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Two sides of a coin: basic and applied research

Basic research is frequently looked upon outside the University as a frill that wastes taxpayer dollars. When a politician makes headlines denouncing the funding of research on the "sex life" of an insect, the public grumbles about academics in ivory towers, unaware that basic research on the reproductive cycle of an insect can be a necessary step in controlling a threatening crop pest. Such research usually is dismissed by the public as of no consequence in solving problems, and the University is blamed for not showing proper respect for real-world needs.

Although we are frequently called upon to say which kind of research is more important, I strongly believe that basic research is neither more nor less important than applied research. How then should the University and the Agricultural Experiment Station respond to critics who dismiss the research we are doing as esoteric?

Basic research is carried out to study a general phenomenon, a process, or an activity of nature. Sometimes it is called pure research, and it may be abstract or theoretical. Basic research deals with principles or fundamentals and frequently is thought of as a starting point in the expansion of knowledge. It may involve such questions as: How do cells divide? What is the chemical nature of a gene? What are the mechanisms of inheritance? What are the building blocks of matter?

Applied research is often thought of as research targeted at solving a specific problem for a utilitarian purpose: How can a particular pest or disease be eliminated? How can we gain increased yield of a particular crop? How can we build a better weapon against a specific pathogenic target? Since applied research is viewed by many as useful research, this creates an impression that basic research is useless.

Simply put, however, basic research provides the tools and raw materials for applied research—the wood, nails, and hammer used in product fabrication. The two types of research nurture each other. Basic research is the needed raw material for application; applied research may lead back to basic research, and vice versa. Knowledge would stagnate and few new practical discoveries would be made if it were not for basic research. Consequently, the Agricultural Experiment Station tries to maintain a balance of basic and applied research, and to the best of our ability, we carry on both types of research within our departments.

Not too many years ago, two scientists in our Department of Entomology at UC Riverside teamed up to study the mechanisms involved in the mating behavior of the pink bollworm. Many of us, and perhaps the researchers themselves, thought of their work as basic research. Yet what took place at Riverside was the isolation of a chemical substance—a pheromone—that provided an olfactory cue to bring the pink bollworm sexes together. Once that pheromone was identified, it or a synthetic pheromone substance could be used to send out signals at various points in a field to confuse male bollworms and reduce mating effectiveness. The latter discovery was applied research. More recent pheromone research has led to a combination of pheromone plus insecticide that lures insects into a trap, where they become mired in a sticky substance laced with insecticides. Thus, basic research has led to a better bug trap.

Not all basic research leads to new knowledge for which we can find a ready application. Sometimes we have to expand our general scientific knowledge before we can move forward, and only as more knowledge accumulates can we begin thinking about applications. Yet any top-flight university receiving public support must have a balance of basic and applied research, and eliminating or decreasing one will only result in a decline in the other.

Attempting to maintain a balance of basic and applied research requires vision, intuition, imagination, independence, and sometimes bullheadedness on our part. Growers and the public often pressure us for quick solutions and become impatient with research that may have problematical results or a possibility of application in the distant future. It required vision for Herbert John Webber to add a citrus geneticist, Howard Frost, to his small staff during his first year as director of the old Citrus Experiment Station at Riverside in 1913. Citrus breeding and genetics were in their infancy, and both Webber and Frost recognized that an immense fund of basic genetic knowledge had to be acquired to develop principles of citrus breeding. Citrus trees are slow-growing, and it was clear that research would extend over generations of trees. In the 1930s, a later Experiment Station director, dissatisfied with Frost's progress, slashed his budget; even his colleagues failed to see the importance of his research and came to view him as an eccentric lone wolf. Yet Frost persevered through these decades of effort before his research came to fruition. His citrus hybrids and nucellar budlines revolutionized the citrus industry, and he is viewed today as one of the great pioneer citrus scientists of his era.

There are no easy answers to educating the public on the necessity of basic research. But we need to make such an effort far more often than we do, perhaps because many of us as scientists or administrators are wary of being misunderstood by the press or public. How can we defend basic research positively without engaging in complex, possibly boring explanations? An obvious approach is for us to mention in passing the background of basic research that went into a successful applied research project, when we are addressing growers or the public. We need not dwell on the contribution of basic research at great length, but if we give credit to the basic side of the research coin in announcing applied discoveries, we will go a long way toward eliminating the popular misconception that basic research is a frivolous activity of academe.