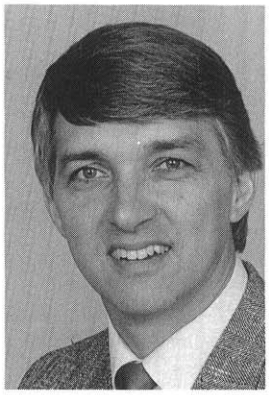
Ruth Allen Award

The Ruth Allen Memorial Fund was established in 1965 by means of gifts from the estate of Dr. Ruth Allen through the generosity of her heirs: Sam Emsweller, Mabel Nebel, Hally Sax, and Evangaline Yarwood. The award, consisting of a certificate and income from the invested fund, is given for outstanding contributions to the science of plant pathology.

Roger N. Beachy



Roger N. Beachy was born in Plain City, OH, in 1944. He obtained a B.A. degree from Goshen College in 1966 and he was awarded the Ph.D. degree in plant pathology under the supervision of Dr. Harry Murakishi at Michigan State University in 1973. He then took a postdoctoral fellowship with Dr. Milton Zaitlin at the University of Arizona and moved to Cornell University with Dr. Zaitlin to continue research on the replication and translation of tobacco mosaic virus (TMV) RNA and its association with plant polyribosomes. He accepted a position at the USDA-ARS U.S. Plant, Soil and Nutrition Laboratory in Ithaca, NY, where he initiated studies on soybean seed storage proteins. In 1978 he moved to Washington University in St. Louis where he established himself as a recognized authority on the genetic organization and expression of soybean seed storage protein genes. He holds the rank of professor in the Department of Biology and is director of the Center for Plant Science and Biotechnology at Washington University. His continuing interest in plant virus research, coupled with his association as a consultant in plant virology and plant molecular biology for Monsanto Company, led to his appreciation of the *Agrobacterium* Ti plasmid-mediated plant transformation system and its potential application to plant virology. His success in realizing that potential has opened a new area of plant virus research.

Dr. Beachy is the recipient of the Ruth Allen Award for his seminal work in 1986 which demonstrated that genetically transformed plants expressing the coat protein of a virus often resist infection by that virus. This observation suggested a potential method of virus disease control that is now being actively studied in numerous laboratories around the world. The experiments by Dr. Beachy and his colleagues were designed to identify the viral gene(s) which mediated cross protection and to implement a practical method of eliciting virus resistance in crop plants. The experiments demonstrated that transgenic tobacco, expressing TMV coat protein, appeared to exhibit cross protection against TMV but not against unrelated viruses, and that some of the plants also expressed sufficient resistance to reduce the spread of TMV in greenhouse and field trials. Although the resistance could be overcome by using very high levels of TMV inoculum or by inoculating with TMV RNA, the degree of resistance was nevertheless commercially viable for engineering resistance in tomato for protection against TMV. Resistance to TMV was correlated with expression of coat protein, but not with the accumulation of coat protein messenger RNA, and it was also expressed in protoplasts. These results strongly imply that the protective effect occurs during the early stages of virus infection, probably by interference of the expressed coat protein with the disassembly of the invading virus and subsequent release of viral RNA into the cell.

The value of Dr. Beachy's experiments extend far beyond the initial observations with TMV. Resistance to other viruses has been experimentally demonstrated in a number of crops. Such tests have shown that expression of the coat proteins of alfalfa mosaic, cucumber mosaic, potato X, tobacco rattle and tobacco streak viruses, as well as several polyviruses, in transgenic plants can confer varied degrees of resistance to the respective viruses. Additional unpublished results with other viruses reinforce the concept that coat protein-mediated protection of transgenic plants is a general phenomenon that may have broad application for control of virus diseases infecting many crop species.

Dr. Beachy has also investigated whether viral genes other than the coat protein gene are able to interfere with infection. Plants expressing antisense RNA derived from the 3′ end of TMV RNA expressed a lower degree of resistance than that conferred by coat protein, although experiments by others indicate that higher levels may sometimes be obtained. These results suggest that other genes may be able to elicit resistance to infection in transgenic plants and, indeed, transgenic plants expressing satellite RNAs of cucumber mosaic and tobacco ringspot viruses exhibit partial resistance to these viruses.

In wider ranging investigations, Dr. Beachy has demonstrated that the non-structural 30 kilodalton protein of TMV is functional in transgenic plants and that its expression affects long-distance movement of TMV in plants. These experiments stimulated other workers who subsequently incorporated gene 6 of cauliflower mosaic virus into tobacco and demonstrated that such plants developed a mosaic-like symptom. These examples thus illustrate that expression of individual virus genes in transgenic plants provides a very powerful tool which enables us to understand the function of various virus genes and the mechanisms underlying the development of disease.

There is no doubt that the concepts elaborated by Dr. Beachy will be widely applied in future research. The results of his research have already had a major impact on applied and fundamental aspects of plant virology and should soon yield suitable varieties of crops with resistance to different virus diseases. It is expected that genes of fungal and bacterial plant pathogens will be identified and that they, too, will be expressed in transgenic plants in attempts to determine their roles in pathogenesis and their potential for disease control. Although it is less than four years since the publication of Dr. Beachy's original report, he and his colleagues have changed the course of plant virus research, and their achievements promise to bring exciting advances to research on other plant pathogens.