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Protein Derived from Cottonseed for Human Nutrition One Step Closer to Reality

GUEST COLUMN

Kay Ledbetter
Communications Specialist, Texas A&M AgriLife Research and Extension Center in Amarillo

A veteran agricultural writer and business editor, Kay Ledbetter joined the Texas A&M AgriLife Research and Extension Center in Amarillo as the communications specialist on Jan. 24, 2005. She began her career as a general assignments reporter with the Amarillo Globe-News newspaper in 1982. She was the Globe-News farm and ranch writer for two years, and served as farm and ranch editor since 1986. She also worked as an assistant regional editor and senior business writer during her last four years at the newspaper.

Cottonseed ground into flour to deliver protein to millions of people, a project to which Dr. Keerti Rathore has devoted more than half his professional career, is one step closer to reality.

Rathore, a Texas A&M AgriLife Research plant biotechnologist in College Station, received word that Texas A&M's "Petition for Determination of Non-regulated Status for Ultra-Low Gossypol Cottonseed (ULGCS) TAM66274" has been approved by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service, or APHIS.

Texas A&M University Chancellor John Sharp, who oversees Texas A&M AgriLife Research along with 11 universities and seven state agencies, said Rathore's work will have a dramatic effect across the world.

"The work and dedication of Dr. Rathore has paid off," Sharp said. "He and his team exemplify the values of the Texas A&M System, and because of them, more than half a billion people across the world may have access to a new form of protein, and our farmers will be able to earn a much better living."

Through a project funded by Cotton Incorporated, Rathore and the Texas A&M team have developed a transgenic cotton plant – TAM66274 – with ultra-low gossypol levels in the seed that maintains normal plant-protecting gossypol levels in the rest of the plant.

Dr. Kater Hake, vice president of agricultural and environmental research at Cotton Incorporated, said it has been a decades-long journey. "Gossypol suppression in cottonseed has been part of our funded research portfolio for

Dr. Keerti Rathore, a Texas A&M AgriLife Research plant biotechnologist in College Station, received word that Texas A&M's "Petition for Determination of Non-regulated Status for Ultra-Low Gossypol Cottonseed (ULGCS) TAM66274" has been approved by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service, or APHIS. (Texas A&M photo by Lacy Roberts)

over 30 years," Hake said. "It took time to tap the innate protein potential in the seed; time for the right technologies to develop; and time for the right research team to come along."

Tom Wedegaertner, director of cottonseed research and marketing at Cotton Inc., underscores the potential of the breakthrough and the journey through the regulatory process. "Gossypol in the leaves and stalks of the cotton plant serve as a pest deterrent, but its presence in the seed serves no purpose," Wedegaertner said. "The more widespread use of cottonseed as a livestock feed and even for human consumption has been stymied by the natural levels of gossypol in the seed. As we progress through the regulatory review, the ability to utilize the protein potential in the seed gets that much closer."

The recent USDA action confirms that TAM66274 and any cotton lines derived from crosses between TAM66274 and conventional cotton or biotechnology-derived cotton granted non-regulated status by APHIS are no longer considered federally regulated articles, he said.

Only six months after starting to work with Texas A&M in 1995, Rathore, who had never seen cotton growing in a field prior to coming to Texas, decided something needed to be done about the underutilized protein in cottonseed. For the past 23 years, he has been determined to create cotton plants that produce seeds containing gossypol well below what the U.S. Food and Drug Administration considers safe levels while maintaining normal levels of gossypol and related chemicals in the foliage, floral parts, boll rind and roots.

Gossypol, while toxic to humans and monogastric animals such as pigs, birds, fish and rodents, is useful to cotton plants for defense against insects and pathogens. Therefore, cottonseed containing gossypol is currently used mainly as ruminant animal feed, either as whole seed or cottonseed meal after oil extraction.

"Biotechnology tools that made the ULGCS technology successful had just become available when I started looking at the potential to make this new source of protein available to hundreds of millions of people," Rathore said.

