# INSECT IN RELATION TO PLANT FERTILIZATION

## Thesis by Mr. S. D. Craig, Which Ranked Highest of Those Offered by the Second Year Class.

The subject of cross fertilization as accomplished by insects is of great interest and importance, not only to the botanist, but also to the entomologist; for to the habit of insects in visiting the different flowers, both insects and plants owe a great many of their present characteristics.

Nearly all the scientists who have taken up this branch of study have come to the conclusion that it is not in accordance with the laws of nature for one flower to fertilize itself, or to be fertilized by any closely related flower. This principle holds good in the animal as well as the vegetable kingdom.

Darwin expressed his view along this line in the words, "Nature abhors self fertilization." This conclusion is corroborated by the existence of great numbers of clever devices by which nature tends to prevent self pollination and promote cross pollination. The weakening results of self fertilization also strengthen the argument in favor of cross fertilization.

Darwin conducted a great number of experiments in this connection and invariably found that in the course of self fertilization the plants lost their vigor and to a marked degree their fertility. An experiment on the species *Ipomea decanea*, showed that the cross fertilized plants were to the self fertilized in weight, as 100 to 22. In the case of Iberis umbellata, seedlings of a cross were to those of self-fertilization, in weight as 100 to 89, and in fertility as 100 to 75. Self-fertilization carried on for a number of generations shows a more marked difference between the cross and self-fertilized plants. In experiments carried on with the *Ipomea purpurea*, the first generation gave a difference in height of one hundred to 76, and the tenth generation, 100 to 54. The loss in fertility is shown splendidly in Darwin's experiments with *Nolana prostata* in which thirty flowers were crossed producing twenty-seven capsules, while thirty-two which were self-fertilized produced only six capsules.

In some plants the necessity for cross pollination seems to be still greater, the flowers being completely self-sterile. This is characteristic of some of the species of Verbascum; the pistils being entirely unproductive towards the pollen of that flower, while with the pollen of other plants it is quite effective. The flowers of Lobelia fulgens are also sterile to their own pollen while both pollen and pistils are efficient in relation to other flowers. This sterility is due to the sexual organs being too uniform to admit of any interaction and may be often overcome by changing the environments of one set of organs as placing them in different plants. This change gives sufficient variation to allow interaction. Just what this uniformity is botanists have been working some time to find out, but as yet it is not entirely understood.

Having noticed some of the reasons for cross fertilization, let us consider a few of the ways whereby self-fertilization is prevented. One very strong preventive is having the stamens and pistils in different flowers, or even on different plants, as is seen in many anemophyllous plants. In some plants the stamens and pistils ripen at different times. Among these Dichogamous plants are a number of the Geraniums. Another preventive is to be observed in Heteromorphous plants such as the Primrose, where there are two kinds of flowers; one kind having the anthers at the top of the tube and the pistil about half-way down. In the other kind the order is reversed the stigma being situated superiorly. In this case the pollen from the short styled flowers, owing to the position it would take on the insect, would not fertilize any but long styled varieties. In some other flowers self-pollination is prevented by the anthers of the flowers turning away from the stigma and shedding their pollen in such a manner that it is almost impossible for any of it to fertilize the stigma. After having considered the reasons for cross fertilization and some of the means by which self fertilization is prevented, it would be well to notice the agents used in effecting fertilization. The most important of these are water, wind, birds and insects. Water plants are usually fertilized by water currents, while grasses, sedges, and usually trees are fertilized by the wind. The anemophyllous plants are usually characterized by the production of enormous quantities of pollen, having very little beauty or perfume, and no nectar. The bird which does the most in fertilizing flowers is the little humming bird, which like the insect goes around from flower to flower in search of nectar. But by far the most important bearers of pollen are the insects, and without them many plants would cease to be reproduced.

In this connection it is instructive and interesting to note the uses of the different properties or organs which most flowers possess. The economists of nature have found that to ensure the services of any living creature, something of material benefit must be given in exchange for that labor. So to get the insect to carry the pollen from one flower to another, the plant secretes nectar which forms a great part of the food of the insect. This nectar is deposited in such a place that the insect cannot cheat the plant, but in getting the nectar it must also come in contact with the stamens and pistil of the flower. To enable the insect to find the nectar the flowers are supplied with perfume and color. Different flowers have different odors to attract the insects upon which they depend for their pollination. The Carrion plant for instance, which is fertilized almost entirely by flies and other scavenger insects, gives off the smell of decaying animal matter. This smell is so strong that insects have been known to be attracted for two hundred yards. Flowers fertilized by bees and butterflies have, on the other hand, very pleasant odors; the taste of these insects in this regard being the same as our own. The colored lines which ornament so many of our flowers serve as guides for the insect to the honey-sac. The color also attracts the insect and enables it to distinguish between different varieties of flowers. It may be here noticed that night flowers are usually white or pale thus having the best color to make them conspicious in the semi-darkness.

The insects as well as the flowers have been modified so that they may carry on pollination to the best advantge. For instance, moths and butterflies have developed very long proboscides to enable them to reach the nectar in long tubed flowers such as the Honeysuckle.

These changes in both insects and plants have undoubtedly been brought about by the slow but sure process of natural selection and the survival of the fittest. In this manner flowers that are the most attractive and give the choicest honey are almost sure to be fertilized while less inviting ones are left unproduced. Butterflies with short proboscides or other hinderances to their gathering nectar, though they may manage to exist for a time, become weakened and eventually