

How could a sentient plant evolve and what conditions would be required for this evolution?

This is my entry for the fortnightly topic challenge

In [Day of the Triffids](#), many people go blind and the basic summary is this:

- virulent plague makes most of humanity blind
- giant, semi-intelligent plants take over.

In the world I am creating, humans have to face off with an intergalactic plant "empire" that has more advanced tech than we do. My question is this:

- **How could a sentient plant logically evolve and what are some key environmental and sociological factors that might come into play or dramatically impact the evolutionary process?**



In order to develop 'sentience,' as well as things like technology and civilization, a plant first needs to have use for those things. Plants on Earth didn't really evolve in such a way as to need those things, so plants that developed sentience need to evolve in a very different manner.

What is a plant?

Lets start by defining a plant. Conceptually, a plant is an organism that produces its energy through photosynthesis. (More specifically, plants are everything in the kingdom 'Plantae,' which evolved and lived on Earth, so our organisms are actually plant-like aliens, but that's a semantic quibble.) Most plants derive all of their nutrients from their soil, as well, though some carnivorous plants eat animals to supplement this. Even carnivorous plants, though, don't have an energy-producing metabolism. Animals can provide nutrients, but all energy comes from the sun.

What does a plant need for sentience?

So what does a plant need to do to become sentient? Well, if we assume that plant sentience is similar to human sentience, we'll need to do the following:

- Have a language capable of abstract communication

- Have a brain that can store a sense of self
- Manipulate their environment

We'll also probably need better developed sensory organs in order to perceive the environment.

How could this evolve?

All of this is tough for a stationary plant to evolve on its limited supply of energy, but what if the plant isn't always stationary? What if large plants are the mature form of the species, producing nutrients to feed smaller mobile plants that can clear out competing plants as well as travelling away from the central plant to kill animals for fertilizer?

These creatures would be the 'seed' form of the plant as well. They'd have a large internal reservoir of pure glucose, but no digestive system. They would grow and mature while helping farm their parent plant. When they became too large to efficiently perform their tasks, they'd wander to the edge of their parent grove and root into the ground, growing into another stationary mature plant.

These creatures would be the vector for evolution in the plants. They'd probably start out as simple, flagellar organisms that would writhe around the base of the plant, damaging competitors and wriggling off to find an ideal place to grow. Evolution would extend their motile lives and improve their ability to move around and manipulate their environments, providing their parent plants with a competitive advantage over the other plants in the region. They'd develop brains and nervous systems as part of this, but probably only after developing a method for gaining nourishment from their parents, since brains and nerves are energetically expensive things.

The trees, too, would probably begin to take on some traits of their animal children. A brain, probably rudimentary at first, would develop, as well as some nerves. These would aid the tree in signalling to its children what they need to do. Pheromones would probably be used to start, but eventually, a deeper level of communication could be developed that would allow the intelligent sessile parents to 'program' their dull, but motile, children.

Multiple trunks, one mind

On earth, trees form [anastomosis](#) between their roots, allowing them to provide each other with structural support and nutrients. For the aliens, these could also allow individual mature trees to combine into a single larger organism.

Since a tree, based on the limited energy it has available through photosynthesis, can't maintain a large brain on its own, combining multiple trunks together into a single organism that thinks as one would allow intelligence to reach levels that we would consider 'sentient'. Each colony of trees would be a single 'individual', with new mobile seed children produced by that colony acting to grow their parent colony. A colony would not necessarily need to be genetically homogeneous, though. If seed children are produced through pollination, pollen blowing on the wind currents would enable seed children to be born with genes from other colonies, or from multiple stalks in a colony that is not genetically homogeneous.

Controlled evolution

The fact that a single tree colony would be effectively immortal and would possess many different genes would also lead to another really cool fact about these aliens: by using their seed bodies to selectively pollinate their own flowers, they could guide their own evolution. They'd be able to see

what the mind of each new stalk they grew was, and choose to plant only seed children that would give them powerful new children and healthy minds.

Different stalk types could also give rise to different *kinds* of children. Some strains of tree could be selectively bred for producing warrior children, for example, that were stronger and better suited for fighting than their brethren, but less energy efficient. Others could produce workers with dexterous hands, capable of building and manipulating tools.

