Plants, Pollen and Bees—the early days.

In this article, I want to share a bit of history with you and explain the dynamic relationship between plants and insects. So step back, if you will, and try to imagine a world devoid of plants till about 510 million years ago when the first land plant appeared in the form of green algae. There was not much interesting plant life to be seen then or for a few more million years during which time plants evolved only slowly.

The first group of plants were known as the gymnosperms and were seed bearing plants which, unlike the flowering angiosperms, had naked ovules, not inside ovaries, but carried in cones. These plants appeared even before the dinosaurs around 200 million years ago and were probably like the giant tree ferns and palm trees of today

Paleobotanists have relatively recently discovered much new information about the evolution of plants from discovering fossils, carbon dating them and studying their DNA. The term gymnosperm is no longer used in formal classification today. Many of these ancient seed bearing plants became extinct and now there are four recognised major groups of former gymnosperms known as: cycads; welwitschia; conifers; and ginko. These plants are all different but have in common naked unprotected ovules.

The new terms Cycadophyta and Coniferophyta describe, respectively, the cycads and conifers living today. The cycads are a small group of plants containing around 250 species and grow in the tropics and sub-tropics. Palms and tree ferns comprise this group. All cycads have male and female reproductive organs on different plants and are thus referred to as being dioecious.

During the period, before flowering plants arrived the planet was green, peaceful, and subdued with no lumbering dinosaurs kicking up a rumpus around the forests. Only fish, turtles and dragonflies inhabited the world then.

Moving on a few million years to the Cretaceous period around 130 million years ago and the scene changes. Insects are now here to stay and flowers evolve from the mostly wind pollinated (Amenophillus) grasses to insect (entomophilus) pollinated flowers of increasing varieties.

Flowering plants (angiosperms--from the Greek words, vessel and seeds) thrive and the forests are colourful. One strategy that enables angiosperms to gain a firm toe hold is the protection of the seeds enclosed in the fruit ovules inside the ovary like double packing. Each fruit has one or more carpels which are hollow chambers that protect and nourish the seeds. Slice a tomato and see the carpels for yourself. These are the defining traits of the angiosperms.

Flowers provide food for: ants; wasps; solitary bee; and social bees including the stingless bee (*Melliponiae*). The first birds start to arrive. Things move a pace and the dinosaurs thunder through the forests bulldozing trees and clearing space for flowering plants that take a tremendous hold on the land quickly outnumbering the gymnosperms. Seeds are ingested by the dinosaurs and disperse across the planet.

Interestingly, magnolia was once the oldest known flower with pollen grains having only one aperture, but recently it has been side-lined by the discovery of a fossilised fruit in Australia dating back to 120 million years and showing evidence of enclosed seeds.

After another few million years, honey bees (*Apis*), as we know them, and bumble bees (*Bombus*) came on the scene around 55 million years ago during the Eocene period. The interactions between insects and flowering plants shaped the development of both organisms and they co-evolved to become the key to our success on the planet today. If you think about it, all our non-meat foods are derived from flowering plants, and all meat, egg and milk production depends upon them too. Most of the clothes that we wear, for example, our cotton jeans, rely on the angiosperms or anthophyta for raw materials. Remember the old adage, “Say it with flowers”, and consider all the specialised florist shops, garden centres, stately homes and garden displays, flower poetry etc. in our lives and you realise just how important flowers are to us. So aesthetically our lives are also greatly enriched by the angiosperms.

The relationship between flowers and bees is based on the “you scratch my back………” principle with flowers requiring a vehicle for moving pollen from the anthers of one flower to the stigma of another in order to allow fertilisation to take place, and the bees needing pollen and nectar for survival of their species. After all, flowers are firmly rooted to the ground and bees are highly mobile so it is a satisfactory mutual arrangement beneficial to both parties.

Flowers evolved arresting colours, seductive scents and specialised petals with special landing pads utilising UV light and patterns seen only by bees. Bees developed specialised plumose hairs which hold magnetic charges thus enabling pollen to stick more easily to their bodies as they move from flower to flower collecting pollen and nectar and disseminating pollen.

Pollen itself is complex and the individual grains are variously shaped, some having spikes which help them better adhere to pollinator bodies. All pollen grains are coated to some extent with pollenkitt which is a lipid (fat) that functions to protect from solar radiation the germinal sex cells surrounded by cytoplasm inside the nucleus. It prevents the grain from drying out completely in hot weather, and keeps the pollen proteins inside the exine cavities. The lipids provide another nutritional reward for pollinators and the stickiness improves pollen grain adherence to their bodies. If you look at dandelion pollen grains under a microscope you can very clearly see the copious greasy yellow pollenkitt, providing you have not already de-greased the sample using 50/50 alcohol/water solution.

Pollen is the only source of protein for bees and is essential for feeding the brood and sustaining adult bees. Not all pollens have the same protein value which is why a wide variety of pollens are required to keep bees healthy. Crude pollen protein content is measured by its nitrogen content x 6.5 and is calculated in percentage. A colony requires a pollen value of greater than 25% to be efficiently fed otherwise they have to eat much more to sustain themselves.

Of the 20 amino acids (proteins) in pollen bees require 10, and interestingly oil seed rape (*Brassica napus*), gorse (*Ulex europaeus*) and field beans (*Vicia faba*) contain 9 of those required. The following list is an example of pollen values of some important plants and I hope it may inspire you to think about planning your plants for bees around those with better nutritional value:

* **Vipers Bugloss**, *Echium vulgare*, Boraginaceae family, pollen value=**35%**
* **Lupin**, *Lupinus angustifolius,* Fabaceae family, pollen value=**34%**
* **Scorpionweed**, *Phacelia tanacetifolia* Boraginaceae family, pollen value=**30%**
* **Gorse**, *Ulex europaeus*, Fabaceae family, pollen value=**28.4%**
* **White clover**, *Trifolium repens*, Fabaceae family, pollen value=**25.9%**
* **Willow**, *Salix spp,* Salicaceae family, pollen value=**21.9%**
* **Bramble**, *Rubus fruticosus*, Roseaceae family, pollen value=**14.8%**
* **Buckwheat**, *Fagopyrum esculentum,* Rhamnaceae family, pollen value=**11%**
* **Sunflower**,*Helianthus annus,* Asteraceae family, pollen value= **13%**

Compared with plant life, humankind is a relative newcomer to our planet with the evolution of the genus *Homo* in Africa only 2.5 million years ago. After a few thousand years *Homo sapiens* were the last of the surviving human species and they developed farming skills around 12,000 years ago giving up their hunter gatherer role. This is the point at which the gradual destruction of our planet began as more forests were cleared to cultivate wheat which became the universal food crop found originally in the wild and harvested randomly as required until the domestication of plants and animals some time later.

Over the course of history, rising world population became the driver for food production and further planet degradation. As I write, the world population just reached 7.5 billion and is increasing as I complete this sentence. Log into <http://www.worldometers.info/world-population/> and see for yourself.

I hope that this article helps highlight the very special relationship between plants and pollinators and encourages you to make changes that promote and enhance both.