History of Soil Microbiology and Biochemistry at WSU[1]

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The specialty of soil microbiology-biochemistry in soil science has traditionally addressed the study of bacteria in soil, especially on how they influence plant growth and how they participate in the nutrient cycles, especially nitrogen. During the early years, the subject matter was often addressed within the department of bacteriology, which was part of the college of agriculture. In recent years, many of these departments have changed into the department of microbiology which reflects the more broadened interest in all microorganisms. Likewise, the field of soil microbiology-biochemistry has changed to include a broader study of microorganisms other then bacteria. Most recently, scientists in soil microbiology and biochemistry are shifting their interest to some aspects of molecular biology and genetic engineering. While soil microbiologists and soil biochemists have tended to be 'microbe oriented' and "process oriented", respectively, the current interest in genetic engineering and molecular biology will likely merge these interest.

Washington State University has an interesting history in soil microbiology-biochemistry. Dr. S. C. Vandecaveye (respectively known as Dr. Van) was the first soil scientist at WSU in this field. Reared on a farm in Belgium, Dr. Van with a 9th grade education and no knowledge of English came to America. He gained experience in soils - he said - as a ditch-digger in the USA, then as a factory worker, a lumberjack, and a farm manager in Michigan. He initially attended Ferris Institute to gain an education in

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English and business. After working his way through high school in 15 months and going on to Michigan State College, his schooling was interrupted in 1917-18 by his enlistment in the Army. In 1919 he resumed college, then accepted a fellowship at Iowa State College where he completed his Ph.D. in soil microbiology in 1922 and accepted a position at Washington State College. He was first housed in Science Hall. Supplied with an autoclave, microscope, a few test tubes, and petri dishes, he was left mostly to his own resources. In 1928, he moved to Wilson Hall, succeeding E. J. Sievers as the Head of the Soil Section of the newly enlarged Department of Agronomy. Vandecaveye cooperated with Sievers and Henry Holtz who did early work on the carbon-nitrogen relationships of organic matter of Palouse soils. He continued this work in addition to his teaching and administrative activities.

Dr. Carl Larson was Vandecaveye's first Ph.D. student and upon completing his degree, was employed by the Irrigated Experiment Station at Prosser. dr. C. D. Moodie, a later graduate student of Vandecaveye worked in the area of soil chemistry and collaborated closely with Dr. Van in research. Dr. Van, in addition to his work on soil carbon and nitrogen, published some of the first research on the culturing of strains of Rhizobium for inoculation of peas. He also conducted research on the desiccating effects on and persistence of Rhizobium in soil which is still quoted in the literature today.

From the late 1940's to mid-1960's, little work in soil microbiology was carried out at WSU. Although C. D. Moodie studied under Vandecaveye and was well-grounded in soil microbiology, he chiefly functioned as a soil chemistry with special interest in soil analytical chemistry. His studies on periodate oxidation of soil organic matter and on soil fixed ammonium were, however, some of the pioneering work in soil biochemistry. Henry Smith, the "complete soil scientist", best known for his work in soil genesis and characterization

and heavily influenced our understanding of soil components, was responsible for developing a cation exchange capacity determination method with few inherent errors. He had also conducted soil fertility studies and provided background knowledge on soil organic matter and nitrogen status in the Palouse country.

By the early 1960's, the need for a person in soil biochemistry became obvious. The environmental impact of pesticides was the concern of the time. A battle was waged as to which department should hire a soil biochemist. Agronomy won over Agricultural Chemistry in this instance. H. H. Cheng ("HH") was hired in 1965 from Iowa State University, where he was a postdoctorate associate in J. M. Bremner's laboratory after receiving his Ph.D. degree at Illinois under L. T. Kurtz. With background in soil nitrogen chemistry and the use of ^{15}N tracer technique, he was thrusted into initiating a research program on pesticides. Given an empty laboratory to furnish, out went the petri dishes and glass slides inherited from earlier days. In their place came the gas chromatograph, solvent extraction apparatus, and steam distillation units. Eventually, he helped the department to acquire several major analytical instruments including a liquid scintillation spectrometer, a mass spectrometer for stable isotoipe-ratio measurements, UV and IR spectrophotometers, carbon oxidizers, and a high performance liquid chromatograph. His program evolved around methodology development and the application of ^{15}N and ^{14}C isotope tracing techniques to study the transformations and fate of pesticides, naturally occurring organics, and nitrogen in the soil. Through collaborations with other researchers, his research activities have ranged from evaluation of fertilizer use efficiency in crop production to allelopathy to assessment of the potential of organics to pollute ground water. He has also developed an active teaching program by

