Azotobacter Encyclopedia Article

Azotobacter

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Azotobacter

The genus *Azotobacter* is comprised of **bacteria** that require the presence of oxygen to grow and reproduce, and which are inhabitants of the soil. There are six species of *Azotobacter*. The representative species is *Azotobacter vinelandii*.

The bacteria are rod-shaped and stain negative in the **Gram staining** procedure. Some species are capable of directed movement, by means of a flagellum positioned at one end of the bacterium. Furthermore, some species produce pigments, which lend a yellow-green, red-violet, or brownish-black hue to the soil where they are located.

Relative to other bacteria, *Azotobacter* is very large. A bacterium can be almost the same size as a **yeast** cell, which is a eucaryotic single-celled microorganism.

Azotobacter has several features that allow it to survive in the sometimes harsh environment of the soil. The bacteria can round up and thicken their cell walls, to produce what is termed a cyst. A cyst is not dormant, like a spore, but does allow the bacterium to withstand conditions that would otherwise be harmful to an actively growing vegetative cell. When in a cyst form, *Azotobacter* is not capable of nitrogen fixation. The second environmentally adaptive feature of the bacterium is the large amounts of slime material that can be secreted to surround each bacterium. Slime naturally retains water. Thus, the bacterium is able to sequester water in the immediate vicinity.

A noteworthy feature of *Azotobacter* is the ability of the bacteria to "fix" atmospheric nitrogen, by the conversion of this elemental form to ammonia. Plants are able to utilize the ammonia as a nutrient. Furthermore, like the bacteria *Klebsiella pneumoniae* and *Rhizobium leguminosarum*, *Azotobacter vinelandii* is able to accomplish this chemical conversion when the bacteria are living free in the soil. In contrast to *Rhizobium leguminosarum*, however, *Azotobacter vinelandii* cannot exist in an association with plants.

Azotobacter can accomplish nitrogen fixation by using three different **enzymes**, which are termed nitrogenases. The enzyme diversity, and an extremely rapid metabolic rate (the highest of any known living organism) allow the bacterium to fix nitrogen when oxygen is present. The other nitrogen-fixing bacteria possess only a single species of nitrogenase, which needs near oxygen-free conditions in order to function. The enhanced versatility of *Azotobacter* makes the microbe attractive for agricultural purposes.