Taking Biotechnology into the Classroom

Biotechnology Tissue Culture Workshop

By Maggy Zanger

In June, 32 agricultural education instructors from Arizona high schools and junior colleges returned to school themselves.

The week-long Biotechnology Tissue Culture Workshop at the University of Arizona taught basic skills in the high technology of tissue culture plant propagation. However, low-tech equipment used in the class will enable teachers to pass along biotechnology principles to their students without requiring large expenditures on equipment.

"We were updating them on new technology and concepts that they can go back and teach," says Carolyn Zeiher, an assistant professor in department of plant sciences who was one of the workshop instructors.

"More specifically, we were trying to bring basic tissue-culture techniques into the high school level," says another instructor Randy Ryan, a UA senior research specialist. "We gave them the tools to use and different experiments that are potentially usable at their level."

The workshop, sponsored by the UA agricultural education and plant sciences departments, focused on teaching tissue culture methods. But the teachers were also taught the underlying principles of biotechnology as applied in tissue culture propagation. Ryan says biotechnology is the use of modern biological technology for the making of a product; for example, making a genetically engineered plant that is insect resistant.

"We take current technology and alter living organisms so that they better fit our needs," Ryan says.

The workshop represents a new focus for the department of agricultural education also. Department head Roger Huber says it's part of an effort to broaden the traditional basis of vocational agriculture to include such modern, sophisticated tools as biotechnology, computer-aided design and other skills.

The ag teachers spent their mornings learning the basic principles of biotechnology. Their afternoons were spent experimenting with propagating plants from pieces—tissue—of growing plants, rather than seeds or plant cuttings.

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Michael R. Stoklos

Randy Ryan (left) and Deer Valley teacher Greg Thompson prove a covered cardboard box can substitute for a $10,000 piece of equipment.

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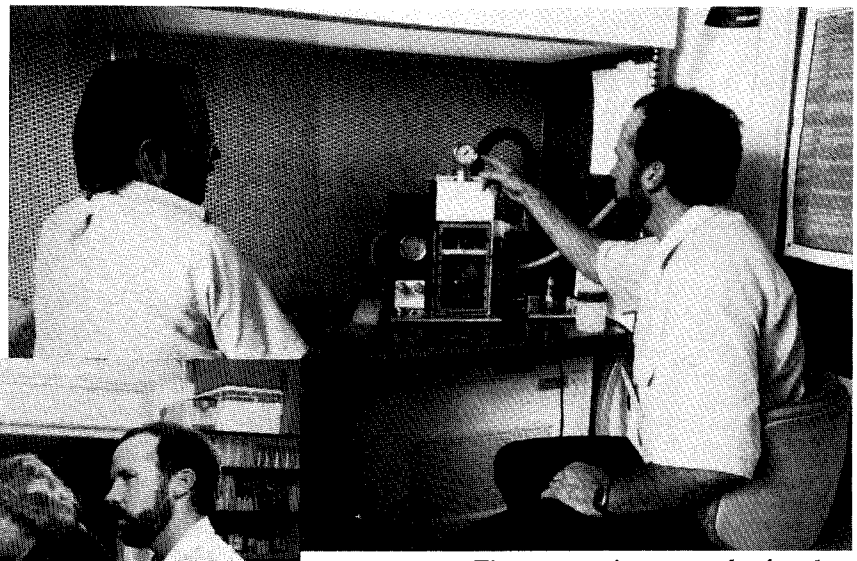
Cutting a small piece of the leaf, called an explant, from a tobacco, fern, ficus (weeping fig) or carrot plant, the teachers placed it in a special medium containing all the nutrients a plant needs to grow. The medium also contained plant hormones which make the plant cells grow into a mass of cells, called a callus. When teachers then removed the plant hormone from the nutrient-rich medium, the cells began to grow into little plants.

"We can have hundreds of little plants on the surface of the callus," Ryan says. When the little plantlets were clipped off the callus and placed in rooting medium, each plantlet formed roots and soon was ready for planting.

"And we end up with hundreds of little plants from a very small piece of tissue," Ryan says.

This tissue culture technique is now commonly used in large commercial greenhouses to propagate a variety of household plants and crops, including strawberries, raspberries, orchids, weeping figs, and roses. Aside from the obvious advantage of producing hundreds of plants from one small piece, tissue-culture propagation assures a grower of specifically desired genetic characteristics. The offspring plants are a genetic duplicate of the parent from which the explant was taken.

In addition, the plants are disease-free because they are propagated in a sterile environment. They can be shipped across state lines without fear of spreading disease. *continued*



Michael R. Stokos

The gene gun is an example of modern agricultural biotechnology. Randy Ryan and Greg Thompson discuss its usefulness.

Michael R. Stokos

Randy Ryan, Carolyn Zeiher, Joyce Wallace and Greg Thompson discuss bringing the science of tissue culture into high school classrooms.

"We're not just cows and plows anymore. We're trying to make ag education applicable to today's society."

While this commercial application involves state-of-the-art knowledge and technology, the teachers were taught the same principles and techniques using simple, affordable equipment.

"I'm a reductionist at heart," Ryan says. "I believe you can take complex phenomena and reduce them down so you can demonstrate the technology involved at the higher level." Biotechnology techniques are really simple.

"They are really more knowledge than equipment," Ryan believes. If you have enough knowledge, you can bypass the equipment needs. That's what we were trying to teach—basic knowledge."

He showed teachers how to create a sterile environment in which to work without using the usual expensive, high technology equipment that a commercial grower or Ryan might use. In his laboratory, Ryan uses a $10,000 laminar flow hood which blows sterile air across the work area, keeping bacteria and fungi out. But he demonstrated how to keep a propagation area sterile using much cheaper and readily available materials— simply, a cardboard box covered with plastic and a plastic window to see into the box. He cut small portholes into the side of the box so the teachers could reach into the box and work with the plant tissue in a sterile environment.

"So they learned sterile technique in a pretty dirty environment—which the classroom is," Ryan says. The ag teachers appreciated the low-tech approach to learning and teaching high-tech principles.

"They gave us lots of real practical ways to do things on a low budget," says Tucson's Flowing Wells High School agricultural education instructor Kert Bertelsen. "Maybe it's not perfect, but schools cannot possibly afford the lab set-up they have in industry. But now we can take the kids through all the steps to create plants."

"Our goal as ag teachers is to keep our education relevant and on the cutting edge," says Joyce Wallace, an agriculture instructor in Willcox who is now a graduate assistant in the UA agricultural education department. "We're not just cows and plows anymore. We're trying to make ag education applicable to today's society.

"Many high school agricultural education programs now not only train students for jobs as greenhouse operators and ranch hands, but also try to prepare those interested in a college education in agricultural research fields like plant biology and animal sciences," Wallace says.

"It's real important for my kids to be exposed to biotechnology and know a bit about it. Hopefully, it will spark an interest, and some of them will want to go into that field," Bertelsen says.

Equipped with the knowledge of biotechnology and the simple techniques needed to illustrate the principles, teachers say they are ready to return to the classroom and spark that interest.

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