Finally: sentience

This selective differentiation of workers would allow the plants to become 'sentient'. They'd grow dull workers, which would produce tools and weapons for warriors to use in battle. Diplomats, with powerful brains that would allow them to act intelligently when disconnected from their parents could be used to allow distant colonies of trees to communicate with one another, though they'd still be dwarfed in terms of intelligence by their parent colonies. Different colonies could forge civilizations together, banding together for mutual defense and aggression. New colonies could be started by sending a child to root outside of the bounds of a colony, allowing the aliens to develop broad alliances and nations of colonies related to one another. Swords, axes, and cannon would be forged for war, but their most potent tool would remain a deep and intuitive knowledge of genetics bio-engineering born from countless generations of directing their own evolution. They would be a fascinating, and sentient, race of aliens.

Plants store their **brains** (short term memory, immune memory and transgenerational memory) in their roots, and they **communicate** via airborne emissions (and **root-talking**).

Btw, plants have a large number of senses already. They can hear, can see, smell, and a large number of other senses (gravity), motion, etc, etc.

Being root-bound (or having a sessile life style), really limits their mobility.

But. they're really good at biochem. Maybe they make/co-opt insects to do the physical fast work, and are the brains of the operation?

As to needs, they're going to have to compete; most likely with an animal race - as plants tend to work together. They will probably be after our sunlight.

My starting place was to determine what made a sentient plant different from an animal (maybe I'm dense? Took me a while). Here's a starting place for differences between the two. <http://www.mcwdn.org/Plants/PlantsDiffer.html>

Basically:

- A. Plants don't move
- B. Plants make their own food
- C. Plants give off oxygen and take in CO₂
- D. Plant cells have cell walls and other "planty" structures
- E. Plants have only basic abilities to sense

Of course, I can think of exceptions, for example, some carnivorous plants don't make their own food, can move, and can sense objects pretty well.

Because they're sentient, they need to be able to interact with their environment (smart, paralyzed races don't seem likely to last, and are unlikely to be intergalactic), so A and E are out. So let's say that to make a plant, we'll need them to make their own food from the sun, and they need planty-parts in their cells, viz. **chloroplasts to make food and cell walls**.

So they're going to be a lot more animal-like than some animals, but with ability to make their own

food.

Plants (along with...pretty much any other life form) have 3 major needs:

1. Reproduction
2. Food
3. Water

Reproduction: Most plants reproduce using insects to transfer vital bits of DNA (trying not to be too graphic). Much of the plant's structure is devoted to this - in fact, anything that isn't root or leaf is probably connected to reproduction. So fruits, flowers, sugar-filled-liquid-producing organs, and bright colors would probably cease to exist if plants had a different way of reproducing.

Food: Plants can mostly make their own food. But to do this, they need periods of sun and darkness. Also water, CO₂, and O₂, if my memory serves correctly. You'll also need a pretty large amount of sun-facing surface. The nice thing with a plant is that mostly they need to make sugar, so carbon, oxygen, and hydrogen are pretty much all they need to function nicely. For repairs, they will need other elements, but these are largely gotten from soil and seem to be widely available. So making food isn't a problem, but storing food could be. Your plant-people will need some type of "camel hump" for sugars. Many plants use roots for this.

Water: Plants need a pretty steady supply of water. This seems to be the biggest problem preventing plants from moving - traditionally, a massive root system ensures a steady water supply. Trouble is, massive root systems are hard to move.

Plant Society

I'm going to keep my imaginary Plantains pretty "planty." Of course, if you want to slap some chloroplasts on an animal, I'm cool with that. But then, it wouldn't really be flora would it?

I can see two possible primitive plant societies. Later histories could be extrapolated from these initial points.

1. Plant Nomads. A group of (probably) small sentient plants with minimal root systems that move around, following water sources and rainy seasons.
2. Stationary Plant Societies. Plants develop a way to pass along knowledge to seeds and send them out, much like coral polyps, to establish new colonies. The older plants would be stationary once their roots developed. Some motion might be possible by selective growth and allowing parts to die. But that would be on a months-to-centuries timescale.

In either case, I can think of a few interesting features of such a society:

No family units. Since plants have almost no control over breeding, there wouldn't be families. Sexual prohibitions would not exist, generation differences would not be nearly as obvious. Gender roles would be more balanced. Mixed races could be an interesting social problem (half-sentient plants?), though many plant combinations can't produce viable offspring.