offering courses in advanced soil biochemistry, advanced soil analysis, and the literature of soil science. In addition, he has been chair of the WSU Program in Environmental Science and Regional Planning, and currently serves as Associate Dean of the Graduate School, although he still maintains an active research and teaching program in the Department.

In the early 1970's the need for a soil microbiologist became evident in view of the environmental concerns in ground water contamination, soil runoff, and animal waste and sewage sludge disposal. D. F. Bezdicek was hired in 1973 to fill a void after a lapse of about 25 years without a soil microbiologist. He was previously at the University of Maryland where he served five years after receiving his Ph.D. from the University of Minnesota. He spent considerable effort and time equipping the laboratory with the appropriate equipment and supplies. He introduced an upper division course in soil microbiology and alternates teaching a graduate-level course in advanced soil microbiology-biochemistry with H. H. Cheng. After spending about seven years on land application of animal waste, seqate sludge, and mine tailings, his program shifted to research on the ecology of Rhizobium in soil, on methodologies for estimating nitrogen fixation in legumes, and on nitrogen budgets in conventional and alternative cropping systems. His program has included development of technologies in immunofluorescence, antibiotic resistant mutants and ^{32}p-DNA proves for enumerating strains of Rhizobium in soil and rhizosphere. More recently, after his return from professional leave at Battelle Pacific Northwest Laboratories, he has begun a research program on the fate and detection of genetically engineered microorganisms in soil.

During the mid-1970's, L. F. Elliott, ARS Soil Microbiologist, joined our department as a third member of the soil microbiology-biochemistry team. He initiated studies on the modeling of carbon and nitrogen in conventional and

no-tillage systems which filled a much-needed void in our knowledge. This research addresses the degradation of crop residues under a variety of climatic and management conditions. Through the collaborative efforts of soil physicists G. S. Campbell and R. I. Papendick, Elliott and his associates have developed a number of mechanistic models which have added to our knowledge on residue management under conventional and reduced tillage. His studies have also contributed significantly to our understanding of the interaction of residue management and phytotoxicity and cereal productivity. The collaborative efforts of the soil microbiolgists, the soil physicists, and plant pathologists at WSU are recognized worldwide for their contribution in the area of soil water, plant growth, and disease interactions. More recently L. F. Elliott and co-workers have identified growth inhibitory bacteria which colonize the rhizosphere of winter wheat. These organisms are believed to reduce the yield potential of wheat especially under no-till conditions.

Through the combined efforts of Cheng, Bezdicek, and Elliott the soil microbiology-biochemistry group has grown considerably over the past 20 years, both in terms of equipment and laboratory space and in national and international recognition of their scholarship and intellectual leadership. They have been active in serving the profession, as symposium speakers and editors of scholarly publications. All three have been elected Fellows of the American Society of Agronomy and they all have served as chairs of Division S-3 (Soil Microbiology and Biochemistry) of the Soil Science Society of America. Bezdicek currently serves as ASA and SSSA Board Representative from Division S-3. Recent graduates in soil microbiology-biochemistry from WSU are occupying prominent positions in federal agencies, universities, and industry, including USDA-ARS, Purdue University, University of Nebraska, and Battelle Northwest Laboratories. A recent graduate, James Fredrickson, received the

1985 Emil Truog Award from the American Society of Agronomy for his outstanding Ph.D. dissertation.