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SCIENTISTS IN AGRICULTURE: 100 YEARS SINCE THE BIRTH OF DR. JOHANNA DÖBEREINER

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Abstract. Since time immemorial, agricultural scientists study all aspects of living organisms and the relationships of plants and animals to their environment. It is known that wild grains have been collected and eaten from at least 105 000 years ago, and possibly much longer. To this day, the key role of agriculture in people's existence has not diminished in any way. On the contrary, agricultural sciences continue to address a number of global issues, led by a number of great minds in the field. One of these great minds, the Brazilian agronomist and soil biology pioneer Dr. Johanna Döbereiner, inevitably left a lasting mark on agronomy as a science and practice. This article examines the biography, life path and achievements in the field of science of Dr. Döbereiner, her career, scientific interests and honours, thereby aiming to give her the undeniably deserved respect and popularize her work. The interesting scientific career of this remarkable woman is an incentive for many people to immerse themselves in the world of agricultural sciences.

Keywords: agricultural scientists; biography; achievements; science; Dr. Johanna Döbereiner

1. Early life of Dr. Johanna Döbereiner

Talking about Johanna Döbereiner (Figure 1) is not an easy task. A woman with a strong personality, who pioneered science and faced many obstacles until she was able to prove that her research was on the right track, she was always one step ahead of the reality of her time. She believed in herself and kept moving forward.[1]

Johanna Liesbeth Kubelka Döbereiner (28 November 1924 – 5 October 2000) was a Czechoslovak-born Brazilian agronomist and pioneer in soil biology. Dr. Döbereiner's early life was not easy for sure as her family was forced to immigrate to Germany at the end of the World War II.[2] Her family were German Czechoslovakians from Aussig in Bohemia, which at the time of their birth was the Austria–Hungary Empire, who left their country after World War II.[3]

At the age of seventeen, in the middle of the World War II, she was forced to separate from her family and for a period of about four years had only occasional

encounters with her parents and grandparents. She worked in several places in a broad range of activities. To begin with, she took care of children in government-sponsored colonies inside Czechoslovakia, and later she lived and worked on farms, milking cows, distributing natural fertilizers in the farms and orchards, and helping in the weeding of crops. Through these activities she was able to sustain and help her grandparents' survival (Pavan 2001, p. 50).

Figure 1. Dr. Johanna Döbereiner (1924 – 2000)
Source: mujeresconciencia.com

In 1945, as a consequence of the war, together with her grandparents, she was expelled from Czechoslovakia, from which she went to Germany where she continued working in farms until 1947 (Pavan 2001, p. 50), in which year she was offered a place in the Ludwig Maximilian University of Munich, where, in 1950, she graduated as an agricultural engineer.

Her mother, after enduring great deprivations and even internment in concentration camps, died and was buried under a changed name, Anna, instead of Margareth Kubelka (Pavan 2001, p. 51). Her widowed father, Professor Paul Kubelka, and her brother Werner, with the help of foreign teachers based in Brazil and the Brazilian citizen Mário Pinto, managed in 1948 to migrate to Brazil. In 1950, Johanna, already married to Jürgen Döbereiner, a university colleague, emigrated with him to Brazil. She became a naturalized Brazilian citizen in 1956.

2. Career, achievements and scientific interests

In 1951, in Rio de Janeiro, she was employed by the Department of Agriculture and began her work on nitrogen fixing bacteria, an area that she knew only from references to it in her agronomy course. Even without a specialized adviser, she believed so much in the importance of the subject that initially, with very

few resources and a great deal of perseverance, she achieved, with students and collaborators, excellent progress in this field. Her work was abundant in practical results and publications that went beyond the borders of Brazil to receive wide international recognition (Pavan 2001, p. 51).

In her early work, Döbereiner found a number of bacteria in Brazilian soils, including *Azotobacter* (later named *Azorhizophilus*) *paspali* and *Beijerinckia fluminenesis*, surrounding cereal grasses, the latter in the rhizoplane of sugarcane. She also studied a number of Brazilian species of *Azospirillum*, the only other genus other than the rhizobia used as inoculants for crops.[4]

Two critical happenings in the 1970s enabled Dr. Döbereiner to advance her research further. One was the gasoline crisis of the early 1970s, which caused the price of chemical fertilizer to increase significantly, and the other was the development of the acetylene reduction assay (ARA), a relatively easy detection system for determining low levels of nitrogenase, i.e. biology nitrogen fixation (BNF) activity. Many Brazilian pasture grasses tested positively for nitrogenase activity using ARA and a semi-solid medium developed by the Brazilians, strongly suggesting the presence of an associated nitrogen-fixing bacterial species.[4]

In the 1980s, Johanna Döbereiner and her colleagues found a number of nitrogen-fixing bacteria that colonized the inner tissues of plants (diazotrophic endophytes). *Herbaspirillum seropedicae* was isolated from maize (*Zea mays* L.), sorghum (*Sorghum bicolor* (L.) Moench), and rice (*Oryza sativa* L.), whereas *Gluconoacetobacteria diazotrophicus* was isolated from sugarcane. Indeed, various sugarcane varieties were found to obtain 30 to 50% of their nitrogen from BNF, and the discovery of *Gluconoacetobacteria* led to a tripling of the production of bioethanol in Brazil. Nitrogen-fixing (Nif) ability of these bacteria was later confirmed by Christine Kennedy and her co-workers using $^{15}N_2$ incorporation and Nif mutants. Thus, associative nitrogen fixation was firmly established as a means of providing fixed nitrogen to plants, and shows the potential for partnerships between biofuel crops and all nitrogen-fixing bacteria.

Her work on soybean (*Glycine max* (L.) Merr.) culture, involving the selection of bacteria which fix nitrogen from the air and pass it on through symbiosis to the plant, led to the substitution, with great advantages, of the application of artificial nitrogen fertilizers. With collaborators she produced the most efficient culture of soy-bean existent today, something which has proved to have great economic and ecological value. By planting in Brazilian soil, without the use of artificial nitrogen fertilizer, she obtained a productivity comparable to the North American cultures, which depended on artificial fertilizers and were the largest soy-bean producers per unit area in the world. These cultures are now generating great profits (hundreds of millions of dollars) for Brazilian and Argentinian farmers, and this latter group uses the same technology as that elaborated by the group of researchers led by J. Döbereiner (Pavan 2001, p. 51).

During her 50-year career, Dr. Johanna Döbereiner has written over 500 publications. As a consequence of her research and ideas, numerous soybean plantations in Brazil are now completely supplied for nitrogen by *Rhizobia* and not using any N-fertilizers.[4]

3. Recognition and honours

In a survey carried out in 1997 by the „*Folha de São Paulo*", a major Brazilian daily newspaper, she was classified as the most cited (Citation Index International) of Brazilian female scientists and belonged to the top 10% of both male and female cited scientists (Pavan 2001, p. 52).

This outstanding scientist (Figure 2) received several prizes, including the Prize for Science of UNESCO (1989); the Bernard Houssay Prize of the OEA (1979); the Mexican Prize for Science and Technology (1992) and others.

Figure 2. Dr. Johanna Döbereiner revolutionized agriculture worldwide
Source: oglobo.globo.com

She belonged to the Brazilian Academy of Sciences (1977), to the Pontifical Academy of Sciences (1978), and was a Founding Member of the Third World Academy of Sciences (1981). Her work on soybean was one of the reasons that Dr. Johanna Döbereiner was indicated for the Nobel Prize in the 1990s. The Embrapa Agrobiology Biological Resources Center in Rio de Janeiro is named after her.

NOTES

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