

*Historical review*

## **Hundred years of history and the future of the Foundation ‘Willie Commelin Scholten Phytopathological Laboratory’**

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### **The past**

More than a century ago, on December 18th, 1894, the Foundation ‘Willie Commelin Scholten Phytopathological Laboratory’, in short ‘WCS-Foundation’ (WCS), was established in Amsterdam. It was one of the first institutes in the world dedicated to scientific research and higher education in plant pathology.

The finances were by courtesy of Mr C.W.R. Scholten and Mrs H.H. Scholten née Commelin, in commemoration of their late son Willie, who had shown himself highly interested in plant pathology when studying botany under the supervision of Prof. Dr Hugo de Vries, one of the founders of the WCS. The families Scholten and Commelin both were well-known in the Amsterdam community for many centuries. Johannes Commelin, a botanist who lived from 1629 to 1692, was Director of the Amsterdam Botanical Gardens. In 1920, the WCS-laboratory moved to the town of Baarn where it could use the field facilities of the Botanical Gardens of the Utrecht University. In the course of time, the responsibilities for education and research in plant pathology in Baarn were assigned to the University of Utrecht, the University of Amsterdam and the Free University at Amsterdam (Kerling, 1966; 1969).

As part of the general cut-backs in higher education, the Free University withdrew in 1987 and the boards of the Universities of Amsterdam and Utrecht decided in 1988 to transfer their Department of plant pathology from Baarn. As a result, the Department was split and moved to the Faculties of Biology at the University campuses at Amsterdam and Utrecht, respectively. In June 1991, the facilities of the Willie Commelin Scholten Phytopathological Laboratory at

Baarn were closed. The WCS-Foundation carrying the same name, however, set a new course to continue her objectives of promoting research and education in plant pathology, as will be discussed later.

For more than 100 years, the WCS-Foundation greatly influenced the development of plant pathology and mycology in the Netherlands. On the initiative of the first director, Prof. Dr J. Ritzema Bos, the Plant Protection Service was founded in 1899, and under his directorship located in the Willie Commelin Scholten Phytopathological Laboratory in Amsterdam. His research was application-oriented and finally resulted in his nomination as Director of the newly founded ‘Institute of Phytopathology’ at Wageningen. Ritzema Bos took his ‘Plant Protection Service’, the Netherlands Society of Plant Pathology and his ‘Tijdschrift over Plantenziekten’ with him to Wageningen. This journal later became The Netherlands Journal of Plant Pathology and since 1994 is being continued as the European Journal of Plant Pathology, published in co-operation with the European Foundation for Plant Pathology. Ritzema Bos was succeeded by Johanna Westerdijk as the new director of the WCS-Laboratory in 1906.

Dr Johanna Westerdijk was appointed professor of Plant Pathology at the Utrecht University in 1916 and at the University of Amsterdam in 1930. During the 46 years of her directorship (1906–1952) the research became more fundamental of character and especially focused on the life cycles of pathogenic fungi and on the redefining of the ‘species concept’, based on both their pathogenic behaviour on host plants and their appearance in pure culture (Westerdijk, 1919). The WCS-Laboratory obtained international reputation with the description of the life cycle of the causal



Figure 1. Aerial view of the grounds with buildings of the Willie Commelin Scholten Phytopathological Laboratory at Baarn, taken in 1982. In the center the main building 'Java'. At the far left parts of the building 'Madoera' where plant pathology and mycology courses were given. At the right the Centraalbureau voor Schimmelcultures (CBS).

agent of the 'Dutch elm disease' *Ophiostoma ulmi* and with the development of resistance breeding against this disease (Holmes and Heybroek, 1990). Professor Westerdijk also initiated research on viruses causing plant diseases (Ten Houten, 1963).

Under her direction, the fungal type culture collection 'Centraalbureau voor Schimmelcultures' (CBS) was rapidly growing and moved into a separate building on the WCS grounds at Baarn in 1964. In 1968 the CBS became an independent scientific institute of the Royal Netherlands Academy of Sciences (KNAW).

Prof. Dr Louise C.P. Kerling (1952–1970), successor of Johanna Westerdijk, among other things stimulated research on the infection process by wilt-causing *Fusarium* spp., and on the disease-suppressing antagonism of non-pathogenic micro-organisms on the plant surface and in the soil (Kerling, 1964; Oort and Ten Houten, 1970). Thereby she introduced a more physiologically and ecologically oriented research in the WCS-laboratory. Under the supervision of Dr Doekle M. Elgersma, Dr Nycle J. Fokkema and Dr Bob Schippers this research gained international recognition (Elgersma, 1972; Fokkema and Van den Heuvel, 1986; Schippers and Gams, 1979). In 1963 Mrs. Dr

Hendrien Wieringa-Brants was nominated lecturer in Plant Virology and focussed her attention on the transport of viruses through the plant and on mechanisms of resistance against plant viruses (Brants, 1965). The mycologist Dr J.A. von Arx, already co-worker of Johanna Westerdijk, contributed much to the international recognition of the WCS-Laboratory. In 1963 he became director of the CBS at Baarn.

