

Tobacco Tech



Looking to the Future of Tobacco

Issue 5, October 2001

Research Seeks Plants Tolerant to Environmental Stress

Improved production practices (e.g. efficient use of chemical fertilizers, herbicides and pesticides, better irrigation systems, no-till production and advances in management) have greatly increased the productivity and sustainability of production agriculture. However there are still environmental constraints that significantly limit the genetic potential for improvements in crop performance. Variation in soil salinity, pollutants such as ozone, heavy metals or other toxic compounds in soils, as well as extreme variation in climate (e.g. drought, damaging heat or cold, etc.) ensure that crop production will hardly ever be free from environmental stress.

Considerable research is now focused on understanding how plants react to environmental stress. Plants have built-in tolerance mechanisms which allow them to respond when conditions are not favorable. The goal is to determine how plants cope with stress and use this information to improve crops, and potentially to find new ways to obtain valuable compounds from plants.

Because these defense systems are composed of many different changes in the plant, it is difficult to

determine exactly how these responses occur. But included in these protective systems is the ability to synthesize a range of natural products called antioxidants. Some plants produce large quantities of antioxidants. For example, many plants produce an abundance of the antioxidant ascorbic

acid (vitamin C), or α -tocopherol (vitamin E). These are only two examples of many such valuable compounds that are produced in plants, and it will be useful to have a better understanding of how these types of molecules relate to stress tolerance and how plants produce them. This information could be used to improve the productivity of crops and may also lead to the identification and elevated production of new antioxidants.

As part of this effort to find new natural products from plants, Dr. Deane Falcone's group at THRI is searching for genes that result in enhanced tolerance to stress conditions in lines of the experimental plant *Arabidopsis thaliana*. This small plant is easily used for scientific discovery, and because plant genetics are often very similar, the results can be extended to other

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THRI Technology Part of BIO 2001

A new technology under development at THRI was recently showcased at the world's largest biotechnology conference. Over 14,000 people representing 44 different countries attended the BIO 2001 conference in San Diego.

The THRI technology was exhibited in the "Technology Partnering Forum" where more than 1,200 meetings were arranged for representatives from 422 companies. The goal of this forum was to allow companies, universities and other scientists to display their technologies

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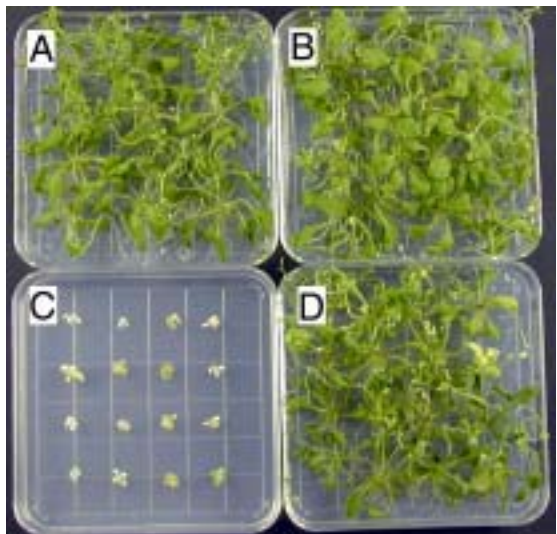
Stress-Tolerant Plants

crops of interest (for THRI this includes tobacco, but the results might also be used to improve stress tolerance in other crops.)

The process involves generating thousands of genetically altered lines and then screening them to determine if any are tolerant to a variety of stress conditions. Once these stress-tolerant plants are found, the goal is to identify the specific genes in the plant that result in increased tolerance.

To date almost 9,000 of these genetically altered lines have been tested under high-stress conditions. The stress was created using a variety of chemical compounds in the growth media as well as placing the plants under extreme light and high temperature. Plants were screened based on the extent of seedling root growth. Of the genetic lines that were tested, seven were found to exhibit distinct responses to the stress conditions that were applied. One line in particular not only showed apparent resistance to the various chemical stress conditions, but also improved growth under more natural stresses such as high temperature.

The preliminary results below show the growth of this particular line under stress and non-stress conditions. Section (A) shows the



normal plants grown under natural conditions, while section (B) shows the altered line under natural conditions. Notice that even in this low stress environment the altered line exhibits enhanced growth. Section (C) and section (D) show the normal plants and the altered line respectively, both grown under

stress. Growth of the normal plants is severely stunted while the altered plants appear quite healthy. This result holds true for most of the imposed stress conditions that were tested.

Genetic tests reveal that the improved growth and survival under the various stresses appear to be the result of a single, dominant genetic change. The next step in this process is to isolate the controlling gene and then use this as a tool to alter stress responses in other plants. Yield improvements in crops like corn, soybeans or tobacco are within the scope of potential benefits. Along with yield increases, other desirable traits may be possible such as cold tolerance and enhanced seedling vigor. These traits will be useful in THRI's efforts to establish direct-seeded tobacco. Also, by increasing the production of natural products (in this case small-molecule antioxidants) there is the added potential for finding new valuable compounds in plants, and in particular in tobacco.

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which are available for licensing or commercialization, as well as to provide an opportunity for networking on the development of cutting-edge technology. The forum was designed to bring scientists together with business development professionals and investors.

The THRI "Natural Products Genomics" project was selected in a highly competitive application process. It represents a new application of the field of functional genomics to plant natural products. THRI investigators are developing the technology using tobacco, searching for useful new substances which the tobacco plant may already be genetically capable of making.



THRI representatives Dr. Deane Falcone and Dr. Maelor Davies discuss potential collaborations with other scientists as part of the "Technology Partnering Forum" at BIO 2001. This THRI project was one of the few university-developed technologies to be included in a forum where potential investors and interested scientists could discuss collaborations and investment opportunities.

Tobacco Tech is an occasional series published by THRI to inform growers and others about exciting new possibilities for tobacco. Topics will provide information on our cutting-edge biotechnology research program and our efforts to stimulate new crop opportunities for Kentucky tobacco farmers.