"I also realized the value to cotton farmers everywhere of removing gossypol from the cottonseed because such a product is likely to improve their income without any extra effort on their part or additional input," he said. "Such a product can also be important from the standpoint of sustainability because farmers will produce fiber, feed and food from the same crop."

Cotton-producing countries with a limited supply of feed protein can realize great benefits by utilizing this seed-derived protein as a feed for poultry, swine or aquaculture species, Rathore said. These animals are significantly more efficient in converting plant protein into high-quality meat protein, he said. Egg and broiler production could become the most efficient use of any available feed protein source, including the ULGCS.

Despite the obstacles, failures and lack of funding at times, Rathore said it was the

Seeds containing gossypol have glands showing up as black specs. (Texas A&M AgriLife photo by Dr. Devendra Pandeya)

The glands are still there, but are much lighter, reflecting the very low levels of gossypol in the deregulated cottonseed. (Texas A&M AgriLife photo by Dr. Devendra Pandeya)

dedication and loyalty of his team and supporters such as the late Dr. Norman Borlaug, who was known as the "father of the Green Revolution," that kept him going on this project.

"Dr. Borlaug was the biggest supporter of this project and during the lean times when I was struggling to get funding and after the failed attempts – there were many, it was his words of encouragement that provided the inspiration to continue," Rathore said.

While there were many team members over the years working on the project, he said key contributors to its advancement were Dr. Devendra Pandeya, LeAnne Campbell, Dr. Sreenath Palle and Dr. Sunilkumar Ganesan, all who worked in his laboratory at Texas A&M, as well as by Dr. Robert Stipanovic and associates with USDA-Agricultural Research Service who conducted biochemical analysis of gossypol levels in the ULGCS lines.

"It feels good to have come this far as Texas A&M AgriLife is only the fourth public institution to have accomplished such a feat as deregulation of an engineered crop."

Rathore's research has been reported on in numerous peer-reviewed science journals and he has been granted several U.S. patents. In 2006, he published in the Proceedings of the National cademy of Sciences announcing the cotton plants had been successfully altered in the lab to "silence" gossypol in the seed. In 2009, field trials verified the lab and greenhouse studies indicating the crop could become a source of protein.

The cottonseed from these plants met World Health Organization and FDA standards for food consumption, he said, thus opening the potential to make the new source of high-protein food available to hundreds of millions of people a year.

Rathore said cottonseed, with about 23 percent protein content, can play an important role in human nutrition with the gossypol eliminated, especially in countries where cereal/tuber-based diets provide most of the calories but are low in protein content.

"Growing up in rural India as the son of a doctor, I had seen the effects of malnutrition first hand in my father's patients," he said. "Many of their health issues were due to inadequate food and nutrition."

Rathore said for every pound of cotton fiber, the plant produces about 1.6 pounds of seed. The annual global cottonseed production equals about 48.5 million tons.

"The kernels from the safe seed could be ground into a flour-like powder after oil extraction and used as a protein additive in food

Dr. Keerti Rathore discusses the ultra low gossypol cottonwith his team, Dr. Devendra Pandeya and LeAnne Campbell. (Texas A&M photo by Beth Luedeker)

preparations or perhaps roasted and seasoned as a nutritious snack," he said.

Rathore said cotton will continue to be grown as a source of natural fiber, but the adoption of the ultra-low gossypol varieties by farmers has the potential to make the seed just as valuable as the lint.

"Our approach, based on the removal of a naturally occurring, toxic compound from the cottonseed, not only improves its safety but also provides a novel means to meet the nutritional requirements of the burgeoning world population," he said.

Aside from the human aspect, Rathore said the potential of ultra-low gossypol cottonseed as a fish meal replacement in the diets of shrimp and southern flounder has been demonstrated. Additional aquaculture and poultry feeding studies are planned to fully evaluate the nutritional value of the unique cottonseed.

