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Insects as pollinators- intimidation they face and their conservation

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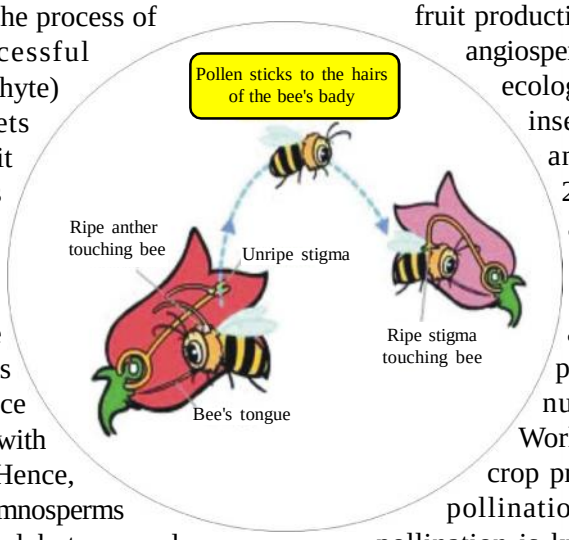
Pollination is the process by which pollen is transferred from the anther (male part) to the stigma (female part) of the plant, thereby enabling fertilization and reproduction. This takes place in the angiosperms, the flower bearing plants. In spite of a common perception that pollen grains are gametes, like the sperm cells of animals, this is incorrect; pollination is an event in the alternation of generations. Each pollen grain is a male haploid gametophyte, adapted to being transported to the female gametophyte, where it can effect fertilization by producing the male gamete (or gametes), in the process of double fertilization). A successful angiosperm pollen grain (gametophyte) containing the male gametes gets transported to the stigma, where it germinates and its pollen tube grows down the style to the ovary. Its two gametes travel down the tube to where the gametophyte (s) containing the female gametes are held within the carpel. One nucleus fuses with the polar bodies to produce the endosperm tissues and the other with the ovule to produce the embryo. Hence, the term: "double fertilization".In gymnosperms the ovule is not contained in a carpel, but exposed on the surface of a dedicated support organ such as the scale of a cone, so that the penetration of carpel tissue is unnecessary. Details of the process vary according to the division of gymnosperms in question.The receptive part of the carpel is called a stigma in the flowers of angiosperms. The receptive part of the gymnosperm ovule is called the *micropyle*. Pollination is a necessary step in the reproduction of flowering plants, resulting in the production of offspring that are genetically diverse.The study of pollination brings together many disciplines, such as botany, horticulture, entomology and ecology. The pollination process as an interaction between flower and pollen vector was first addressed in the 18th century by Christian Konrad Sprengel. It is important in horticulture and agriculture, because fruiting is dependent on fertilisation, which is the result of pollination. The study of pollination by insects is known as *anthecology*. A pollinator is the biotic agent (vector) that moves pollen from the male anthers of a flower to the female stigma of a flower to accomplish fertilization or 'syngamy' of the female gametes in the ovule of the flower by the male gametes from the pollen grain. Though the terms are sometimes confused, a pollinator is different from a pollenizer, which is a plant that is a source of pollen for the pollination process. *Anthecology* is the scientific study of pollination. Pollination is one of the first and most important steps in fruit production and for almost 90 per cent of angiosperms (Ollerton *et al.*, 2011) this vital ecological service is facilitated through insect vectors, mainly bees (Kevan and Baker, 1983 and Michener, 2007).The contribution of bees to apple fruit production have been appreciated for a long time. Often, low yield and poor fruit quality are attributed to poor pollination performance by bees due to low numbers (Garratt *et al.*, 2013). Worldwide an estimated 35 per cent of crop production is dependent on insect pollination (Klein *et al*., 2007). Insect pollination is known to be essential or at least important for 70 of 108 major crops (Klein *et al*., 2007).



Economic Importance of pollinators :

–Animal pollinators are needed for the reproduction of 90 per cent of flowering plants (Buchmann and Nabhan, 1996).

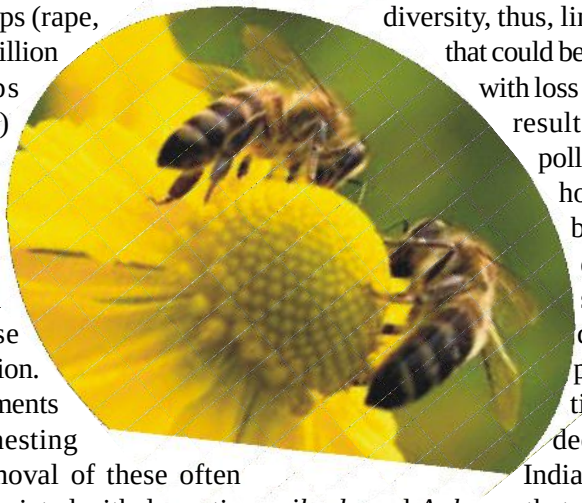
–Value of pollination services for global agriculture is $ 200 billion (Maheshwari , 2003).

