Discovery of Nitrogen Fixation Script

Did you know that soybeans helped poor Southern farmers rise out of poverty at the turn of the 20th century?

One of America’s most famous agricultural scientists made it his life work to bring science out of the lab and into the hands of American farmers.

“The primary idea in all of my work was to help the farmer and fill the poor man's empty dinner pail. My idea is to help the 'man farthest down'.”

These are the words of George Washington Carver, world-renowned botanist and inventor who rose out of slavery to revolutionize the South’s agricultural economy.

But how did one man accomplish such a feat? And how does it relate to the science of soybeans?

This story starts in Alabama in the late 1890s. For years, Southern farmers had made a living off of growing cotton. But after decades of growing the same crop year after year, the soil became depleted of nutrients. Fields became dry and brown, and many could no longer sustain crops. Dust filled the air as soil blew away from erosion. Many white farmers moved further west to farm new land, and emancipated slaves were left in the south to farm the depleted land.

Now here’s where Carver and his scientific research comes in. Ever since Carver was a boy, he loved plants. He collected, drew and studied them while he worked on farms as a child and teenager. He even earned the nickname “The Plant Doctor.”

Eventually, Carver earned a Masters degree in bacterial botany and agriculture. He started working with the Tuskegee Institute, and began a series of experiments to figure out a way to enrich the South’s nutrient-depleted soils. Carver wondered if crop rotation might hold the key. But what crops should farmers plant?

Carver knew that plants like cotton needed certain vital nutrients to grow, such as nitrogen, which they got from the soil. Nitrogen is part of both the nucleotides in DNA and RNA and the amino acids in proteins, and all plants need nitrogen to grow and reproduce. But there’s only a limited amount of nitrogen in the soil, and once plants use it up, it has to be replenished.

So basically, it all boiled down to the fact that most of the farmland in the South was seriously lacking in nitrogen. Carver knew if he could figure out a way to return nitrogen to the soil, the fields would be much more productive. Perhaps in this way he could help poor black farmers earn a sustainable living on the farm.

It wasn’t long before Carver made an important discovery that would shape the future of agriculture. He figured out that fields could be fertilized naturally with nitrogen by rotating the planting of cotton every other year by planting legumes, such as soybeans, clover, alfalfa, peas or peanuts. By rotating these crops, nitrogen can be returned to the soil through a process called “nitrogen fixation.”

So how does this process work? Essentially, legumes such as soybeans have the rare ability to convert pure nitrogen gas that’s in Earth’s atmosphere into a more usable form of nitrogen called ammonia. They achieve this feat with a little help from a bacterium that grows on their roots, which is called Rhizobium.

Here’s how it works in the soybean plant. The Rhizobium bacterium enters the roots of the soybean and forms nodules or little round bumps in the roots. It looks like a root disease but it’s actually a symbiotic or mutually beneficial relationship with the plant. The soybean hosts the bacterium in its roots and allows the bacterium to take up carbohydrates. In exchange, the bacterium in the root nodules converts the nitrogen gas from the air into ammonium. Most of this nitrogen is taken up and used by the soybean plant. But when the soybean dies and its leaves and roots decompose, the extra nitrogen is returned to the soil.

So what happened to the depleted soils in the rural South? Well, it took some time, but over the years Carver was able to convince Southern farmers to rotate planting cotton with nitrogen-fixing legumes like soybeans and peanuts. The resulting surpluses of these legume crops led Carver to discover hundreds of new uses for soybeans and peanuts, which included dyes, paints, cosmetics, plastics and even fuel. Carver’s discoveries boosted the South’s economy and even helped supply the U.S. army with new products during World War One – in a large part because of the soybean’s nitrogen fixation process.

Today Carver’s work is as important as ever. Rotating crops by planting legumes such as soybeans allows a new generation of organic farmers to maintain or improve soil quality without the use of chemical fertilizers. It also helps them to manage weeds, pests, and disease.

Carver will always be remembered for not only the work he did to transform agriculture and improve soil quality in the United States, but how he showed society the importance of applying scientific research in order to improve the lives of every day men and women – with the help of the soybean.