

# BACTERIA

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Years ago, Dinosaurs were ruling every continent. Suddenly, they disappeared. Since then, life continued as if nothing happened.

Imagine, Elephants, Gorillas, Lions, Sharks, Whales, Eagles, Ducks, Orchids, Pine trees, Flies and Mosquitos disappear “overnight”. We will miss some of them; however, life will continue uninterrupted as if nothing happened.

**With Bacteria it is different. If Bacteria disappear overnight from the face of the Earth, life as we know it will cease to exist.**

Think about it and ask your selves. **WHY?**

The answer is simple: **Bacteria keep the living alive.**

Bacteria are heavily involved in protecting and supporting life on Earth. Most are not aware of the importance of Bacteria in the life of the living, especially Plants.

**Nitrogen gas (N<sub>2</sub>)** is the largest constituent of the Earth’s atmosphere. With Carbon, Oxygen and Hydrogen, it is part of the organic but not the inorganic world. There are NO nitrogen containing minerals. Many believe, because somebody said so, that by using rainwater we can provide (fertilize) plants with Nitrogen. That is wrong. Nitrogen is one of the most inert elements known and that is fortunate because it is also one of the most poisonous and dangerous. It is relatively non-reactive and unusable by plants. Chemical processing or natural fixation (**bacterial conversion**) are necessary to convert gaseous nitrogen into compounds such as nitrate or ammonia which can be used by plants.

The contribution of Bacteria in the **recycling of organic matter** is well known. The **fermentation of foods** consumed by the living, incl. humans (meat, fish, fruit, Cheese) is also known and documented. Fewer people are aware of the role Bacteria play **in the food digestion process, especially the digestion of poisonous plants**. Finally, Bacteria also **protect life** by attacking life forms with aggressive behaviour, including other bacteria and fungi as well as parasites. Bacteria are often used commercially to fight pests and disease causing microorganisms.

There is a “black” sheep in every family and Bacteria are no exception. Be prepared. Know your enemy. Prevention is always the best cure.

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Putting together a credible account of Bacteria that damage orchids isn’t easy. Scientists finding it difficult to make up their mind about the species and the Genera they belong to.

Bacteria are tiny, microscopic, mostly single cell micro-organisms capable of multiplying by themselves, by division. Their cells, have neither a membrane enclosed nucleus nor other membrane enclosed organelles i.e. mitochondria and chloroplasts.

Bacteria multiply and mutate very rapidly and unlike viruses, do grow in the spaces between cells and do not invade them. Some scientists subscribe the view that Viruses evolved from Bacteria (retrogressive evolution). I do not support that view.

Like all life forms, Bacteria carry genetic material, reproduce and evolve through “natural selection” (survival of the fittest). In my opinion, evolution through natural selection requires a degree of intelligence, it is not easy to adapt and survive; therefore, I believe, all living must have a degree of intelligence.

Bacteria associated with plants are predominantly saprophytes and are of great benefit, helping with the decomposition of dead and rotting plant tissue and organisms as well as with Nitrogen fixation. Only parasitic or “**Phytopathogenic**” bacteria, when present, can cause serious damage. Bacteria exist in various shapes: **spherical = cocci** (Greek coccus = grain, seed), **rod-shaped = bacilli** (Latin baculus = stick), **slightly curved = vibrio**, **spiral-shaped = spirilla**, **coiled shaped = spirochetes**, **thread-like shape = filamenti**, etc.

Phytopathogenic bacteria are predominantly rod shaped (**bacilli**) and have flagella that are aerobic and parasitic, and distinct symptoms and names such as: Brown Rot (**BR**), Brown Spot (**BS**), Bacterial Soft Rot (**BSR**), Bacterial Leaf Spot (**BLS**), etc.

Bacterial infections are more common in tropical and sub-tropical regions and can spread rapidly if left untreated and are destructive and deadly and should be taken very seriously. Fortunately, there are only a few bad bacteria, and symptoms are easy to identify.

### **Common symptoms:**

When it comes to bacterial infections, veins often limit the growth of a lesion. In other words, bacterial lesions (spots) are more often than not angular or irregular in shape and rarely round.

Translucent lesions and black or brown soft lesions that when squizzed ooze smelly fluids with distinct foul smell especially *Erwinia carotovora* are normal occurrences.

Misinformed orchid growers and horticulturalists, associate chlorosis (yellowing of the leaves) with Bacterial infections. That assumption is wrong. Bacteria “decompose” leaves, stems, bulbs or roots. The process of decomposition doesn’t cause yellowing of the leaves, on the contrary, creates concentrations of greener “lines”, “patches” or “spots” that may appear adjacent or around bacteria infected areas (lesions). (See last pic)

The decomposition (re-cycling) of aged yellow leaves is a different process done by different, useful bacteria. In fact, growers use “organic potting mix”, fully aware that the starting components, leaves, braches, paper, etc. were re-cycled predominately by Bacteria. The mix is full of micro-organisms including Bacteria.

