4- Study properties and biochemical functions of key factors responsible for fiber initiation and development for fiber quality maintenance and improvement.

5- Isolation and purification of megabase size DNA and construction of Egyptian megabase DNA bacterial artificial chromosome (BAC) libraries to be used in gene family identification and map-based cloning.

6- Development of transgenic cotton tolerant to abiotic stress via carbohydrate accumulation via overexpression of manitole dehydrogenase gene and fructane synthase gene for manitole and fructan accumulation and also, via amino acid accumulation using over expression of Delta-1-Pyrroline-5-Carboxylate Synthase gene.

Additional progress in these areas is likely to be achieved in a shorter period of time than before due to new developments in gene identification and transformation technologies. Genomic technologies associated with structural, functional and bioinformatics are being developed under the AGERI biotechnology program targeting the most needed economic traits for Egyptian cotton such as fiber quality, earliness and multiple adversity gene families associated with host plant resistance. Using new AGERI genomic laboratory facilities and BAC libraries that are developed, screening for these traits is carried out. Several genes for stress resistance and fiber modification are being tested in various laboratories. New genes for insect and herbicide resistance are being sought. A strategy to modify fiber using metabolic pathway engineering to produce aliphatic polyester compounds is under development. Particle bombardment technology has been developed to introduce and test genes in elite varieties of cotton, without the need for regeneration or other tissue culture practices and backcrossing. These developments will lead to improved agronomical and fiber traits in cotton and enable the industry to expand its market share.

Impact of Transgenic Cotton on the International Cotton Trade

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Introduction

This paper is presented at the invitation of the International Cotton Advisory Committee, and the material presented documents the reported experiences of the international cotton trade in addition to relying on the available scientific literature documenting the use of insect resistant cotton seeds and Roundup Ready cottons.

Discussion

The controversy generated by the transgenic modification of fruits, vegetables, and feed crops has not affected the international trade in cotton. While some questions were raised by environmental activists in England and Germany at the onset of the use of insect resistant (Bt) and herbicide tolerant (Roundup Ready) cottons in 1996 and 1997, the cotton industry has effectively communicated to the environmental and political communities and to the consumer through sound scientific evidence of benefits to the soil, fauna, beneficial insects, birds, fish, wild life, and the ground and surface water through a substantial reduction in the use of pesticides.

The other important attributes of the new genetic varieties are the significant reductions in costs achieved through reduced use of pesticides and the increase in yields. In 2002, about 25-30% of total world production is transgenic cotton. Based on the increase in the use of the new seeds it is estimated that by 2005 approximately 50 percent of the total world production will make use of the new genetic varieties and the level should encompass two-thirds of production by 2008[1]. The benefits of the new varieties come at a critical time, as they will allow small producers in Africa, China, India, and Brazil to reduce their production costs and be more competitive with producers from the developed nations. The needed breakthroughs have come in two categories, insect resistance and weed control.

Insect Resistant Cotton

Since the transgenic cotton carrying the insect-resistant Bt gene was commercialized in the United States in 1996 the research data[2] documents that Bt cotton has provided 95 percent control of the tobacco budworm; 90 percent control of the cotton bollworm (pre-bloom) and 70 percent control of the cotton bollworm (bloom); and 99 percent control of the pink bollworm. More importantly, yield losses were suppressed. The adoption of Bt varieties was extremely rapid in states that experienced resistance problems (Arizona, Alabama, Georgia, Florida). After a year of very high budworm populations and damage in 1995, growers in Alabama adopted the new technology at an extremely rapid rate, planting over 60% of total acreage to Bt varieties in 1996. The results were astounding and Bt cotton is credited with saving the cotton industry in

Alabama. At the 26th International Cotton Conference in Bremen this year, Hugh H. Summerville, a cotton producer from Aliceville, Alabama reported that prior to 1996, "it was normal to spray a cotton crop about 15 times to control insects and 6 times to control weeds and grass. Over the entire growing season those sprays could include 8 to 10 different insecticides and a similar number of herbicides." Summerville reported that he planted a Bt seed the following year and that in the past six years he has not sprayed his cotton crop with any insecticides. He only uses three Round-Up sprays. "One early spray over the top of the crop and two sprays directed to the base of the stalk. No herbicide is used which leaves any residual in the soil, as was the common practice before Round-Up Ready cotton."

In 2001, 42% of the cotton acreage (over 6 million acres) in the United States was in Bt and Stacked Gene varieties. Adoption has been low in California (5%) because the worm pests are not a problem in the San Joaquin Valley. Adoption has also increased in certain states (Mississippi, Louisiana, Texas, Oklahoma, Arkansas, and Tennessee) due to the implementation of the Boll Weevil Eradication Programs (BWEP) given that producers in BWEP areas are advised to plant Bt cotton due to the negative effects of the weevil sprays on predators of bollworms/budworms. It is estimated that insecticide use was lowered by 1.9 million pounds in 2000 as a result of planting insect resistant (Bt) cotton[3].

Weed Control

In the last sixty years, the rigors of controlling weeds during cotton production advanced from manual labor to the use of herbicides in order to suppress the decline in yields. Up until 1952, the use of the hoe reigned supreme as herbicides were used on only 5 percent of the U.S. acreage. By 1976, the level of use increased to 84 percent. By 1997, the U.S. cotton industry had reached a new era of weed control through the use of Round-Up Ready and Stacked Gene varieties of seed that were utilized on about 70 percent of the planted acreage in 2001 (USDA, AMS). In only four years the amount of herbicide use fell by almost 20 percent. It is estimated (Gianessi, et al.) that in 2001 herbicide use was reduced by 6.2 million pounds from 1997 use due to the decline in use rate per acre, although glyphsoate (RR) (which is much safer than the replaced herbicides) use increased considerably. Also, production costs were significantly reduced. Here, it is important to note that in those cases where herbicide use could not be reduced, the availability of glyphsoate (RR), a much safer material, has proven to be a beneficial improvement. These developments portend great advances in cotton production throughout the world, particularly for producers in the developing nations.

