are also capable in strict pest management. IPM strategy is the combination of mechanical, cultural and biological methods utilised for the pest management. Indian farmers are less known to approach the IPM strategy as they rely on the toxic chemicals more as it gives the quick results. Farmers who are growing pulses are willing to adopt IPM practices but IPM packages are not easily available to them as compared to chemical pesticides (Kumar and Shivkumar, 2004). Though new strategies come, undergo trials and if cleared, are permitted to enter the insecticide market, but to what an extent are these research programs reaching to the local farmers? Are they really aware about such promotional agricultural practices? Are these pesticides economically available for individual farmer to apply for his own crop fields? If the answer still remains a big no, it will result into non judicious pesticide utilization causing decline in the butterfly population!

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