The Trigona Species, (Stingless Bees). Their roll in higher plant pollination.

Introduction

Bees are social insects which are closely related to wasps and ants. The bodies of bees are divided into head, thorax and abdomen, with three pairs of legs, pairs of segmented antennae and two pairs of wings on the thorax. The queen lays eggs in a wax cell by the ovipositor that is modified in the workers to form a sting.
Bees live in colonies. They have divisions of labour in which individuals carry out particular duties. There are three kinds of bee in a colony, a few hundred drones or males, one or two egg-laying females or queen, and from 300 to 100,000 thousand workers bees,(number are varied on species and environment).
The mature queen is easily recognized by her large abdomen. Bees have combined mouth parts, so they can both chew and suck (whereas grasshoppers can chew and moths can suck, but not both)
Honey bees are primarily distinguished by the production of honey, beeswax and pollination. Honey bees belong to members of the tribe Apini and genus *Apis*. They represent only a small part of the approximately 20,000 known species of bee.
Also some other types of related bees produce and store honey, but only members of the genus *Apis* are true honey bees.
The largest bee in the world is an Indonesian resin bee or leafcutter bee (Megachile pluto) whose females can attain a length of 39 mm while the smallest bee is *Trigona minima*, a stingless bee those workers are about 2.1 mm

Stingless bees

Stingless bees are very diverse in behaviour, but they are highly eusocial.

Stingless bees are of the tribe of Meliponini in the family Apidae, and closely related to the common honey bees and found in most tropical or subtropical regions of the world.
Stingless bees are not active all year round; they are less active in cooler weather. Unlike other eusocial bees, they do not sting but will defend by biting if their nest is disturbed.

They live usually in nests in hollow trunks, tree branches, underground cavities, or rock crevices. 500 stingless bees' species are recorded and they are classified into five genera: *Melipona, Trigona, Meliponula, Dectylurina* and *Lestrimelitta* and some of them like *Trigona* and *Melipona* are the honey producing bees.

Australian stingless (*Teragonula carbonaria*) bees produce less than one kilogram honey but it is prized as a medicine in many communities.

Trigona Species

Trigona is the largest genus of stingless bees and have many subgenera. *Trigona* is a genus of the Meliponini tribe which is found extensively in tropical regions. It extends from Mexico to Argentina, India, Sri Lanka to Taiwan, the Solomon Islands, South Indonesia and New Guinea, but no members of the genus occur in Africa.
Two species (***Trigona binghami*** **and** ***Trigona minor*****)** are newly added to the list of 30 species recorded earlier by Schwarz (1939), and Michener and Boongird (2004) making a total of 32 stingless bees of *Trigona* species currently recorded in Thailand. The newly recorded species were found in HM Queen Sirikit Botanical Garden in Maerim, Chiang Mai, Chanthaburi and Mae Hong Son Provinces, Thailand. During 2004 to March 2005 in the lower mixed deciduous forest at the Golden Jubilee Thong Pha Phum Project, in Kanchanaburi Province, 2 genera (*Trigona* and *Hypotrigona*.) and sixteen species of stingless bees were found in this area, namely *Trigona apicalis* Smith, *T. melanoleuca* Cockerell, *T. atripes* Smith, *T. canifrons* Smith, *T. thoracica* Smith, *T. terminata* Smith, *T. ventralis* Smith, *T. flavibasis* Cockerell, *T. iridipennis*, *T. iridipennis*, *T. iridipennis*, *T. iridipennis , Hypotrigona scintillans, H. pendleburyi* and *H. klossi*
The diversity of *Trigona*. and their resin and gum collecting behaviour mostly depended on environmental factors. The bees prefer to collect resin and gum from 16 plant families including Anacardiceae, Dipterocarpaceae, Euphobiaceae, Hypericaceae, Meliaceae and Moraceae. During the rainy season they collected resin and gum all day, whilst during the dry season start from afternoon until late in the day. *T. apicalis* collect resin and gum to make the largest number of propolis compared with the other bee species. The cytogenetic study of 31 species of genus *Trigona* found females had 2n = 34chromosomes and males had n = 17 chromosomes. The C-banding patterns showed that the karyotypes of these species consisted mainly of acrocentric and pseudoacrocentric chromosomes.

Pollination

Pollination means the transfer of pollen grains from plant to stigma by the help of biotic and abiotic agents by the same plant or same kind of species. After transfer, pollen grains then fertilise and sexual reproduction take place. Pollination is a necessary step in the reproduction of flowering plants and results in the production of offspring. The pollination process is interactive between flower and vector and was first addressed in the 18th century by Christian Konrad Sprengel It is important in horticultural crops because fruits are the end product of pollination after fertilization. There are two types of pollination, abiotic and biotic pollination.

Abiotic pollination

Abiotic pollination means where pollination takes place without the involvement of living organisms or transfer of pollen by help of wind and water. It’s quite rare, only 10% of flowering plants are pollinated without organisms. This form of pollination is predominant in grasses, most conifers, and many deciduous trees. In aquatic plants pollination occurs through water by releasing their pollen directly into the surrounding water. About 80% of all plant pollination is biotic. Of the 20% of abiotically pollinated species, 98% is by wind and 2% by water.