Issues Pertaining to New Genetic Varieties

Three levels of federal regulation administered by the U.S. Food & Drug Administration, the U.S. Department of Agriculture, and the Environmental Protection Agency assure the U.S. consumer of safe food and fiber products. These overlapping jurisdictions govern the use of new seed varieties and the application of chemicals to agricultural products in order to assure that food and fiber are fit for human consumption and utilization and that chemicals or pharmaceutical products applied to agricultural products or fed to poultry and livestock are not harmful to the plant, animal, or environment and most importantly to the ultimate consumer. The basis for the U.S. regulatory process in this area is "sound science". In contrast, in Europe the regulatory process appears to be based on the so-called "precautionary principle." As a result you have in Europe a confusing mix of regulatory rules, which in some instances are dictated by emotional politics. More so than the United States, there are significant political variations both between the various European Union (EU) member states and between the states and the EU institutions. Unlike the United States, Europe is a diverse group of countries; peoples with different cultures and languages making it difficult to reach a consensus on this and other thorny issues.

Moreover, given the trust the U.S. consumer places in the regulatory framework, the new advances in technology, particularly in fruits, vegetables, and feed grain products, have been accepted by the consumer. The U.S. food industry does an effective job of educating its consumers regarding the sound research involved in new product development and the government approval process required to bring these products to market.

Yes, there have been questions raised by environmental organizations, but a full and transparent debate of the subject in the U.S. media established that the concerns expressed had no basis in fact. The U.S. consumer and the U.S. political system reviewed the facts and concluded that based on the principle of "sound science" that transgenically modified food crops are beneficial to the environment and that there is no evidence of any potential harm through their consumption.

Simply put, the debate surrounding agricultural biotechnology has been riddled with misinformation and hyperbole. When confusing and inaccurate information is presented to consumers, it is easy to get a false impression of the attributes of transgenic cotton. As previously noted the U.S. regulatory process is fully focused on the environmental impact and consumer safety and these vigilant government entities have determined that the insect-pro-

tected and herbicide-tolerant transgenic cottons are beneficial to the environment and safe for consumers to use. These cottons have all of cotton's consumer-friendly characteristics and people throughout the world have been wearing clothes made with fiber produced from transgenic cottonseed for several years. It is estimated that some 20 billion garments and home furnishings are in use worldwide with no adverse consumer impact[4].

Acceptance of Transgenic Cotton By Textile Mills & Consumers

The case for cotton fiber is even stronger, given that the fiber itself goes through extensive processing phases as it moves from the field, to the gin, yarn production, knitting or weaving, bleaching, and dyeing and finishing before being utilized by the ultimate consumer. Cotton byproducts used in personal care products, and cotton seed oil and meal also go through an extensive processing phase before being consumed as animal feed or utilized as cooking oil, salad oil, or margarine. Thus, transgenic proteins and DNA, which are not toxic or allergic to humans, also cannot be detected in consumer products produced by transgenic cottons.

A review of the scientific and safety literature indicates that transgenic cotton does not pose any different risks to human or animal health than conventional cotton varieties. More importantly, there are no reported instances, other than antidotal in the form a few mill complaints pertaining to fiber quality characteristics, of any problems being incurred in the use and consumption of cotton fiber or any of its seed byproducts.

In the review of the fiber quality characteristics of conventional and transgenic varieties of cotton, the literature[5] discussing fiber analysis concludes that there are no meaningful differences in micronaire, leaf grade, color, length and length uniformity, strength, and elongation. The scientific literature makes it clear that quality variations are due to environmental factors or growing conditions.

While the benefits to the farmer are significant, the U.S. consumer is more impressed with the benefits to the environment with the steady improvement in wild life habitat and the quality of the ground water in cotton producing areas. The new cotton varieties have clearly demonstrated they are environmentally sound and beneficial and this case has been effectively made to the consumers of U.S. cotton in its major export markets throughout the world. No single case is known where the seed variety was questioned or rejected. If anything, there is a growing acceptance of the new varieties. It cannot pinpointed how much of the 11 million bales of U.S. cotton sold in the export market this past season are transgenic cottons, but we estimate it is no more than half given that much of the Eastern U.S. cottons, where transgenic cottons are used to the greatest extent, moves into domestic consumption. Neither do we represent or provide warranties in our contracts that the raw upland cotton being marketed is produced from such seed since we cannot make such a guarantee as the ginner does not provide such information to the buyer. U.S. cotton is sold on the quality terms assigned by the U.S. Department of Agriculture and the only guarantee that U.S. exporters can make pertains to the qualities they merchandise.

Conclusion

There is no problem with the acceptance of transgenic cottons by the world textile industry given there are no differences in the quality characteristics. While there may be perceived problems by uninformed consumers in certain European markets the great majority of the world's consumers of cotton have been fully assured of its safe use and they have readily accepted this positive development knowing of the benefits to the environment. Further, lower production costs associated with transgenic cottons assures the availability of cotton products and byproducts at competitive and affordable prices. Given these reasons transgenic cotton varieties have been fully

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