

Cottonseed: Looking in the Crystal Ball

Work is continuing in research labs worldwide to develop new varieties of cottonseed. Here's a brief look prepared by Catherine Watkins at what's in the pipeline and what the future might hold.

COTTONSEED (*Gossypium*)

Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia

What: Canola and cotton (*Gossypium hirsutum*) plants engineered to produce oil containing eicosapentaenoic (EPA) and docosahexaenoic (DHA) fatty acids, the omega-3 long-chain polyunsaturated fatty acids (LC-PUFA) found in cold-water fish and algal oils.

How: Genetic modification: Food Futures National Research Flagship researchers have taken key LC-PUFA genes from marine microalgae, a form of lower plant, and transferred them to land plants. "In a world first, the team was able to demonstrate synthesis of the key nutritionally active omega-3 LC-PUFA, EPA and DHA, in the seed oil of the model oilseed plant *Arabidopsis thaliana*," CSIRO's Surinder Singh explains. Following this key breakthrough, the team has been working to transfer an optimized group of microalgal omega-3 LC-PUFA encoding genes into canola and cotton.

Benefits: The primary sources of omega-3 LC-PUFA in the human diet are fish and marine algae. Two trends indicate that there is an urgent need for novel sources of omega-3 LC-PUFA in the diet. First, the awareness of the need to increase one's intake of omega-3 LC-PUFA is growing among consumers, health professionals, and the food industry, leading to a steadily increasing demand. Second, fish-derived sources of omega-3 LC-PUFA are under pressure because of the need to conserve and manage marine ecosystems. "Algal sources of omega-3 LC-PUFA are very expensive and unlikely to supply the expected demand," Singh suggests.

Canola or cottonseed oil containing EPA and DHA can revolutionize the ability of agrifood industries to deliver the nutritional benefits of LC-PUFA. For example, this type of oil can be used directly to produce omega-3-enriched margarines, fish and animal feeds, as an ingredient in other processed foods, as a nutritional supplement (such as in infant formula), and in specialized nutraceutical applications and will go a long way in meeting the projected worldwide increase in demand for omega-3 LC-PUFA.

When: The technology has progressed beyond proof-of-concept stage. Commercial production of omega-3 LC-PUFA canola and/or cottonseed is targeted to begin in 2015.

Samples: Samples are not available currently. No date has been set for their availability.

Contact: Surinder Singh, group leader, Oilseeds Group (surinder.singh@csiro.au).

CSIRO, Canberra, Australia

What: High-oleic cottonseed (*Gossypium hirsutum*) that is also low in saturates and cyclopropanoic fatty acids (CPFA).

How: Genetic modification involving silencing of endogenous fatty acid biosynthetic genes and introduction of novel fatty acid biosynthesis genes. In cottonseed, RNAi-mediated gene silencing has been used to down-regulate the synthesis of palmitic acid, CPFA, and PUFA, resulting in an oil that is highly enriched for oleic acid and reduced in nutritionally undesirable saturates and CPFA.

Benefits: The high-oleic cottonseed oil has greatly enhanced oxidative stability and improved nutritional value. It could replace hydrogenated oils in food service frying applications, thereby avoiding use of oils with *trans* fatty acids, and may open up the possibility of a retail bottled cottonseed oil for household use. This development will also provide additional crop production opportunities and potentially higher value for oilseed growers.

When: High-oleic cottonseed is undergoing product evaluation as a prelude to a decision to develop commercial varieties. It could be brought to market within five to seven years.

Samples: Will be available for evaluation within a year.

Contact: Allan Green, program leader of the Metabolic Engineering of New Plant Products team (Allan.Green@csiro.au).

Southern Plains Agricultural Research Center (SPARC), Agricultural Research Service (ARS), US Department of Agriculture (USDA), College Station, Texas, USA

What: "Cottonseed provides a high-quality protein that currently is underutilized because of the presence of the toxic compound called gossypol," Robert Stipanovic of SPARC writes. Gossypol occurs in the plant as enantiomers. The enantiomeric ratio in commercial cottons is approximately three parts (+)-gossypol and two parts (-)-gossypol. (-)-Gossypol is toxic to nonruminant animals, but (+)-gossypol is not toxic. Cottonseed with

a (+)- to (-)-gossypol ratio that is >9:1 can be safely fed to poultry, and by extension to other nonruminants such as swine and fish. The Brazilian “moco” cotton cultivars (*G. hirsutum* var. *marie galante*) exhibit ratios of (+)- to (-)-gossypol as high as 98:2. Moco cotton does not produce bolls until the second year and thus is grown as a perennial in Brazil. Using traditional breeding techniques, SPARC incorporated this high (+)-gossypol seed trait into cotton plants with fiber quality and yields that are comparable to commercial cotton varieties.

