Recent Developments in Cotton Breeding and Biotechnology Fields in Turkey

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INTRODUCTION

Cotton has an important place in **agriculture, industry** and **trade** both in Turkey and the World.

It is **a strategic plant** that makes ***important contributions to national economies*** with ***its added value and employment opportunities.***

- Cotton fiber is the main raw material of textile industry.
- Cotton seeds are an oil source for human consumption and also biodiesel production.
- Cotton stalks are important sources for biomass and biofuel. For this reasons, cotton is a part of energy agriculture.
- High-protein cotton meal is used as livestock feed.
- Cotton has other different uses such as fertilizer, paper, cardboard, etc.

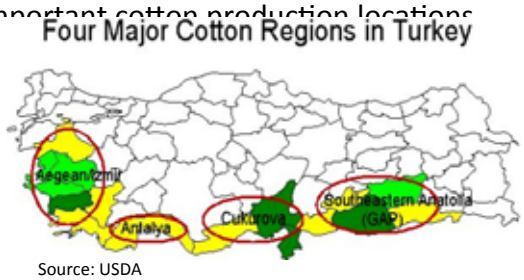
INTRODUCTION

Turkey, one of the leading countries in the world both in terms of textile industry and cotton processing capacity, provides various textile products to world markets.

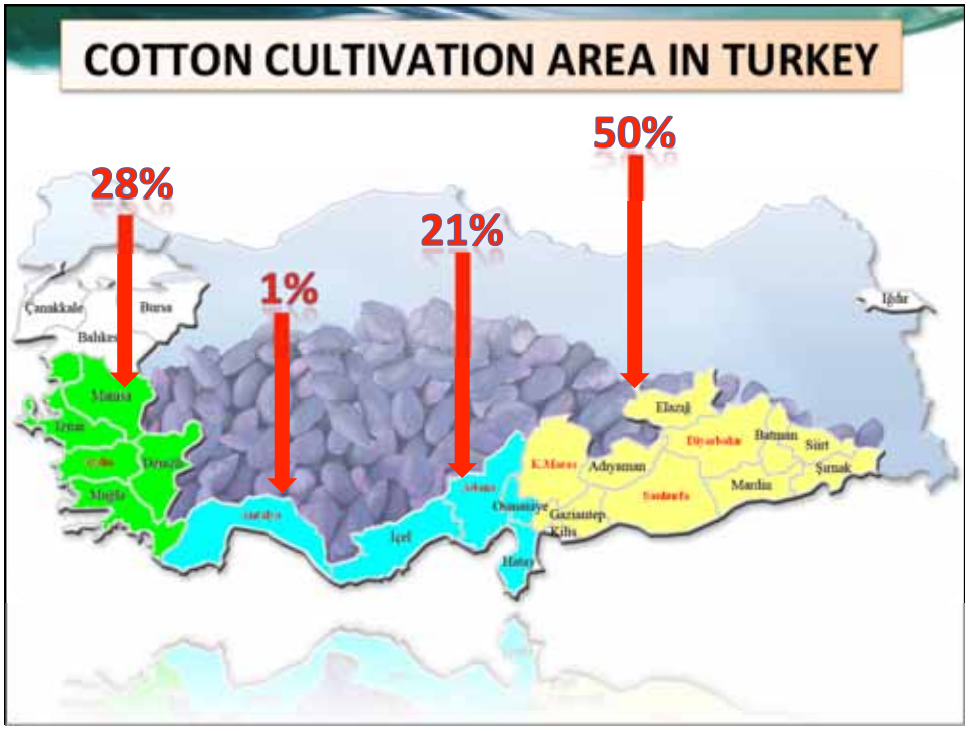
Cotton production has decreased to a critical threshold in Turkey.

There are several causes effecting on it:

- high production cost of cotton,
- lower subsidy rates compared to other cotton producing countries,
- having alternative crops or rich crops diversity in Ege and Cukurova Regions which are important cotton production locations



Source: USDA


COTTON CULTIVATION AREA IN TURKEY
28%
1%
21%
50%
Çanakkale
Bursa
Balıkesir
Manisa
Aydın
Denizli
Muğla
İçel
Osmaniye
Gaziantep
Kilis
Adıyaman
Elazığ
Batman
Siirt
Şırnak
Mardin
Iğdır


CONVENTIONAL COTTON BREEDING IN TURKEY

CONVENTIONAL COTTON BREEDING IN TURKEY

The most important issues of cotton breeding programs include:

- increasing income levels of producers by improving yield potential with higher quality and,
- meeting the requirements of consumers.