–Pollinator services of insects are worth about $19 billion annually in the United States (Borror *et al.*, 1992)

–Pollination services provided by all insects (including honey bees is approximately $40 billion per year (Pimental *et al.*, 1997).

–Non- *apis* bee pollinators are responsible for the successful production of approximately $6 billion worth of agricultural products in the United States (Morse and Calderone, 2000).

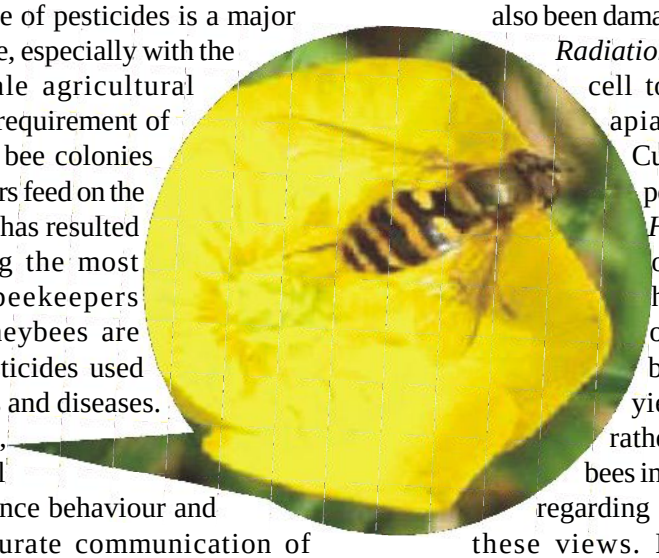
–Value of honeybee and bumble bee as pollinators of major selected UK crops has been estimated to be 172 million Euros for outdoor crops (rape, beans, tree and soft fruits) and 30 million Euros for glasshouse crops (tomatoes and sweet peppers) [Carreek and Williams, 1998].



Causes of decline pollinator biodiversity :

Habitat fragmentation, loss and degradation: Degradation and fragmentation as the main adverse habitat changes for pollinator population. Hedge rows, field margins, embankments and other waste places provide nesting habitat for some native bees. Removal of these often unappreciated habitats has been associated with dramatic declines in Germany's native bee fauna since the 1960s. Fragmentation and habitat destruction can add to the rate of genetic erosion by reducing gene flow between demes (locally interbreeding group within a geographic population) and increases the livelihood that populations and species will become extinct. When large habitats are fragmented into small isolated patches, it is not long before some of the animal residents decline in numbers to the point that they no longer provide effective ecological services.

Pesticides : Widespread usage of pesticides is a major threat to pollinators worldwide, especially with the onset of modern large-scale agricultural practices. This results in the requirement of large number of commercial bee colonies for pollination. These pollinators feed on the contaminated flowers, which has resulted in bee poisoning becoming the most important problem for beekeepers throughout the world. Honeybees are susceptible to almost all pesticides used commercially to control pests and diseases. Poisoned bees not only die but, even on exposure to sublethal doses, suffer disruption in dance behaviour and thereby breakdown of accurate communication of information about resources. Poisoned queens are unable to maintain control over the hive and are often superseded.



Agricultural practices : Modern agriculture is large-scale, usually monoculture and often involves removing surrounding natural vegetation. Monocultures reduce floral diversity, thus, limiting the variety of pollinators that could be supported . Extensive cultivation with loss of intervening natural vegetation results in loss of nesting areas for pollinators such as bees, fewer larval host plants for pollinators such as butterflies as well as loss of diversity of microhabitats suitable for egg-laying and early development. Agricutlural practices that require frequent tilling and irrigation also cause declines in soil nesting bees. In India, the soil nesting bees *Andrena ilerda* and *A. laena* that are important pollinators of the oilseeds, *Brassica compestris* and *B. juncea*, showed six and thirteen-fold declines from 1980 to 1992 (Sihag, 1993).

Parasites and pathogens : Infections by the parasitic mites *Varroa jacobsoni* and *Acarapsis woodi* have been devastating populations of commercial honeybees (Crane, 1988). *Varroa's* original host was the Asian honeybee *Apis cerana* from which it spread to *A. mellifera* when *mellifera* was introduced into Asia for beekeeping. The Thai sac brood viral disease in Asian honeybees has also been damaging to commercial pollinators.

Radiation : Radiations transmitted by cell towers affect the commercial apiary located near the towers. Currently it is not a top priority of pollinator decline.

Hive destruction : Bees are often viewed negatively by homeowners and other property owners. A search for 'carpenter bees' on the Internet primarily yields information on removal rather than information regarding bees in a positive light. Recent hysteria regarding killer bees has contributed to these views. Beekeepers find increased vandalism of their hives, more difficulty in finding ....

Contd from page no. 120.

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