Benefits: This high (+)-gossypol seed could be used to partially replace poultry feeds such as corn that are currently being diverted for gasohol production.

When: SPARC has completed two years of field testing of some lines that produce ~95% (+)-gossypol in seed. “We plan to do a germplasm release in 2010 and hope oil will be available for use by the food industry in 2012,” Stipanek notes.

Samples: Available with germplasm release in 2010.

Contact: Alois A. Bell, research plant pathologist (al.bell@ars.usda.gov).

*Southern Regional Research Center (SRRC), ARS, USDA,
New Orleans, Louisiana, USA*

What: Michael K. Dowd of SRRC reports that ARS scientists are conducting preliminary work to study what variation in fatty acid compositional properties might be bred into cottonseed. “As a first step, the roughly 9,000 available accessions in the US GRIN Cotton Collection are being screened for fatty acid composition. Traits of interest include reducing the cyclopropanoid fatty acid content, reducing the proportion of saturated fatty acids, and increasing the ratio of oleic to linoleic acids,” he notes. Researchers are also studying the variation in current agronomic cotton cultivars and the effect of environment on cottonseed fatty acid composition. “Of course, these efforts must not negatively affect cotton fiber properties, which makes this effort more difficult than similar efforts in other oilseeds,” he notes.

How: Work is preliminary to see what variation in fatty acids exists in cotton germplasm. If traits of interest are found, breeding strategies will then be developed.

Contact: Michael K. Dowd (Michael.Dowd@ars.usda.gov).

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Cottonseed Products Report

US Cottonseed Supply and Disappearance

(000 Short Tons)

	07/08	08/09	09/10
Beginning stocks	489	643	330
Imports	3	0	0
Production	6,589	4,300	4,730
Total supply	7,080	4,943	5,060
Crush	2,706	2,300	2,675
Exports	599	175	350
Other	3,132	2,138	1,700
Total demand	6,437	4,613	4,725
Ending stocks	643	330	335

US Cottonseed Meal Supply and Disappearance

(000 short tons)

	07/08	08/09	09/10
Beginning stocks	62	55	50
Imports	0	0	0
Production	1,262	1,025	1,230
Total supply	1,324	1,080	1,280
Domestic consumption	1,149	955	1,130
Exports	119	75	100
Total demand	1,268	1,030	1,230
Ending stocks	55	50	50

US Cottonseed Oil Supply and Disappearance

(Million pounds)

	07/08	08/09	09/10
Beginning stocks	99	147	135
Imports	0	0	0
Production	856	715	845
Total supply	956	862	980
Domestic consumption	623	512	710
Exports	186	215	185
Total demand	809	727	895
Ending stocks	147	135	85

Source: USDA-ERS July 2009 Oil Crops Outlook.



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Domestic Consumption of Cottonseed Oil to Increase

U.S. production and consumption of cottonseed oil are expected to significantly increase this year, despite fewer cotton acres and a lower supply of cottonseed, says a spokesperson from the cottonseed crushing industry.

“Crushers are expected to produce 845 million pounds of oil in 2009-10, up from 730 million pounds in 2008-09 according to USDA analysts,” says Ben Morgan, executive director of the National Cottonseed Products Association (NCPA), Cordova, Tennessee. “Additionally, domestic consumption is expected to reach 700 million pounds, a 25 percent increase from one year ago.”

For the second year in a row, more available cottonseed will be crushed for oil than fed to dairy cows as whole seed, upsetting a more than decade-long trend favoring cows, he adds. “Cottonseed oil now comprises the largest portion of the total return from cottonseed to growers,” Morgan says. “Strong demand from the food industry sector has undeniably increased the value of cottonseed.”

Morgan further explains the shifting demand curve for cottonseed: “There is a certain maximum amount of dollars that can be made from either selling whole cottonseed and/or crushing cottonseed for its products. In a free market, that level is determined by supply and demand. In previous years, more profit could be made by selling a larger share of cottonseed as whole seed. However, current USDA estimates indicate more dollars can be made from crushing seed.”

Once viewed as a leftover of the cotton ginning process, cottonseed processing is increasingly being viewed as a viable revenue source over and above cotton fiber production, he adds.

“If the price of cottonseed oil can improve by one penny per pound, the added value to the cottonseed crop would exceed \$24 million in an average year,” Morgan says.