Even after this deregulation hurdle has been jumped, the team knows the work is not done. "The next major effort will be aimed at activities to demonstrate the value-added potential of this technology," Wedegaertner said. "The first step will be to produce enough ULGCS seed for a commercial-scale production run at a cottonseed oil mill. This will take a couple of years."

Rathore said development of ULGCS involved several patented technologies, so additional steps must be taken to secure agreements with the patent holders, then to find a seed company willing to market the ULGCS trait and make it available to cotton farmers worldwide. Rathore said as a scientist who has conceived and developed this technology, "My personal preference as we move forward would be to follow the 'Golden Rice' example in terms of its use for humanitarian purposes."

(Published with permission from the Texas A&M AgriLife Extension Service)

(The views expressed in this column are of the author and not that of Cotton Association of India)

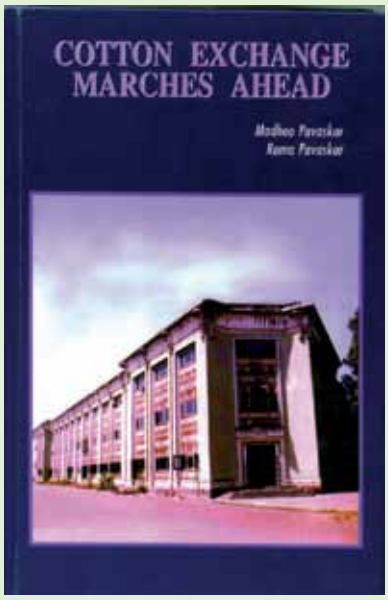
COTTON EXCHANGE MARCHES AHEAD

Madhoo Pavaskar, Rama Pavaskar

Chapter 9
In Service of King Cotton

Loyalty to King Cotton

Despite the closure of its futures market in cotton more than three decades back, and the absurd controls and curbs on stocking, pricing and trading in physical deals, the East India Cotton Association has not only survived, but grown in stature and status over the years to the admiration of both the domestic and international cotton organizations. This is due mainly to its unswerving loyalty and devotion to King Cotton, in whose service it has worked all these years. The Cotton Exchange is essentially a service institution, and not a profit making body. All its activities are aimed at providing efficient and effective services to not only its members, but to the cotton economy at large. Therefore, aside from undertaking a strenuous march towards freeing King Cotton from the governmental regulatory shackles, the Cotton Exchange has sought to improve the cotton quality, productivity and processing, as also adopted a harmonious approach for resolving manifold problems through co-ordination and co-operation with all the other interests of the cotton industry, both domestically and globally. For that purpose, not only did the Exchange strengthen its organizational structure to become a representative national body of diverse and even conflicting cotton interests, but it also initiated steps to build new bridges to tie friendly knots with the diverse trade and non-trade interests in the commodity.



If the East India Cotton Association has grown into a premier national institution inspite of all odds, it is solely because it has maintained, above all, the noble objective of its founding fathers to serve King Cotton through thick and thin. Hence, even though it was denied for over 30 years its core activity of futures trading, for which it was initially set-up in 1921, it is a tribute to those at the helm of affairs of the Cotton Exchange to take it to new heights and receive recognition as the sole representative body of the Indian cotton trade from the Government authorities. The credit for this remarkable achievement goes to the nature of its organization and the types of services that it renders. While celebrating the completion of its 80 years, with the blissful revival of its futures market, the ongoing saga of the Cotton Exchange will never be complete without reference to its character and the men who guided its destiny during the difficult times in the service of King Cotton.

Service Organization

Being a company limited by guarantee, the East India Cotton Association was never in practice a profit-making body with its profits distributed amongst its members. Nevertheless, its profits were liable to corporate tax and only the net profits after tax contributed to its reserves. Recently on September 14, 1998, the Cotton Exchange has received a formal approval from the Department of Company Affairs as well as the Income-tax authorities as a non-profit making body not liable to any income-tax. The Association has also been allowed to drop the suffix "Limited" from its name. These formal changes have confirmed the service character of the Cotton Exchange. What was the de-facto situation since its inception has now become a de jure position.