Relationships. Inter-plantain-ial relationships could get interesting. "Hermit" plants by choice would probably be rare, but once you're in a group, you're pretty stuck. Plants would have great emphasis on applied psychology and conflict resolution skills.

Reduced desire for exploration. Because plants need water, huge swaths of the world would remain unexplored, at least until specially engineered plants with water-carrying abilities could explore rockier/less rainy areas. Maybe this wouldn't become a cultural norm, but it would be the initial mindset.

So what would plants do? Plants really wouldn't have the "survival struggle" animals have. Food production is pretty passive. There would be a high emphasis on proper shelter (windbreaks, erosion prevention, temperature stabilization). Aesthetics would be important. Lots of thinking would occur, so plants would focus on philosophy before applied sciences. "Thought is cheap, action is expensive" would probably become a mantra.

No need-based economy. Because food is free, and necessities are minimal, the focus wouldn't be on needs as much as on services (like a doctor for when you get buried in a landslide). Maybe plants are the perfect candidates for a communist system.

Honestly, I don't see anything that can fly a spaceship being very plant-like. That's probably just the limits of my imagination, but a plant's sheer mass-to-movement ratio seems to preclude the rapid responses needed to develop early flight.

But, they'd be tough to beat. Once they came to a new world, seeding it could be done easily, and from a high altitude. And plants are notoriously tough to kill. Especially since they have the advantage of cell walls and the ability to regenerate from small pieces.

The Biology Part

It appears that plants already do [appear to communicate](#) with each other and with animals, just not on the timescale of animals, and mostly via hormones. That being said, for something without a brain or muscle fiber, plants can react rather quickly. [Acacia Trees](#), for instance, are known to react very quickly to grazers, producing a hormone which not only triggers tannin production in that plant, but in other nearby trees as well. [Venus Flytraps](#), as another example, are quick enough to catch [flies and other insects](#).

Anyways, the plants in question will need reason to be faster than they currently are. Are they predatory? That seems to be the reason why venus flytraps can act so quickly. Are there herbivores? Maybe they have something also slow moving that they're trying to avoid, so they develop defenses which act more and more quickly.

What about developing intelligence? Increasing [Plant Perception](#) will play a role in this. The developing intelligence, though, would require some sort of evolutionary pressure to do so. It could easily go hand-in-hand with dealing with predation or prey capture.

I would start by looking at a book and some articles. Specifically, the [Communication of Plants](#) and the academic article [Rapid Changes in Tree Leaf Chemistry Induced by Damage: Evidence for Communication Between Plants](#) to see evidence on how plants currently communicate, and if you can call any of those communications intelligence.

The Social Part

This depends on the [structure of plants](#), and how detailed their communications could be. I imagine being intelligent and sessile while having others around you who are also intelligent and sessile would greatly influence the social-psychological environment of these plants. Specifically, I would think that you would go to great lengths to be polite, as there is no way to remove yourself from an unpleasant situation.

An analogy to fern's "alternation of generations" is possible. This is how it works on Earth: Ferns disperse spores, which grow independently into a prothallus, the active reproductive part (Gametophyte). The prothallus is fertilized (hopefully by a prothallus from another plant), and yields a new plant - the sporophyte, the one we know as the fern we encounter at the nursery.

In your sci-fi model, the gametophyte, may be a motile animal-like creature. This allows it to wander and search for mates. Once it mates, it forms the "seed" to a new plant which will grow and make new gametophytes. Now is the fun part: which one is more long-lived, the motile gametophyte, or the tree-like sporophyte? If the gametophyte lives long enough, it may become more advanced and sentient.

But why would it get sentient? What evolutionary pressure?

To clarify my last sentence: longevity all by itself does not guarantee a creature will evolve into a "sentient". I just meant it is an important prerequisite in the evolutionary process towards sentience.

Cephalopods are quite intelligent and relatively short lived, you know...

Cephalopods are quite intelligent indeed, but a species having its own culture and the equivalent of a stone-age civilization is one thing, while having a high-tech civilization is another thing. If humans lived, suppose, up to 20 years, would we have time to make breakthrough researches? I find it hard to go much beyond college. You may need an outstandingly high intelligence and learning ability to make-up for such a deficit.
