



Chocolate's Sweet Little Secret

"A tiny fly no bigger than the head of a pin is responsible for the world's supply of chocolate."
—Allen Young, a leading cacao expert

When you bite into a sumptuous piece of chocolate do you ever wonder about the biological processes that brought it to you? Chocolate, derived from the seeds of the cacao tree, is an excellent example of a product dependent on the critical, and often underappreciated, work of pollinators.

CACAO PRODUCTION

POLLINATION

The cacao flower, while only about the diameter of a nickel, is complex in design and behavior, necessitating a special kind of animal to pollinate it. Recent studies in cacao plantations indicate that midges, tiny flies that inhabit the damp, shady rain forest, are the only animals that can work their way through the complex cacao flower and pollinate it. A member of the same insect family as the "no-see-um" flies that plague us with their bites, this millimeter-long fly is from the family Ceratopogonidae and the genus *Forcipomyia*—a very tiny animal with a very long name. These cacao-pollinating midges are endemic not to plantations, but to the tropical rain forest itself.



FLOWERS TO FRUIT

The odorless white flowers (and the fruit) are on the trunk of the cacao tree, which flowers (and fruits) all year long. This means that cacao has the very unusual quality of having flowers and fruit on the tree at the same time! It takes 5 to 8 months to progress from blossom bud to ripe fruit. Although they possess both male and female parts, the flowers cannot fertilize themselves, so must rely on a pollinator to transport pollen.

CACAO PLANTATIONS

On cultivated cacao plantations, on average only 3 out of 1,000 flowers are pollinated, fertilized and progress to fruit. It turns out that the cacao plantations themselves are the reason for the extremely low fertilization rate of the cacao flowers, and the potential chocolate shortage that has chocolate manufacturers and consumers worried.

The cacao-pollinating midges require humid shade with a wide range of plant species and decaying matter on the ground, which is the natural habitat of cacao. The bigger a cacao plantation, the less likely the midges will find their way into the sunny, dry and cultivated groves of cacao trees to pollinate individual flowers. Additionally, while wild cacao flowers give off over 75 distinct aroma ingredients (compare that to 14 in the rose and 7 in the onion) to attract pollinators, cultivated cacao has only a small percentage of those, leaving the midges even less likely to venture onto the plantations.

ALFALFA PRODUCTION

A MILK CHOCOLATE ESSENTIAL

Pollinators are also essential for production of alfalfa, a major fodder source for dairy cows, which in turn contributes to milk chocolate. Alfalfa's major pollinator is the alfalfa leaf-cutting bee (*Megachile rotundata*), a solitary bee that is extensively commercially propagated to supplement wild populations. Other pollinators include bumblebees (*Bombus* sp.), honeybees (*Apis mellifera*), and alkali bees (*Nomia melanderi*).