Although the Association has a democratic constitution based on the principle of 'one member, one vote' , to safeguard the interests of mills and merchants vis-à-vis the brokers, the elected seats on its governing body, namely, the Board of Directors, are reserved for the different categories of members separately. The elected

strength of the Board is distributed among the four panels of members as under:

Mill Members		2
Buyers other than mills		4
Sellers		8
Growers & Growers' Co-operatives	1	
Ginners	1	
All Other Sellers	6	
Brokers		6
Total		20

The election, however, continues to be by general franchise, and not panel wise.

In addition to the 20 elected directors, the Articles of Association of the Cotton Exchange provide for nominations of 2 representatives of growers by the Indian Cotton Development Council, 4 Directors by the Central Government (through the Forward Markets Commission) to represent the interests not otherwise directly represented on the Board, 9 associate directors elected by the up-country cotton trade associations and 2 more associate directors elected by the co-operative cotton marketing societies registered with the Association. The Associate Directors are entitled to attend all the meetings of the Board, but can vote only on the issues specifically relating to (a) all-India cotton price policy, (b) cotton production and (c) taxation.

Following the suspension of futures trading during the mid-1960s, the membership of the East India Cotton Association dwindled swiftly. At the end of December 1984 the Association had a total membership of 332, as against 468 when futures trading was stopped. In 1948 the Association had a record of 1120 members on its roll. But with the growing restrictions on futures contracts, and the consequent slump in the futures business, the membership of the Cotton exchange began to slide year after year even through the 1950s and the early 1960s. This process gathered further steam after the closure of the futures market.

The last decade of the last century saw a sudden reversal of this trend. Thanks to the invaluable services rendered to the diverse cotton interests, the Cotton Exchange began to attract new members, mostly merchants who were reeling under the crushing governmental controls and regulations and looked at the Exchange as its saviour. The Exchange was prompt to rush to their rescue by pulling all its weight to help them. Not surprisingly, at the end of July 2002 the Association had 416 members, divided into four panels as under:

Mill Members	47
Buyers other than mills	61
Sellers	170
Brokers	138
Total	416

Besides the full members, the Associate Membership of the Cotton Exchange covered 20 upcountry associations and 11 co-operative marketing organizations, including the All-India Co-operative Cotton Federation Ltd., the Maharashtra State Co-operative Cotton Growers' Marketing Federation Ltd. (which implements the Monopoly Procurement Scheme for kapas of the Maharashtra Government), and the Karnataka State Co-operative Cotton Growers Marketing Federation Ltd. With such a large membership of the upcountry cotton associations and the leading co-operative marketing organizations, the East India Cotton Associations has truly become a representative all- India association of the cotton growers, trade and industry.

After the annual elections to the Board, at the first Board meeting the directors elect from amongst themselves the President and Vice-President. The Board also appoints at the beginning of every year several statutory (as enjoined by the by-laws of the Association) and non-statutory committees to perform specific functions on a regular basis. The statutory committees include the Daily Rates Committee for fixing the daily spot rates of cotton of various standard descriptions of basic grade and staple at selected upcountry markets; the Standards Committee for fixing the quality standards of different cotton varieties; the Super Appeal Committee to decide the appeals against the awards from the panel of surveyors; and the Vigilance Committee to investigate into and report to the Board the violations of various laws and rules. The non-statutory committees include the Crop Estimation Committee, the By-laws Committee, the Hedge and TSD Contracts Committee and the Publications Committee. In fact, more than two dozen committees are appointed by the Board every year to ensure efficient working of the Association and to render proper and prompt services to both the trade and non-trade interests in cotton.

(To be continued...)

