

Are plants intelligent? New book says yes

Jeremy Hance

Plants are intelligent. Plants deserve rights. Plants are like the Internet – or more accurately the Internet is like plants. To most of us these statements may sound, at best, insupportable or, at worst, crazy. But a new book, [Brilliant Green: the Surprising History and Science of Plant Intelligence](#), by plant neurobiologist (yes, plant neurobiologist), Stefano Mancuso and journalist, Alessandra Viola, makes a compelling and fascinating case not only for plant sentience and smarts, but also plant rights.

For centuries Western philosophy and science largely viewed animals as unthinking automatons, simple slaves to instinct. But research in recent decades has shattered that view. We now know that not only are chimpanzees, dolphins and elephants thinking, feeling and personality-driven beings, but many others are as well. Octopuses can use tools, whales sing, bees can count, crows demonstrate complex reasoning, paper wasps can recognise faces and fish can differentiate types of music. All these examples have one thing in common: they are animals with brains. But plants don't have a brain. How can they solve problems, act intelligently or respond to stimuli without a brain?

“Today's view of intelligence - as the product of brain in the same way that urine is of the kidneys - is a huge oversimplification. A brain without a body produces the same amount of intelligence of the nut that it resembles,” said Mancuso, who as well as co-writing *Brilliant Green*, is the director of the International Laboratory of Plant Neurobiology in Florence.

As radical as Mancuso's ideas may seem, he's actually in good company. Charles Darwin, who studied plants meticulously for decades, was one of the first scientists to break from the crowd and recognise that plants move and respond to sensation – i.e., are sentient. Moreover, Darwin – who studied plants meticulously for most of his life, observed that the radicle – the root tip – “acts like the brain of one of the lower animals.”

Plant problem solvers

Plants face many of the same problems as animals, though they differ significantly in their approach. Plants have to find energy, reproduce and stave off predators. To do these things, Mancuso argues, plants have developed smarts and sentience.

“Intelligence is the ability to solve problems and plants are amazingly good in solving their problems,” Mancuso noted.

To solve their energy needs, most plants turn to the sun – in some cases literally. Plants are able to grow through shady areas to locate light and many even turn their leaves during the day to capture the best light.

Some plants have taken a different route, however, supplying themselves with energy by preying on animals, including everything from insects to mice to even birds. The Venus

flytrap may be the most famous of these, but there are at least 600 species of animal-eating flora. In order to do this, these plants have evolved complex lures and rapid reactions to catch, hold and devour animal prey.

Plants also harness animals in order to reproduce. Many plants use complex trickery or provide snacks and advertisements (colours) to lure in pollinators, communicating either through direct deception or rewards. New research finds that some plants even distinguish between different pollinators and only germinate their pollen for the best.

Finally, plants have evolved an incredible variety of toxic compounds to ward off predators. When attacked by an insect, many plants release a specific chemical compound. But they don't just throw out compounds, but often release the precious chemical only in the leaf that's under attack. Plants are both tricky and thrifty.

"Each choice a plant makes is based on this type of calculation: what is the smallest quantity of resources that will serve to solve the problem?" Mancuso and Viola write in their book. In other words, plants don't just react to threats or opportunities, but must decide how far to react.

The bottom of the plant may be the most sophisticated of all though. Scientists have observed that roots do not flounder randomly but search for the best position to take in water, avoid competition and garner chemicals. In some cases, roots will alter course *before* they hit an obstacle, showing that plants are capable of "seeing" an obstacle through their many senses.

Humans have five basic senses. But scientists have discovered that plants have at least 20 different senses used to monitor complex conditions in their environment. According to Mancuso, they have senses that roughly correspond to our five, but also have additional ones that can do such things as measure humidity, detect gravity and sense electromagnetic fields.

Plants are also complex communicators. Today, scientists know that plants communicate in a wide variety of ways. The most well known of these is chemical volatiles – why some plants smell so good and others awful – but scientists have also discovered that plants also communicate via electrical signals and even vibrations.

"Plants are wonderful communicators: they share a lot of information with neighbouring plants or with other organisms such as insects or other animals. The scent of a rose, or something less fascinating as the stench of rotting meat produced by some flowers, is a message for pollinators."

Many plants will even warn others of their species when danger is near. If attacked by an insect, a plant will send a chemical signal to their fellows as if to say, "hey, I'm being eaten – so prepare your defences." Researchers have even discovered that plants recognize their close kin, reacting differently to plants from the same parent as those from a different parent.

"In the last several decades science has been showing that plants are endowed with feeling, weave complex social relations and can communicate with themselves and with animals," write Mancuso and Viola, who also argue that plants show behaviours similar to sleeping and playing.

And it turns out Darwin was likely right all along. Mancuso has found rising evidence that the key to plant intelligence is in the radicle or root apex. Mancuso and colleagues recorded the same signals given off from this part of the plant as those from neurons in the animal brain. One root apex may not be able to do much. But instead of having just one root, most plants have millions of individual roots, each with a single radicle.

So, instead of a single powerful brain, Mancuso argues that plants have a million tiny computing structures that work together in a complex network, which he compares to the Internet. The strength of this evolutionary choice is that it allows a plant to survive even after losing 90% or more of its biomass.

“The main driver of evolution in plants was to survive the massive removal of part of the body,” said Mancuso. “Thus, plants are built of a huge number of basic modules that interact as nodes of a network. Without single organs or centralised functions plants may tolerate predation without losing functionality. Internet was born for the same reason and, inevitably, reached the same solution.”