Under the directorship of Prof. Dr Koen Verhoeff (1970–1986) within the WCS-laboratory three Sections were established, named 'Susceptibility and Resistance', 'Ecology of Pathogenic and Non-pathogenic Micro-organisms' and 'Virology', supervised by Profs Verhoeff, Schippers and Wieringa-Brants, respectively. Schippers was nominated lecturer in 1973. In 1980, Wieringa-Brants and Schippers became professors in Virology and Plant Pathology, respectively.

The Section 'Susceptibility and Resistance' concentrated on the mechanisms of resistance of carnation and tomato against fusarium wilt disease (Elgersma, 1982; Baayen and Elgersma, 1985), on the mechanisms of resistance and the biological protection of elms against the Dutch Elm Disease (Scheffer and

Strobel, 1988), and on the infection process of *Botrytis cinerea* (Verhoeff, 1974, 1980; Coley-Smith, J.R., Verhoeff, K. and Jarvis, W.R. 1980; Van den Heuvel and Grootveld, 1980; De Leeuw, 1985; Salinas et al., 1986).

The Section 'Ecology of Pathogenic and Non-pathogenic Micro-organisms' studied the microbial interactions in the rhizosphere (Van Vuurde and Schippers, 1980; Schippers et al., 1987) and phyllosphere (Fokkema et al., 1979), after initially having paid attention to the formation and degradation of resting structures of *Fusarium* spp. in the soil (Schippers and Van Eck, 1981) and volatile compounds involved in soil mycostasis (Schippers et al., 1982). The studies on disease-suppressing and plant-growth promoting fluorescent *Pseudomonas* strains in the rhizosphere and antagonistic yeast populations in the phyllosphere, contributed to the understanding of mechanisms of natural disease suppression and the development of bio-control methods.

The Section Virology concentrated on mechanisms of resistance against viruses (Weststeijn, 1978). It was established that the hypersensitive reaction was preceded by membrane leakage (Weststeijn, 1978) and followed by increases in peroxidase activity and the accumulation of inhibitory compounds. However, their role in resistance and systemic acquired resistance remained enigmatic (Modderman et al., 1985).

Prof. Dr Bob Schippers became director of the WCS after Prof. Verhoeff had resigned and had accepted the position of Director of Agricultural Research at the Ministry of Agriculture, Nature Management and Fisheries in 1986. Dr Elgersma took over the supervision of the Section 'Susceptibility and Resistance'. Soon, efforts were made to keep the WCS-Laboratory in Baarn and later, when this appeared to be impossible, to divide the cooperation between the Universities of Utrecht and Amsterdam within the Phytopathological Laboratory at Baarn, that had lasted for more than half a century. Teaching and research in plant pathology had to be initiated at the campuses at Utrecht and at Amsterdam, respectively. Nevertheless, the research on mechanisms of disease suppression by rhizosphere pseudomonads and on resistance against fusarium wilt diseases made considerable progress during this period. Using genetically modified WCS-*Pseudomonas* strains, mechanisms of disease suppression and root colonization were analysed, among which the competition for ferric iron by means of siderophores and the specificity of siderophore receptors (Bakker et al., 1990; Glandorf et al., 1993;

Raaymakers et al., 1995; Schippers et al., 1987). For the first time the induction of systemic resistance by fluorescent *Pseudomonas* strains against fusarium wilt diseases in carnation and radish was demonstrated, as well as the involvement of the bacterial lipopolysaccharides in this process (Van Peer et al., 1991; Van Peer and Schippers, 1992; Leeman et al., 1995). With the withdrawal of the Free University of Amsterdam in 1987, the phyllosphere research came to an end with field studies demonstrating microbial nutrient competition and its importance in disease suppression (Dik et al., 1991).

The research on vascular wilt diseases led to the elucidation of defense mechanisms against fusarium wilt (Elgersma and Liem, 1989). Significant results were obtained on the inheritance in carnation of resistance against different races, on the induction of resistance in tomato by a race of *Fusarium oxysporum* that is pathogenic on carnation (Baaijen et al., 1991; Kroon et al., 1991) and on the biological protection of elms against the Dutch elm disease (Elgersma et al., 1993).