CONVENTIONAL COTTON BREEDING IN TURKEY

In Turkey, the early developments on cotton production started with the establishment of Cotton Research Institutes in Adana in 1924 and in Nazilli in 1934.

The traditional cotton breeding studies in Turkey first started with the introduction materials provided from USA in 1927 and then the selection studies were continued by using these plant materials.

Cotton breeding studies gained acceleration in 1960s.

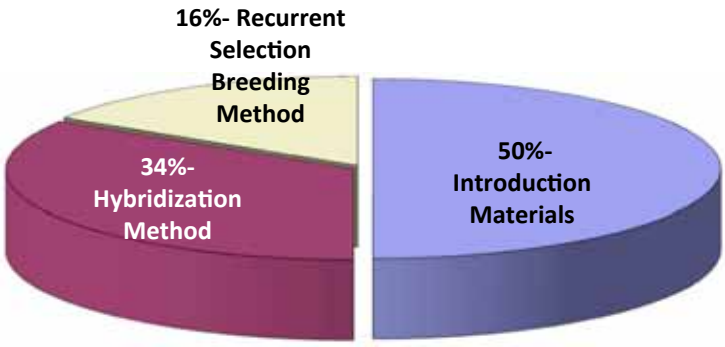
CONVENTIONAL COTTON BREEDING IN TURKEY

- A total of **123** cotton varieties between 1950 and 2012 in Turkey have been registered by research institutes, private companies and universities using various breeding methods.

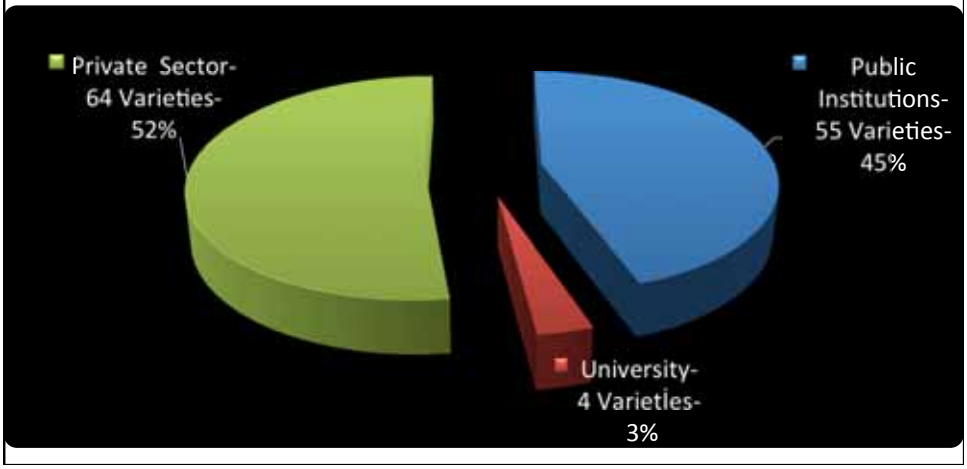
COTTON VARIETIES WERE OBTAINED BY USING

- Introduction materials
- Combination breeding depending on hybridization technique
- Recurrent Selection Breeding Method

Percentage of varieties developed according to different breeding methods in Turkey



Percentage of varieties registered by private sector, research institutes and universities in Turkey



CONVENTIONAL COTTON BREEDING IN TURKEY

- Approximately 20 varieties are commercially produced at present.
- There is no transgenic cotton variety in official records.

