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get a grip

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Someone once told me that they had spread grease all over the drainpipe that crawled up the front of their house, to prevent cats from climbing up it. It's a very simple and pretty harmless way of keeping the enemy away. It's hardly surprising, then, that Nature thought up just the same trick millions of years ago. Many higher plants' stems – and also sometimes their leaves – are covered with a whitish surface, which is slightly greasy to the touch. Botanists have known for a long time that wax in plants has many roles and that the powdery blooms on stems seem to be involved in keeping harmful insects away. The question is: how? But perhaps even just as important a question is: what makes the wax? Because if scientists are able to be on a more intimate level with what produces it, then they will be able to think up insect repellents that are more in keeping with Nature's ways. Not so long ago, researchers discovered an enzyme which synthesises lupeol, the wax component which forms the greater part of the powdery bloom.

Beach plum with the characteristic powdery bloom
photo by "Wildman" Steve Brill

Courtesy of the photographer

The phenomenon of insects sliding off plant stems because of a greasy surface is known as the "greasy pole syndrome" in botanical circles. This comes from the expression widely used in politics: "climbing up the greasy pole", which itself probably stemmed from a game which dates back to the beginning of the 19^{th} century in which men tried climbing to the top of a 30 foot pole which had been initially smeared with grease. In fact, the insects don't so much slip down the stems, instead they have great difficulty in creeping up them, either because they don't get a good enough grip, or because there is a reaction between the wax and parts of their body which hinder their movements. In some carnivorous plants, for example, minute powder crystals are able to mix with adhesive fluids secreted by parts of the fly, consequently creating a kind of glue which traps the insect on the plant's surface.

There are two types of wax in plants: glossy wax and powdery bloom, otherwise known as glaucous wax. A plant's epidermis is covered with a cuticle; wax deposited within the cuticular network creates a smooth surface on the stem, and gives the glossy wax appearance. When – and if – the cuticle is saturated with wax, organised threadlike structures, known as wax crystals, begin to form generating a thick whitish waxen layer on the stem's surface, the glaucous wax.

What is the point of larding a stem with wax in the first place? Well, adding a layer of grease to a stem is a great way of strengthening it. It also protects it from harmful radiation, prevents it from losing water and reduces general contamination. A layer of wax is also able to check epidermal cell growth and, as discussed, it can help to keep unwanted creatures at bay. In fact, there is the surprising example of the Macaranga ant-plant whose stem is half glossy, half glaucous. While any ant – as all other insects – can saunter along the glossy part of the stem, only one ant – a Macaranga partner ant –

can actually cross the glossy/glaucous threshold and continue up the stem.

Higher plants produce sterols and non-steroidal triterpenoids from a common biosynthetic pathway which starts with 2,3-oxidosqualene. Triterpenoids are the basis of cuticular and glaucous (epicuticular) wax. One particular triterpenoid, known as lupeol, constitutes almost 60% of the glaucous wax – as opposed to a mere 12% in glossy wax – thus making it an intriguing compound especially with regards to the enzyme which synthesizes it.

The enzyme in question was subsequently discovered in the powdery bloom of the castor bean and bore the main characteristics of an oxidosqualene cyclase enzyme although it has been classified as the first member of a new class of lupeol synthases. Lupeol synthase performs the last stage in lupeol formation, by cyclising the modified 2,3-oxidosqualene. When lupeol accumulates on the stem's cuticule, it ends up building the thick threadlike wax crystal structure which, to the eye, is the characteristic whitish powdery bloom.

Researchers do not know if this particular bloom on the castor bean serves to ward off specific insects as it does in other plants. However, getting to know lupeol synthase on the molecular level will certainly be of commercial interest. Plant triterpenoids are known to have anti-inflammatory as well as anti-cancer properties. What is more, they can also be used as sweeteners, detergents and cosmetics – all fields of huge popular consumption. On a more ecological note, if scientists are able to understand, in detail, the mechanism of interaction between plant wax and how it can act as a barrier against insect predators – or on the contrary insect partners – then they can develop insecticides and pesticides which are less harmful than the more traditional repellents.

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