SAVE THE DATES

6th – 8th March 2019

COTTON ASSOCIATION OF INDIA

Established 1921

presents

Cotton India 2019

INTERNATIONAL CONFERENCE

IN

HOTEL TRIDENT, MUMBAI (INDIA)

UPCOUNTRY SPOT RATES

(Rs./Qtl)

Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Strength /GPT	Spot Rate (Upcountry) 2018-19 Crop December 2018					
							17th	18th	19th	20th	21st	22nd
1	P/H/R	ICS-101	Fine	Below 22mm	5.0-7.0	15	11529 (41000)	11501 (40900)	11360 (40400)	11360 (40400)	11360 (40400)	11220 (39900)
2	P/H/R	ICS-201	Fine	Below 22mm	5.0-7.0	15	11670 (41500)	11642 (41400)	11501 (40900)	11501 (40900)	11501 (40900)	11360 (40400)
3	GUJ	ICS-102	Fine	22mm	4.0-6.0	20	- -	- -	- -	- -	- -	- -
4	KAR	ICS-103	Fine	23mm	4.0-5.5	21	10517 (37400)	10489 (37300)	10432 (37100)	10432 (37100)	10432 (37100)	10376 (36900)
5	M/M	ICS-104	Fine	24mm	4.0-5.0	23	11529 (41000)	11501 (40900)	11445 (40700)	11445 (40700)	11445 (40700)	11389 (40500)
6	P/H/R	ICS-202	Fine	26mm	3.5-4.9	26	11838 (42100)	11810 (42000)	11726 (41700)	11670 (41500)	11614 (41300)	11501 (40900)
7	M/M/A	ICS-105	Fine	26mm	3.0-3.4	25	- -	- -	- -	- -	- -	- -
8	M/M/A	ICS-105	Fine	26mm	3.5-4.9	25	- -	- -	- -	- -	- -	- -
9	P/H/R	ICS-105	Fine	27mm	3.5.4.9	26	11979 (42600)	11951 (42500)	11867 (42200)	11810 (42000)	11754 (41800)	11642 (41400)
10	M/M/A	ICS-105	Fine	27mm	3.0-3.4	26	- -	- -	- -	- -	- -	- -
11	M/M/A	ICS-105	Fine	27mm	3.5-4.9	26	- -	- -	- -	- -	- -	- -
12	P/H/R	ICS-105	Fine	28mm	3.5-4.9	27	12120 (43100)	12092 (43000)	12007 (42700)	11951 (42500)	11895 (42300)	11782 (41900)
13	M/M/A	ICS-105	Fine	28mm	3.5-4.9	27	12063 (42900)	12035 (42800)	12007 (42700)	12007 (42700)	11951 (42500)	11895 (42300)
14	GUJ	ICS-105	Fine	28mm	3.5-4.9	27	- -	- -	- -	- -	- -	- -
15	M/M/A/K	ICS-105	Fine	29mm	3.5-4.9	28	12232 (43500)	12204 (43400)	12176 (43300)	12176 (43300)	12092 (43000)	12035 (42800)
16	GUJ	ICS-105	Fine	29mm	3.5-4.9	28	12485 (44400)	12429 (44200)	12401 (44100)	12345 (43900)	12232 (43500)	12176 (43300)
17	M/M/A/K	ICS-105	Fine	30mm	3.5-4.9	29	12513 (44500)	12457 (44300)	12429 (44200)	12401 (44100)	12373 (44000)	12288 (43700)
18	M/M/A/K/T/O	ICS-105	Fine	31mm	3.5-4.9	30	12766 (45400)	12738 (45300)	12710 (45200)	12682 (45100)	12626 (44900)	12570 (44700)
19	A/K/T/O	ICS-106	Fine	32mm	3.5-4.9	31	12991 (46200)	12963 (46100)	12935 (46000)	12907 (45900)	12851 (45700)	12795 (45500)
20	M(P)/K/T	ICS-107	Fine	34mm	3.0-3.8	33	16310 (58000)	16281 (57900)	16281 (57900)	16281 (57900)	16281 (57900)	16225 (57700)

(Note: Figures in bracket indicate prices in Rs./Candy)