(Source: Southwest Farm Press)

Cotton Crop Hit Hard by Texas Drought

Lack of rainfall and record-setting triple-digit temperatures have scorched crops and rangeland throughout parts of Texas, causing drought losses to reach \$3.6 billion, according to economists at the Texas AgriLife Extension Service. If sufficient rainfall is not seen by year-end, the total loss might exceed that of 2006, when statewide losses hit \$4.1 billion.

“Extreme or exceptional drought conditions for the second year in a row and prolonged weather with over 100 degree temperatures have devastated agricultural crops and livestock operations, especially in Central and South Texas,” said Dr. Carl Anderson, AgriLife Extension economist and professor emeritus. “This area covers about 40 percent of Texas. With the exception

of Northeast Texas, the trans Pecos and the Southern Panhandle areas, the entire state is suffering from lack of sufficient rain for more than a year.”

Dr. Travis Miller, AgriLife Extension agronomist and a member of the Governor’s Texas Drought Preparedness Council, said the drought is not only impacting major agricultural operations, but also water supplies “for more than 30 percent of the State of Texas.”

“Most dryland crops in South and Central Texas, the Gulf Coast and the Rio Grande Valley are either zeroed-out (total loss) or will yield a small fraction of their normal yields,” he said.

It’s the hottest, driest summer on record over a large portion of the state, but especially in the central, south, and southwest regions, said Jose Pena, AgriLife Extension economist in Uvalde. “Rainfall in a large part of South Texas has been less than 4 inches since the start of this year,” he said.

The statewide crop condition report by U.S. Department of Agriculture rates one-third of Texas cotton acreage very poor or poor. Dry moisture conditions indicate a large amount of acreage will likely be abandoned, Anderson said, and a small cotton crop is expected because of lost acreage and low yields.

“As a result, a large part of the planted cotton and grain acreage will be abandoned, and the rest of dryland production will produce below average yields,” said Dr. Mark Welch, AgriLife Extension grains marketing economist. “Many of the dryland cotton, grain sorghum and corn crops in the Coastal Bend and Lower Rio Grande Valley have been abandoned.”

While West Texas cotton is in the early stages of the growing season, abandoned planted acreage and low projected yields indicate a loss of \$540 million, Welch said.

At VALCO’s processing facility in Harlingen, former IOMSA president Dennis Easley reports that cottonseed input is down dramatically. “Normally, we’d be ready to start operations, but right now things are pretty bad. We’ll sit tight until we see what the situation is,” he says. “Long-term, we’ll be OK. We’ve weathered this before. This is no different than what we saw in the 80s. We’ll survive this too.”

Cottonseed Nutrient Halts Growth of Brain Cancer Tumors

Glioblastoma multiforme is one of the most dreaded, and most hopeless, diagnoses a doctor can give a patient. It’s not only the most malignant form of brain tumor, but it grows rapidly and is usually quickly fatal. Subjecting patients to chemo, radiation and brain surgery typically only prolongs life for a matter of months. This form of brain cancer is so deadly and considered so hopeless that M. D. Anderson Cancer Center researcher Eric Holland, writing in the *Proceedings of the National Academy of Sciences*, referred to it by the insensitive but accurate nickname “the terminator”.

Now, however, there could finally be a glimmer of hope for those diagnosed with *glioblastoma multiforme*. It’s not stronger

radiation or a new surgery technique but a treatment derived from nature—cottonseed.

An experimental therapy derived from cottonseed is showing remarkable promise in treating multiforme, according to researchers at the University of Alabama at Birmingham (UAB). John Fiveash, M.D., an associate professor in the UAB Department of Radiation Oncology and the lead researcher on the new study, presented his research team's findings on May 30 during the poster discussion of central nervous system tumors at the American Society for Clinical Oncology annual meeting in Orlando, Florida.

The UAB study was a phase II clinical trial of AT-101, a pill made from a potent compound found in cottonseed that appears to overcome the out-of-control growth patterns of malignant cells. So far in the clinical tests, AT-101 stopped the usually lethal brain cancer's progression in many of the 56 patients treated, Dr. Fiveash said at the meeting.

Before the trial began, patients in the study had already undergone standard treatments including brain surgery and chemotherapy. But their aggressive brain tumors had started growing again. The cancer research subjects were then given a treatment consisting only of AT-101 daily for three out of four weeks.

"After getting this drug some of these patients went many months without any new growth in their tumors," Dr. Fiveash said in a statement to the media. "We are able to do that with a well-tolerated oral medication, and that is a major benefit."