It is easy to understand that the perfect growing conditions for Phalaenopsis and Vandaceous orchids, i.e. Temperature and Humidity, are also perfect for the life style of Bacteria. Furthermore, species and hybrids of these two Genera have very attractive for bacteria “fleshy” leaves. In plain English, Phalaenopsis and Vandaceous orchids are by far the most vulnerable plants.

### **Spreading:**

Bacteria require moisture, humidity and stable room temperatures. The spreading of Bacteria occurs during periods of warm weather conditions, high humidity and rain or when watering.

- Water “splashing” on contaminated areas, can “embrace” bacteria and become a Vector. The airborne water droplets, now Vectors, can infect surrounding healthy plants.
- Careless use of contaminated gardening tools, knives or scissors is also a major source of spreading diseases.
- Sapsucking insects can easily become vectors and contaminate healthy plants and spread the bacteria.

### **Prevention:**

Control can be achieved by simply improving the conditions in the Greenhouse or the area where the Orchid are kept.

- Regularly check plants for any signs of injury, insect bites or unusual lesions. Bacteria must find a wound to invade; therefore plants are vulnerable if some kind of wound is present.
- Bacteria need moisture to survive, multiply and attack. Bacteria do not survive at high temperatures (above 45° C) and dry conditions (0% humidity).
- Air circulation must be adequate for the plants to dry at a reasonable time after watering.
- Quarantine newly purchased plants for a few days.

### **Treatment:**

The best eco-friendly remedies to treat bacterial diseases are: Heat (not suitable to treat orchids), Salt (Not suitable to treat orchids), Honey, Cinnamon, Cassia, Garlic and Hot Chilli. Cinnamon or Cassia powders can be mixed with a vegetable oil, like canola oil, to create a “paste”. The paste can be used to smear wounds and prevent infections from spreading. Garlic and Hot Chilli are extremely strong and 100’s of year old recipes do exist. Don’t use them if you don’t know how. Chemicals sold as “Bactericides” do exist but not all work as sold by the manufacturer.

When signs of bacterial infection are noticed, the infected parts such as leaves, bulbs, stems, etc., should be removed (cut) and burned. The plant should be isolated, the wound must be treated and surrounding plants should also attended to with a suitable bactericide.

**Herbicides, Insecticides, Pesticides or Fungicides do not kill bacteria.**

Most disease causing “Phytopathogenic” bacteria are species of the following 6 Genera: Acidovorax, Burkholderia, Pseudomonas, Pectobacterium, Erwinia, and Bacillus. In literature, Phytomonas, a protozoan parasite, is mixed up with Pseudomonas, a bacterium.

## Bacteria

**Genus: Acidovorax:** Bacterial Brown Spot (**BBS**); Leaf Spot (**LS**)

***Acidovorax avenae subsp. cattleyae* (AAC).** Rod shaped, Non-spore forming bacteria. Destructive disease.

**Host Genera:** Cattleya, Cyripedium, Dendrobium, Oncidium, Vanda, and Phalaenopsis.

**Symptoms:** Soft, water-soaked translucent lesions that become soft and often break. The exudates contain numerous bacteria that can easily spread to other parts of the same plant or surrounding plants. Lesions turn slowly brown or black.

***Phytomonas cattleyae* syn. *Acidovorax avenae subsp. cattleyae* syn. *Pseudomonas cattleyae*.**

**Genus: Pseudomonas:** Bacterial Brown Rot (**BBR**); Bacterial Leaf Spot (**BLS**); Bacterial Brown Spot (**BBS**); Bacterial Brown Wet Spot (**BBWS**); Very active when wet.

***Pseudomonas cattleyae*:** Bacterial Brown Wet Spot (**BBWS**).

**Host Genera:** Observed on Phalaenopsis but may attack any other orchid genera.

**Symptoms:** Visible on leaves as brown, brownish or brownish-black moist blisters. The bacteria will spread very rapidly and the disease eventually will kill the plant if not treated. Stop overhead watering. Remove all infected leaves.

**Genus: Erwinia:** Bacterial Brown Rot (**BBR**); Bacterial Soft Rot (**BSR**); Bacterial Soft Brown Rot (**BSBR**); Bacterial Leaf Spot (**BLS**); Bacterial Bulb Rot (**BBR**).

***Erwinia carotovora* syn. *Pectobacterium carotovorum*:** Rod-shaped bacterium that causes the destruction of the plant’s cell walls and creates an osmotically fragile cell.

**Host Genera:** Oncidium Alliance orchids and other Genera.

**Symptoms:** The bacteria are characterized as slimy and foul smelling. The bulbs of infected plants turn soft and yellowish in colour. Allegedly, the bacteria can survive in insects gut for hours and can be transferred from plant to plant by insects. Observed in the surface of water but it is unknown if it can survive in the soil, although in some reports it is described as “a soil inhabitant”.

***Erwinia cypripedii*:** Brown Rot (**BR**): Highly contagious and spread very rapidly when unchecked. It requires over 65% humidity and temperatures above 18°C to grow and multiply.