Since the early seventies, efforts in Baarn were made to integrate basic science and applied research for biological crop protection. Recently, this resulted in the spin-off of two biological products. The first product 'Trigger' marketed by the company Heidemij is based on the vascular pathogen *Verticillium dahliae* and is injected into the elm tree to protect it against the Dutch elm disease (Elgersma et al., 1993). The second product is a coating of seeds of radish with a selected WCS-*Pseudomonas* strain to protect against fusarium wilt disease (Schippers et al., 1996), and is being further developed in cooperation with S & G Seeds at Enkhuizen.

The research at Baarn was carried out in close cooperation with other departments, both national and international, and was financially supported by the Netherlands Foundation for Scientific Research (NWO), the Dutch Technology Foundation (STW) and the European Community (EC).

### The future

The closing of the 'Laboratory' at Baarn and the incorporation of the sections 'Ecology of Pathogenic and Non-pathogenic Micro-organisms' and 'Susceptibility and Resistance' in the Department of Plant Ecology and Evolutionary Biology at Utrecht and the Department of Molecular Cell Biology at Amsterdam, respectively, was accompanied by the retirement of

Prof. Schippers and with the nomination of Dr L.C. van Loon and Dr B.J.C. Cornelissen as professors in plant pathology at these respective universities. The broad expertise of both Baarn Sections on disease-suppressing *Pseudomonas*-plant-pathogen interactions and on plant-resistance against fusarium wilt, respectively, now constitute the basis for more molecular – genetically oriented approaches.

Prof. van Loon's group at Utrecht focusses on *Pseudomonas*-mediated disease suppression through the induction of systemic resistance in the plant using radish and *Arabidopsis* as model species. The *Pseudomonas*-induced systemic resistance (ISR) does not injure the plant tissue and is distinct from the classic 'systemic acquired resistance' (SAR) by not being associated with the production of salicylic acid and the accumulation of plant resistance – associated pathogenesis-related proteins (PR-proteins) (Pieterse et al., 1996). Attention is given to the bacterial determinants required for resistance induction, the nature of the signal that is being transported systemically through the plant, and the physiological, molecular and genetic factors involved in signal transduction and resistance expression. Microbial ecological studies are aimed at elucidating mechanisms of and interactions between disease-suppressing *Pseudomonas* bacteria, as well as how their activities are influenced by the indigenous microflora in the rhizosphere.

Prof. Cornelissen's group at Amsterdam is focusing on interactions between *formae speciales* of *F. oxysporum* and their hosts. As a model system the interaction between *F. oxysporum* f.sp. *lycopersici* and tomato has been adopted. In one line of research the nature and mode of action of both specific and aspecific elicitors are being studied. Another line is directed towards unraveling mechanisms of elicitor-triggered host defence reactions. To study the molecular basis of pathogenicity and host specificity in the fungus, a genetic approach using parasexually crosses is being pursued.

Apart from the continuation of the WCS-research at Baarn, now at the campuses in Utrecht and Amsterdam, it can be concluded that the WCS-research on wilt diseases including the Dutch elm disease, on survival of soil-borne plant pathogens, disease-suppressing antagonistic fluorescent pseudomonads in the rhizosphere, on antagonistic yeasts in the phyllosphere and on *Botrytis cinerea*, had a significant impact both nationally and internationally.

Looking back at a 100 years of history of the Foundation Willie Commelin Scholten Phytopathological

Laboratory, it can be concluded that the initiative of Prof. Hugo de Vries, Dr Ernst Krelage, Mr Scholten and Mrs Scholten née Commelin, to establish the foundation WCS, to this very day, exerted a prominent influence on the development of plant pathology in the Netherlands and abroad.

For many years the main role of the WCS-Foundation was restricted to providing the universities of Utrecht and Amsterdam housing and field facilities at Baarn. After selling the property with buildings at Baarn, the WCS-Foundation is now able to pursue new objectives, that is: 'advancement of higher education and scientific research in plant pathology in the Netherlands', including, for the first time, plant pathology at the Agricultural University Wageningen (LUW) and at the Research Institute for Plant Protection (IPO-DLO) at Wageningen.

Due to the far-reaching financial cut-backs in higher education on the one hand, and the development of phytopathology into a science with a multidisciplinary character on the other, it has become extremely difficult to maintain a relatively broad field of scientific education. In consultation with the professors in plant pathology Van Loon (Utrecht), Cornelissen (Amsterdam) and De Wit (Wageningen), it was decided to establish a WCS-Chair in Phytopathology. Occupation of this chair by an international expert specialized in a particular field of phytopathology, and in rotation by each of the three universities, Utrecht, Amsterdam, and Wageningen, can complement the existing expertise, offer education to PhD students in particular, and stimulate new developments in research.

It has also been decided to introduce a 'Willie Commelin Scholten Award' for excellent research in plant pathology in the Netherlands.

With its new course, the newly named "Stichting Willie Commelin Scholten voor de Fytopathologie" intends to contribute in an innovating way to further development of plant pathology in the Netherlands, far into the 21th century.

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