Dr. Fiveash said the nature-derived drug might be able to boost the cancer-fighting properties of current treatments, too. In addition, he pointed out that research is needed to learn which patients are most likely to benefit from AT-101.

According to the National Cancer Institute (NCI), *glioblastoma multiforme* tumors account for more than half of the more than 18,000 primary malignant brain tumors diagnosed each year in the US and they are the second-most common cause of cancer deaths in the 15 to 44 age group. Considering the ability of *glioblastoma multiforme* tumors to grow and spread remarkably quickly, the UAB findings that a cottonseed derivative could stop the malignancy growth are nothing short of remarkable.

Research into cottonseed over the past decade has shown it to have numerous health-promoting qualities. For example, previous animal research at the University of Michigan concluded that a therapy made from cottonseed oil could boost the effectiveness of treatment for prostate cancer and possibly other common cancers, as well. Another study from Texas Medical Center researchers found that consuming cottonseed oil may help fight heart disease because it is rich in vitamin E and lowers cholesterol naturally.

(Source: NaturalNews)

Study Shows Cottonseed Oil Consumption Boosts Vitamin E Intake

A new study suggests cottonseed oil consumption significantly increases vitamin E intake without affecting fat intake, according to nutrition researchers at Texas Woman's University (TWU), Houston, Texas.

According to the Dietary Guidelines for Americans (DGA), vitamin E is a "nutrient of concern" for children, adolescents and adults. The percentage of Americans consuming the recommended daily level (15 milligrams per day for adults) of vitamin E through diet alone is less than seven percent. An adequate daily intake of vitamin E can promote health and may help prevent diseases such as heart disease, some forms of cancer and cognitive decline with age.

The study's results were unmistakable: when eating cottonseed oil-rich foods, subjects' vitamin E intake was 34 percent higher than their previous "regular" diet, helping them achieve 75 percent of the Recommended Dietary Allowance (RDA) for adults, versus just 53 percent prior to eating the cottonseed oil-rich foods.

The study, conducted by John Radcliffe, Ph.D., RD and Professor of Nutrition and Food Sciences, and fellow TWU researchers V. Imrhan, Ph.D., RD and J. Killough, MS, RD, served as a "pilot," to pave the way for a larger study to be completed later this year. Radcliffe and his fellow researchers studied ten healthy adult subjects (six female, four male), recording their regular

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diets for two weeks to establish a baseline for comparison. The subjects were then asked to consume two cottonseed oil-rich foods (one muffin per day made with commercially available cottonseed oil, and four servings of potato chips per week, fried only in cottonseed oil) for four weeks.

“The food products provided about one tablespoon of cottonseed oil per day,” notes Radcliffe. “That is the equivalent of 33 percent of the Recommended Dietary Allowance, offering significant vitamin E benefit through just a small amount of oil.”

What’s more, the increased cottonseed oil consumption did not impact fat intake. The researchers believe the cottonseed oil-rich foods naturally displaced other foods in the subject’s diets, thus helping them to receive all of the benefits of the added vitamin E, with no additional fat intake.

“It’s important to note that the cottonseed oil-rich foods we provided—carrot muffins and potato chips—were extremely palatable. Subjects consumed 95 percent of both foods—an extremely high rate, and an added bonus to the research,” explains Radcliffe. “After all, what good does it do to identify vitamin E-rich foods that no one likes? The goal is to find vitamin E boosting foods that people will readily eat, and these cottonseed oil-containing foods certainly fit the bill.”

This study was reported at the annual meeting of the American Society for Nutrition in New Orleans earlier this year.

PEOPLE NEWS

POET Biorefining has announced the appointment of Robert Flynn as general manager of its Laddonia, Missouri, ethanol production facility.

Before joining POET, Flynn was Vice President of Operations for GT Technologies in Defiance and Toledo, Ohio. In all, he has 30 years of management experience in manufacturing. Flynn has an Associate of Science in Business, also a Bachelor of Science in Business Administration both from Indiana Wesleyan and an MBA from Notre Dame University.

“I am very excited to join the team here at Laddonia,” Flynn said. “I am fortunate to have such a high-performing group of individuals working as a team toward the continued success of the Laddonia facility. POET has a fine reputation as the world leader in ethanol production and state-of-the-art manufacturing facilities. I am proud to become a part of the POET team.”

The plant recently completed \$2 million project that added a sixth fermenter, increasing capacity by 5 million gallons per year.

Additionally, this year the plant’s natural gas-fired turbine system received an ENERGY STAR Combined Heat and Power Award from the U.S. Environmental Protection Agency for lowering energy consumption and greenhouse gas emissions.

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