**Host Genera:** Serious threat to Paphiopedilum.

**Symptoms:** Small to medium size translucent, almost circular “spots” that grow and join together and form larger “sunken” lesions. If unchecked, it spreads rapidly and when it reaches the crown the plant will be completely rot and collapse, although many leaves may still remain healthy looking. Infected areas exude moisture that contains infectious bacteria, and these pose a serious danger to surrounding plants.

**Erwinia chrysanthemi:** The disease is said to be incurable.

**Host Genera:** Devastating bacterial pathogen in Phalaenopsis.

**Symptoms:** Causes soft-rot by secretion of cell wall-degrading enzymes. Later, a foul smelling liquid starts to ooze from the bulbs.

**Genus: Pectobacterium:** Bacterial Soft Rot (**BSR**); Bacterial Soft Brown Rot (**BSBR**);

**Pectobacterium carotovorum** syn **Erwinia carotovora**. Rod shaped bacterium of the family Enterobacteriaceae, was formerly a member of the genus Erwinia.

**Host Genera:** Diverse host range.

**Pectobacterium chrysanthemi** syn. **Erwinia chrysanthemi**. Anaerobic.

**Genus: Bacillus:** Bacterial Leaf Spot (**BLS**); Bacterial Brown Rot (**BBR**); Bacillus is a rod-shaped bacterium and includes both free-living and pathogenic species.

**Genus: Burkholderia:** Bacterial Brown Rot (**BBR**); Bacterial Leaf Spot (**BLS**); Previously part of Pseudomonas.

**Burkholderia gladioli**. Rod-shaped bacteria.

**Host genera:** Dendrobium, Oncidium, Miltonia species and hybrids.

**Genus: Dickeya:** Bacterial Soft Rot (**BSR**); Bacterial Leaf Spot (**BLS**);

**Dickeya chrysanthemi** syn. **Pectobacterium chrysanthemi** syn. **Erwinia carotovora var. chrysanthemi** syn. **Pectobacterium carotovorum f. sp. chrysanthemi** syn. **Pectobacterium carotovorum var. chrysanthemi** syn. **Pectobacterium parthenii** syn. **Pectobacterium parthenii var. chrysanthemi** and syn. **Pectobacterium parthenii var. dianthicola**.

**Host Genera:** Phalaenopsis, Dendrobium, Oncidium, Miltonia.

**Dickeya dieffenbachiae:**

**Phytomonas:** trypanosomatid parasite of plants and fruit.

**Trypanosomatid.** A Genus of protozoan parasites found in plants that can be lethal causing necrosis. These are fairly common in the latex of many orchids and can be transmitted to the plants in the saliva of various plant insects. I have never seen damage caused by Phytomonas.

## Bacteria known to attack orchids.

Division	Class	Order	Family	Genus	Species	Sub-Species
<b>Proteobacteria</b>						
	Beta-Proteobacteria					
		Burkholderiales				
			Comamomadaceae			
				<b>Acidovorax</b>		
					<i>avenae</i>	
						<i>subsp. cattleyae</i>
				<b>Burkholderia</b>		
					<i>gladioli</i>	
	Gamma-Proteobacteria					
		Pseudomonadales				
			Pseudomonadaceae			
				<b>Pseudomonas</b>		
					<i>cattleyae</i>	
					<i>gladioli</i>	
					<i>grimontii</i>	
		Enterobacteriales				
			Enterobacteriaceae			
				<b>Pectobacterium</b>		
					<i>carotovorum</i>	
					<i>chrysanthemi</i>	
				<b>Erwinia</b>		
					<i>cypripedii</i>	
					<i>carotovora</i>	
						<i>var. carotovora</i>
						<i>var. chrysanthemi</i>
				<b>Dickeya</b>		
					<i>chrysanthemi</i>	
					<i>dieffenbachiae</i>	
<b>Firmicutes</b>						
	Bacilli	Bacilliales	Bacillaceae	<b>Bacillus</b>	<i>cypripedii</i>	



**Early stage: Translucent Lesion**



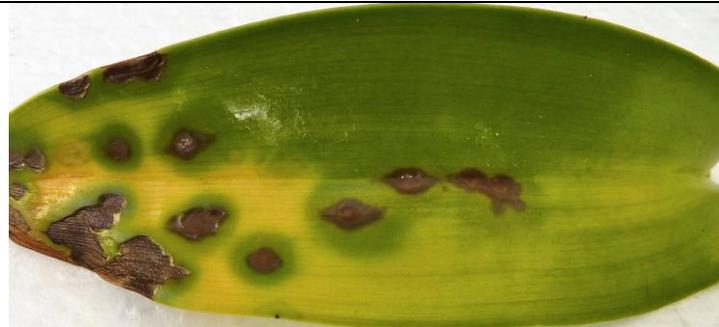
**Advanced Stage: Brown/Black Lesion.**



**Advanced Rot**



**Bacterial decomposition in progress**



**Bacteria lesions (scars) with "Green" rings**