Having a single brain – just like having a single heart or a pair of lungs – would make plants much easier to kill.

“This is why plants have no brain: not because they are not intelligent, but because they would be vulnerable,” Mancuso said.

In this way, he adds, it may be better to think of a single plant as a colony, rather than an individual. Just as the death of one ant doesn't mean the demise of the colony, so the destruction of one leaf or one root means the plant still carries on.

The wide gulf

So, why has plant sentience – or if you don't buy that yet, plant behaviour – been ignored for so long?

Mancuso says this is because plants are so drastically different from us. He says it is “impossible” for us to put ourselves in the place of a plant.

“We are too different; the fruit of two diverse evolutive tracks...plants could be aliens for us,” he said. “But all the same we share with plants life, the same needs, we evolved on the same planet. In the end we respond in the same way to the same impulses.”

Plants also largely live on a different timescale than animals, moving and acting so slowly that we hardly notice they are, indeed, reacting to outside stimuli.

Due to our vast differences, Mancuso says, plants fail to attract interest in the same way as, say, a tiger or an elephant.

“The love for plants is an adult love. It is almost impossible to find a baby interested in plants; they love animals,” he said. “No child thinks that a plant is funny. And for me it was no different: I began to be interested in plants during my doctorate when I realised that they were capable of surprising abilities.”

This has resulted in very few researchers studying plant behaviour or intelligence, unlike queries into animals.

“Today the vast majority of the plant scientists are molecular biologists who know [as much] about the behaviour of plants as much as I know of cricket,” said Mancuso.

Yet, humankind’s disinterest and dispassion about plant behaviour and intelligence may put our very survival at stake.

Totally dependent on plants

While plants are by no means as diverse as the world’s animals (no one beats beetles for diversity), they have truly conquered the world. Today, plants make up more than 99 percent of biomass on the planet. Think about that: this means all the world’s animals – including ants, bluewhales, and us – make up less than one percent.

“We depend on plants, thus plant conservation is necessary for man conservation,” said Mancuso.

Yet, human actions – including deforestation, habitat destruction, pollution, climate change, etc. – have ushered in a mass extinction crisis. While plants in the past have fared better in previous mass extinctions, there is no guarantee they will this time.

“Every day a consistent number of plant species that we never met, disappears,” noted Mancuso who added that mass extinctions “are never happy events and I suspect that, despite their diversity, even plants don’t like to disappear.”

At the same time, we don’t even know for certain how many plant species exist on the planet. Currently, scientists have described around 20,000 species of plant. But there are probably more unknown than known.

“We have no idea about the number of plant species living on the planet. There are different estimates saying we know from 10 to 50% (no more) of the existing plants,” said Mancuso.

Many of these could be wiped out without ever being described, especially as unexplored rainforests and cloud forest – the most biodiverse communities on the planet – continue to fall in places like Brazil, Indonesia, Malaysia, the Democratic Republic of the Congo and Papua New Guinea, among others.

Yet, we depend on plants not only for many of our raw materials and our food, but also for the oxygen we breathe and, increasingly it seems, the rain we require. Plants drive many of the biophysical forces that make the Earth habitable for humans – and all animals.

“Sentient or not sentient, intelligent or not, the life of the planet is green...The life on the Earth is possible just because plants exist,” said Mancuso. “Is not a matter of preserving plants: plants will survive. The conservation implications are for humans: fragile and dependent organisms.”

Still, there are few big conservation groups working directly on plants – most target the bigger, fluffier and more publicly appealing animals. Much like plant behaviour research,

plant conservation has been little-funded and long-ignored.

Mancuso says the state of plant conservation and the rising evidence that plants are sentient beings should make people consider something really radical: plants' rights.

"It is my opinion that a discussion about plants' rights is no longer deferrable. I know that the first reaction, even of the more open-minded people, will be 'Jeez! He's exaggerating now. Plant's right is nonsense,' but should we not care? After all the reaction of the Romans' father to the proposal of rights for women and children, was no different. The road [to] rights is always difficult, but it is necessary. Providing rights to plants is a way to prevent our extinction."

As the crisis escalates...

... in our natural world, we refuse to turn away from the climate catastrophe and species extinction. For The Guardian, reporting on the environment is a priority. We give reporting on climate, nature and pollution the prominence it deserves, stories which often go unreported by others in the media. At this pivotal time for our species and our planet, we are determined to inform readers about threats, consequences and solutions based on scientific facts, not political prejudice or business interests.

More people are reading and supporting The Guardian's independent, investigative journalism than ever before. And unlike many news organisations, we have chosen an approach that allows us to keep our journalism accessible to all, regardless of where they live or what they can afford. But we need your ongoing support to keep working as we do.

The Guardian will engage with the most critical issues of our time – from the escalating climate catastrophe to widespread inequality to the influence of big tech on our lives. At a time when factual information is a necessity, we believe that each of us, around the world, deserves access to accurate reporting with integrity at its heart.

Our editorial independence means we set our own agenda and voice our own opinions. Guardian journalism is free from commercial and political bias and not influenced by billionaire owners or shareholders. This means we can give a voice to those less heard, explore where others turn away, and rigorously challenge those in power.

We need your support to keep delivering quality journalism, to maintain our openness and to protect our precious independence. Every reader contribution, big or small, is so valuable.

Support The Guardian from as little as \$1 – and it only takes a minute. Thank you.

