



Johanna Liesbeth Kubelka Döbereiner



Aussig, Czech Republic, 28 Nov. 1924 - Seropédica, Brazil, 5 Oct. 2000

Nomination 17 April 1978

Field Agronomy - Microbiology

Title Doctor of Science honoris causa

Commemoration – Johanna Döbereiner was born in Aussig, in Czechoslovakia, and lived with her family for some years in Prague, the city where her father, Paul Kubelka, was a teacher at the German University. As a youth her life was afflicted and very difficult. At the age of seventeen, in the middle of the Second World War, 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 fertilisers 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. 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, in which year she was offered a place in the School of Agriculture 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. Her widowed father 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. In 1956 she became a naturalized Brazilian citizen. 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 specialised 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.

Her work on soy-bean 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 fertilisers. With collaborators she produced the most efficient culture of soy-bean existent today, something which has proved to have great economical and ecological value. By planting in Brazilian soil, without the use of artificial nitrogen fertiliser, she obtained a productivity comparable to the North American cultures, which depended on artificial fertilisers 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.

In terms of the ecological aspects of soy-bean culture, it has been demonstrated in works published by the Ecological Society of America that artificial nitrogen fertiliser, used in agriculture throughout the world, is an important polluting agent of the terrestrial aquatic system and is already contaminating the sea systems. The use of nitrogen fixing bacteria is without doubt the most important alternative that exists to achieve a solution to this problem.

Of no less importance are some other achievements of the work of Döbereiner's group, in particular the discovery of several new species of nitrogen fixing bacteria associated with cereals, grasses and other non-leguminous species.

In contrast to the classical concept of rhizosphere associations, these bacteria colonise the roots, stems and leaves of wheat, rice, maize, sorghum, and a great number of other wild plant species. Some of these species of bacteria are obligate endophytes and do not survive in the soil, and their transmission occurs within seeds or stem cuttings. These discoveries by Döbereiner now exert a very important influence on agricultural processes involving the legume plants mentioned above and are expected to make a no less important contribution to the agriculture of nonlegume plants and also to the conservation of biodiversity around the world. Their importance in the transition to sustainability is more than evident.

This outstanding scientist received several prizes, including the Bernard Houssay Prize of the OEA (1979); the Prize for Science of UNESCO (1989); the Mexican Prize for Science and Technology (1992), and others. 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). The list of her publications includes over 370 papers published in international scientific journals. 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.

Apart from losing a great researcher, the Brazilian scientific community, and especially myself, have lost a very dear and esteemed friend whose memory will be cherished by us all.

C. Pavan

Most important awards, prizes and academies

EMBRAPA Frederico Menezes Veiga prize (1976); Research Agriculture of Today prize (1977); OAS Bernardo Houssay prize (1979); Member of the Brazilian Academy of Sciences (1977); Member of the Pontifical Academy of Sciences (1978); Founding member of the Third World Academy of Sciences (1981); First Secretary of the Brazilian Academy of Science (1992), and Vice President (1995).

Summary of scientific research

The main line of my research envisaged from the beginning alternatives for the increasingly expensive and hazardous nitrogen fertilizers. The use of the unlimited reserve of molecular dinitrogen via photosynthesis which uses sun energy seems the obvious solution. Along this line research which permits more efficient use of biological dinitrogen fixation in the legume-*Rhizobium* symbiosis focalized in tropical agriculture, where an infinitely larger choice of still unexplored systems exists. Breeding of grain and forage legumes and selection of *Rhizobium* strains adapted to poor acid soils and high temperatures was one approach. Surveys of nitrogen-fixing legume trees which have not been known as such before, representing additional alternatives. Studies on the physiology of grain legumes in relation to photosynthesis and to the efficiency of the translocation of the fixed nitrogen to the grain yield also are very interesting new prospects. The major challenge of our research was and still is the expansion of dinitrogen fixation to the major cereal crops. Seven new dinitrogen fixing bacteria were described and their association with maize, sorghum, wheat, etc., demonstrated. N balance studies performed over the last few years have shown that several Brazilian varieties of sugarcane are capable of obtaining over 60% of their nitrogen (>150 kg N ha⁻¹ year⁻¹) from biological nitrogen fixation (BNF). This may be due to the fact that this crop in Brazil has been systematically bred for high yields with low N fertilizer inputs. Rice can obtain at least some N from BNF and acetylene reduction (AR) assays also indicate differences in N₂-fixing ability between different rice varieties. Although many species of diazotrophs have been isolated from the rhizosphere of both sugarcane and wetland rice, the recent discovery of endophytic N₂-fixing bacteria within roots, shoots and leaves of both crops suggests, at least in the case of sugarcane, that these bacteria may be the most important contributors to the observed BNF contributions. In sugarcane both *Acetobacter diazotrophicus* and *Herbaspirillum* spp. have been found within roots and aerial tissues, *Herbaspirillum* spp. are found in many graminaceous crops, including rice (in roots and aerial tissues), and are able to survive and pass from crop to crop in the seeds. The sugarcane/endophytic diazotroph association is the most efficient N₂-fixing system to be discovered associated with any member of the gramineae. As yet the individual roles of the different diazotrophs in this system have not been elucidated and far more work on the physiology and anatomy of these systems is required. However, the understanding gained in these studies should serve as a foundation for the improvement/ development of similar N₂-fixing systems in wetland rice and other cereal crops.

Main publications

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