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# Chlorogen closing in on \$6 million funding round

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Chlorogen Inc.'s tobacco is growing in fields in Missouri, Kentucky and South Carolina. The tall, leafy, verdant plants contain proteins that could become cancer treatments, vaccines and research mediums.

Chlorogen's President and Chief Executive David Duncan is getting ready to close on the company's second round of funding in October. He expects to raise \$6 million in new funds, which he said will see the company through the next two years. At that point, Duncan said he expects revenue to start coming in. The company raised \$5.8 million in 2003 in its first round of funding.

Chlorogen's patented technology expresses proteins in the tobacco plant's chloroplast, the component of a cell that carries out photosynthesis. This contrasts with the most common plant-made pharmaceutical approach, which expresses the proteins in the nucleus of a cell. The chloroplast-based approach increases the yield of the expressed proteins in each plant cell, and tobacco yields a large amount of biomass, according to Chlorogen.

The technology is a platform for expressing a wide range of proteins, for use in drugs, vaccines, industrial production, and for food and feed purposes. To create a revenue stream, Chlorogen wanted to partner with another firm to produce nontherapeutic proteins, which could be commercialized quicker than proteins requiring U.S. Food and Drug Administration (FDA) approval before being taken to market.

Chlorogen teamed up with St. Louis-based Sigma-Aldrich Corp. to produce four research-grade proteins, which will be distilled and marketed by Sigma. Sigma-Aldrich produces chemical products used in research, biotechnology, pharmaceutical development and chemical manufacturing.

"Our deal with Sigma gives us access to a good market, validates our platform, and opens up revenue streams," Duncan said.

Duncan expects the proteins to be tested in the market next year. If that goes well, the proteins will become part of Sigma's product catalog in 2007, he said.

Three of the proteins also have therapeutic applications, but the route from tobacco field to clinical use is longer and requires FDA approval.

That route also will be taken by the company's flagship product in development, which is a cell-growth inhibitor, or cell-death protein, for gender-specific cancers. The company succeeded in expressing the complex protein, even though it previously has not been

possible to produce it in other biological systems.

Duncan said the cell-death protein is on the commercial development path, primarily targeting ovarian cancer, which has a high mortality rate. Other researchers hadn't been able to produce enough of it to test in humans, because it destroys the very mammalian or yeast cells in which it's produced. Chlorogen researchers found that's not the case in plant cells. Duncan said there's an entire family of cell-death proteins that hold opportunity for Chlorogen.

The company is partnering with the medical center of a major university, which he declined to disclose, to test the protein and publish the results. Duncan said he expects the partnership to announce its progress in 60 to 90 days.

Chlorogen is looking at a range of vaccines as well. Producing these vaccines in plants will be cheaper and yield higher volumes than traditional production methods. The company currently is looking for a partner to help commercialize the vaccines.

An Indian pharmaceutical company visited Chlorogen the last week in July to discuss licensing vaccine production against malaria, tuberculosis and amoeba-caused disease. Chlorogen is ready to start phase one trials of interferon, which can be used for treatments of hepatitis C and liver disease, next year with a Spanish partner.

The first of Chlorogen's patents was filed in 1988, but the company has strategically shored up that patent with related patents. The patent rights for the technology platform will not expire until 2023. The company will announce the acquisition of a license from Rutgers University at the end of August for a similar patent, which competitors could have used to get around Chlorogen's patent position.

The company's biggest challenge now is to ramp up production volume. Duncan is in discussions with Southeast Missouri State University at Cape Girardeau about establishing a production facility, to both extract and purify the proteins, at the campus by 2007. The facility would begin with about 50 employees, growing to 100. Chlorogen would contract with private growers to produce the protein-specific plants. The company also might open additional extraction facilities to accommodate weather-related interruptions.

"Our technology platform far exceeds our expectation," Duncan said. "Since our first round of financing, we have met every technology milestone."

It is uncommon for biotechnology companies to aspire to develop production facilities and streams of revenue to finance further product development. Most will choose to develop the technology to the point where it can be sold to a large player in the market. Michael Douglas, associate vice chancellor and director of Washington University's office of technology management, said he does not know of any other companies in the St. Louis region that have chosen this model.

Production and distribution systems will be the biggest capital challenge Chlorogen faces, according to Douglas. He said most venture capital investors look to exit a biotech startup with a minimum of 20 times their return on investment within five years.

Chlorogen's venture capital investors include Burrill & Co. of San Francisco; Redmont Venture Partners of Birmingham, Ala.; Prolog Ventures of St. Louis; and Harris & Harris Group of New York. Duncan said all the investors want "as much as they can get" in the second financing round.

"If they do this, and they choose to stay in St. Louis, it is good for this region," Douglas said.  
"If they end up getting acquired, they may end up moving."