Biotic pollination

When pollination takes place by the help of living organisms like insect, birds, etc. we call it biotic pollination. There are roughly 200,000 varieties of animal pollinators in the wild; most of them are insects. Pollination by insects (bees, wasps, ants, beetles, moths, butterflies and flies) and often occurs on plants due to their attractive developed coloured petals and strong scent. Also pollination is carried by vertebrates such as birds and bats. Plants adapted to using bats or moths as pollinators, typically have white petals and a strong scent.

Mechanics of pollination

Sometimes the terms "pollinator" and "pollenizer" are confused, for clear understanding the term pollinator means the agent of biotic or abiotic system which helps to transfer the pollen from source to a definite place, while the term pollenizer is the plant that develops as the pollen source for the same plant or other plants. Some plants are self-compatible and can pollinate themselves while other plants have chemical or physical barriers to self-pollination and need to be cross-pollination.

In pollination management, a good pollenizer is a plant that provides compatible, viable and plentiful pollen and blooms at the same time because pollination requires consideration of pollenizers.

According to pollenizers, pollination can be classified in two ways like cross-pollination (with a pollinator and an external pollenizer) and self-pollination (basically without pollinator).

Plants and pollinator interaction due to biological and physical features such as colour shape and odour of the flower and it is governed by energy needs.

The pollinators are highly selective in their floral visits and are shown to choose those flowers which best meet their energetic needs. The energy needs and foraging dynamics of pollinators are dependent upon prevailing weather conditions which regulate the schedule of pollination.

Pollinators and agriculture

Pollinators provide an important ecosystem service to both natural and agricultural ecosystems. Pollinators ensure fruit set development and dispersal in the vast majority of plants in both ecosystems. In turn, plants provide food and nesting resources for pollinators.

The process of securing effective pollinators to service agricultural fields is not always easy. There is a renewed interest in ensuring pollination services through practices that support pollinators.

Pollinators like honey bees, birds, bats and insects, play a crucial role in flowering plants for the production of fruits and vegetables. Without the help of pollinators those plants cannot reproduce. They can pollinate two-thirds of our food crops.

In countries like Canada, Germany, Italy, Japan, France, Great Britain, Australia, New Zealand, China, Argentina, Mexico, India, Netherlands, Korea, they have developed the beekeeping industry, and increased crop production tremendously. In Israel the beekeepers are able to commercialise the culture of bumblebees for crop pollination, particularly for greenhouses, they export these bees throughout the world.

The fact is there is no country on this planet that has productive crops without a developed beekeeping industry.
The crops and pollinator species belong to each other and the world's food supply depends on the health of these pollinators.
There are more than 100,000 different animal species or perhaps as many as 200,000 species playing a role in pollinating the 250,000 types of flowering plants on this planet.
The annual monetary value of pollination services in the global agriculture industry could be as high as $200 billion.
Honey bees pollinate approximately $10 billion worth of crops in the United States annually, however, the crops that make up most of the world's food supply, only 15% are pollinated by domesticated bees, while at least 80% are pollinated by wild bees and other wildlife,. Australian farmers rely heavily on the introduced Western honey bee to pollinate their crops.

Trigona **species (Stingless bees) and crop production**

Plants and bees are made for each other because their development is closely related.
If bees are allowed to cross-pollination, crops are able to increase up to 40% in production.
Bees are absolute pollinators compared to bats, birds and others due to their vast numbers, for example a *Trigona* colony has a maximum of 100,000 workers while *Apis mellifera* could have 60,000 maximum workers.
Stingless bees have been shown to be valuable pollinators of crops such as Macadamias and Mangoes.
The pollination effectiveness of two species of stingless bees (*Tetragonisca angustula* Illiger and *Nannotrigona testaceicornis* Cresson) and Africanised honey bees (*Apis mellifera* L.) was determined for the ornamental plant *Salvia farinacea* Benth.
All three species of bees highly increased the seed production in comparison with pollinator-deprived plants
They may also benefit strawberries, watermelons, citrus, avocados, lynches and many others.
In the Philippine the *Trigona* are better pollinators than the *Apis* species because they are very efficient and effective under these conditions.
Pollinator bees, particularly *Trigona,* have great markets in Japan and Korea. These countries are now importing *Trigona* species from Australia. The Japanese are now appreciating the value of *Trigona* over the *Apis* species because of the worry of stinging of the *Apis* species.
Trigona have a very low tendency to swarm because there are more than two queens per colony, they rarely absconding and have a longer working life of up to 60 days per worker.
Trigona worker bees forage up to 500 meter radius which means more intensive pollination of crops near to the hive. Also they have very short tongue so they can gather more nectar and pollen compare of other species.
Trigona species are highly tolerance to pests and diseases because of their smaller size and extensive use of propolis which serves as germicidal and pest repellent. They are highly tolerant to heat because of their propolis canopy.
Due to above mentioned characters, *Trigona* species are the best pollinator for pollination in horticultural crops.

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