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## Applications of Biotechnology to Nematology: Symposium Introduction<sup>1</sup>

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This symposium, "Applications of Biotechnology to Nematology," is intended to stimulate your thinking on the potentials of biotechnology to revolutionize research and development in the field of nematology.

Biotechnology is advancing so dynamically that articles written for journals today are often eclipsed by new developments before they appear in print. These new technologies promise to yield untold numbers of improvements in virtually every field of the biosciences as well as in the physical sciences.

Biotechnology is not a panacea for solving all problems in nematology and agriculture. It will not displace many of our traditional approaches to research problems. It is, however, a powerful tool. It is technology that will facilitate solving many problems and crossing barriers that were heretofore at an impasse.

What is biotechnology? At the 10th Beltsville Symposium, "Biotechnology for Solving Agricultural Problems," Dr. Terry B. Kinney Jr., Administrator, Agricultural Research Service, U.S. Department of Agriculture, defined biotechnology simply as "those biological means used to develop processes and products employing organisms or their components." These biological means, he continued, include 1) bioreactors and bioreactor support systems (bioreactions); 2) immobilized cells, organ-

elles, or cell components; 3) plant and animal tissue and organ culturing; 4) recombinant DNA (genetic engineering, gene transfer); and 5) hybridoma techniques. This definition is broad enough to include many present programs in nematology involving classical breeding for plant resistance, biological control of plant nematodes or of insects with insect parasitic nematodes, taxonomy, and the use of bio-regulators such as insect growth regulators and allelochemicals for management of nematodes.

Since biotechnologies are tools of the trade, I prefer that we approach them in a restricted sense and include mainly those biotechnologies that are at the forefront of technology.

1. In taxonomy this would cover biochemical taxonomy, gene identification and gene mapping, use of hybridomas, nucleic acid sequencing, and similar approaches.
2. In developing biocontrol strategies, several techniques could be used such as those involving culturing and mass rearing of biocontrol agents; the isolation and identification of natural toxins from biocontrol agents; or the genetic manipulation of biocontrol agents to make them more virulent or to alter their host range, host recognition, or environmental adaptability to obtain better, safer, and more efficient bioregulators.
3. Determining the basic nature of host-parasite interactions and then applying that knowledge to induce or incorporate resistance into otherwise susceptible crops of the same or different species

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will require the use of biotechnology. For example, new culturing techniques for gene transfer and cloning are revolutionizing studies of the nature of resistance and our ability to develop new resistant germ plasm.

4. The same can be said for the pursuit of fundamental basic knowledge on nematode physiology. Physiology, as you know, covers the functions of living organisms and their parts. Knowledge of the ultrastructure and biochemistry of nematodes is important to understanding the whys and wherefores of their basic physiological functions. The more we learn about the chemical basis of nematode structures and physiological functions such as behavior (semiochemicals or chemical communicators), locomotion, feeding, neurotransmission, osmotic and ionic regulation, chemotaxis, thigmotaxis, hatching factors, quiescence, diapause, cryptobiosis, genetics, structural and nonstructural proteins, nucleic acids, genes and gene expression, and many other vital processes of nematodes, the better are our chances to find and develop new, safer and more effective bioregulators and control strategies.

The ability to apply advanced biotechnologies to nematology has been greatly advanced by technological advances in the physical sciences. Technical advances in chromatography, HPLC, HPTLC, mass spectrometry, nuclear magnetic resonance spectrometry, electrophoresis, isoelectric focusing, micromanipulation, image enhanced microscopy, etc., now enable us to think in terms of single nematode, single cell, and single gene analysis.

While many classical chemical control strategies are here to stay, it is also apparent that industry is becoming increasingly interested in bioregulators. They are keenly aware of the importance of biotechnology as a tool in the development, dissemination, and production of bioregulators.

Biotechnology, however, can have its problems and limitations. For example in genetic engineering a gene may be trans-

ferred for resistance to a crop where none existed before. However, the gene may not be expressed. If the gene is expressed, there can be consequences in terms of interactions with other genes in the organism. In the future, many of these problems may be resolved as biotechnology evolves.

Another problem in developing new nematode control strategies is the lack of knowledge of the basic biology, physiology, biochemistry, and genetics of nematodes in general and plant parasites in particular. For instance: 1) What do we know about chemical communicators in nematodes? 2) What is known about nematode hormones, ecdysis, and steroid metabolism? 3) What are the genetic differences between races? Some approaches to these problems are addressed in the following presentations.

We have made great progress in our knowledge of plant parasitic nematodes, the damage they do, and in ways to control them. However, there is much more that needs to be done if we are to improve our agricultural production efficiency by effectively controlling plant parasitic nematodes. The recent deregistration of DBCP and EDB from nearly all uses and the potential loss of other fumigants and contact nematicides should increase our resolve to find new and better means of nematode control. In the past, as in the future, we will continue to borrow heavily on our knowledge of insects and other disciplines to solve some problems in nematology. But make no mistake, except for a few nematodes that are vectored by insects or parasitize insects, these invertebrates do not speak the same chemical language. Therefore, if we want to control nematodes more effectively, we nematologists will have to aggressively unravel the molecular secrets of nematode behavior and chemically communicate with these organisms.

*Nematode control in the past as in the future will require that a number of different strategies be used.* The following three symposium presentations should help stimulate some new ideas of the potential applications of biotechnology to nematology.