This plant grows shimmering blue leaves to help it survive in the dark.

Photosynthetic structures called iridoplasts give Begonia pavonina an iridescent blue appearance and help it survive in low light. (Matthew Jacobs)

Imagine a place where the oceans were full of purple algae and plants on the forest floor glowed a gorgeous, iridescent blue.

This is not the setting of a Dr. Seuss story or a science fiction novel. This place is Earth.

It may be an article of faith that plant life on our planet must be verdant: Plants make energy with chloroplasts, chloroplasts are full of chlorophyll, and chlorophyll is green. But that hasn't always been the case. Studies have suggested that the earliest photosynthetic organisms were plum-colored, because they relied on photosynthetic chemicals that absorbed different wavelengths of light.

And a new paper in the journal Nature Plants describes how a shimmering blue plant can still exist: Begonia pavonina, or the “peacock begonia,” dwells in the dim rain forests of southeast Asia and has adapted to the low levels of sunlight there by developing leaves that are an iridescent azure.

[The mystery of the ‘ghost trees’ may be solved]

The unusual coloring comes from photosynthetic structures called iridoplasts, explained co-author Heather Whitney, an expert in plant surface interactions at the
University of Bristol in England. Like chloroplasts, these structures provide the cellular machinery for photosynthesis. They collect light and use it to synthesize molecules that store energy. And for that light gathering, they also rely on chlorophyll — a pigment that absorbs red and blue light and reflects green (giving plants their typical appearance).

But when Whitney and her colleagues examined B. pavonina cells under a microscope, they noticed that the iridoplasts had a very strange shape. They were layered on top of one another, membrane upon membrane separated by a thin film of liquid, almost like a stack of pancakes held together with maple syrup.

"This tree might be the oldest living thing in Europe"

The effect is similar to what happens when you see oil on top of water in a puddle.

"The light that is passing through gets slightly bent — it's called interference," Whitney said. "So you have this sort of iridescent shimmer."
Iridescent blue begonias show that plants can adapt to light levels with structural changes as well as chemical ones. (Matthew Jacobs)

This layering of iridoplasts causes the light that hits them to bend over and over again, creating a very dramatic sheen. More important, it enables the structure to absorb the types of light available in the dark landscape beneath the forest canopy — long wavelengths like red and green. Only blue light gets reflected back, and that's what human admirers see.

Whitney and her colleagues also think the layering causes light to react more slowly with the photosynthetic chemicals in the structure, allowing yet more efficient light gathering to take place.

To Whitney, the finding offers further evidence of plants' incredible versatility. Because they are unable to move when conditions are unfavorable, they must find other ways of adapting to the world around them. Often that adaptation is chemical
— like the evolution of a purple photosynthetic chemical on early Earth, which was well suited to the wavelengths of light that were available at the time.

“But plants aren't just factories” stuck using the same types of equipment for generation after generation, Whitney said. Iridoplasts show they can alter their machinery, using those structural adaptations to manipulate light.

“And who knows?” she added. “They've probably got loads of tricks we don't know about yet, because that's how they survive.”