CONVENTIONAL COTTON BREEDING IN TURKEY

The leading Agricultural Research Institutes dependent on Ministry of Food, Agriculture and Livestock of Turkey Republic related with cotton breeding researches are:

- Nazilli Cotton Research Station (Nazilli-Aydın)
- East Mediterranean Agricultural Research Institute (Adana)
- GAP International Agricultural Research and Training Center (Diyarbakır)
- East Mediterranean Gateway Zone Agricultural Research Station (Kahramanmaraş)
- GAP Agricultural Research Institute (Urfa)
- West Mediterranean Agriculturel Research Institute

The leading Agricultural Research Institutes dependent on Ministry of Food, Agriculture and Livestock of Turkey Republic

CONVENTIONAL COTTON BREEDING IN TURKEY

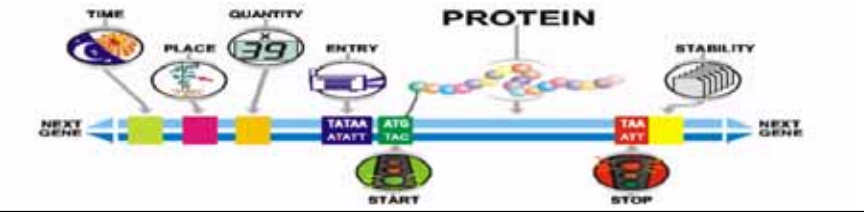
- 35 Cotton varieties are developed by Nazilli Cotton Research Station.
- The tasks of this institute having molecular genetics, tissue culture, phytopathology and fiber technology laboratories are divided into national and international categories.
- This institute is one of 6 Excellence Centers of The Organization of Islamic Cooperation
- In this context, this institute continue to collaborate on cotton breeding issues with some countries such as Azerbaijan, Turkmenistan and Uzbekistan and also with the other members of The Organization of Islamic Cooperation.

COTTON BIOTECHNOLOGY IN TURKEY

Cotton biotechnology including tissue culture and molecular genetics have been conducted for nearly the past 15 years in Turkey.

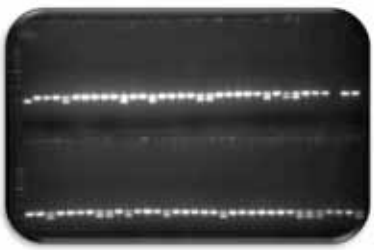
COTTON MOLECULAR GENETICS IN TURKEY

- **Molecular technologies are used as routinely in plant breeding programs in many countries.**
- **Turkey has started to use molecular genetics technologies in plant breeding and genetic programs in mid-1990s for other crops. Many laboratories on this subject have been established in universities and also private companies.**
- **These molecular technologies for cotton have been used for 10 years in Turkey.**



COTTON MOLECULAR GENETICS IN TURKEY

Especially in the last 10 years, the number of researches in Turkey has been quite increased on characterization of cotton varieties using DNA markers by molecular genetics methods and mapping the genes which are effective on fiber quality, fiber color and also the genes controlling resistance to *Verticillium wilt* in cotton genome.



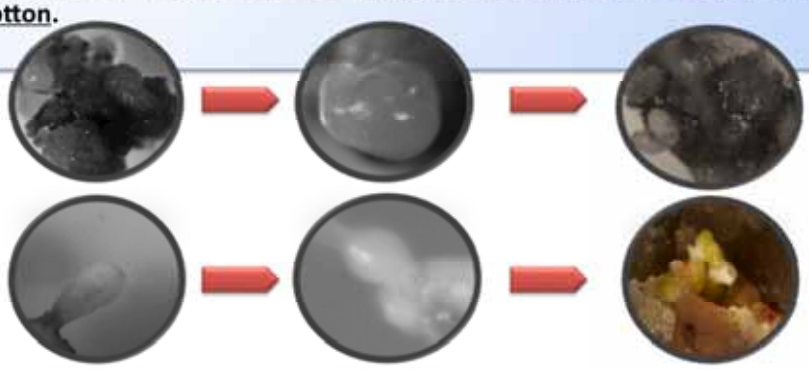
COTTON MOLECULAR GENETICS IN TURKEY

- The universities have leaded the molecular genetics researches in cotton and therefore with their contributions, necessary infrastructures have been started to establish in public research institutions, centers as well as private companies.
- Association and genome mapping are made mostly by using SSR (simple sequence repeats), AFLP (amplified fragment length polymorphism) and SNP (single nucleotide polymorphisms) marker techniques on hybrid populations in our country.

COTTON TISSUE CULTURE TECHNIQUES IN TURKEY

Plant cell, tissue and organ culture techniques are generally used in clonal propagation, creating somaclonal variability and developing new genotypes, and making gene transfers for resistance to pests, diseases , etc.

***In vitro* selection techniques focused on in the recent times have great potentials in order to solve several biotic and abiotic stress problems in cotton.**



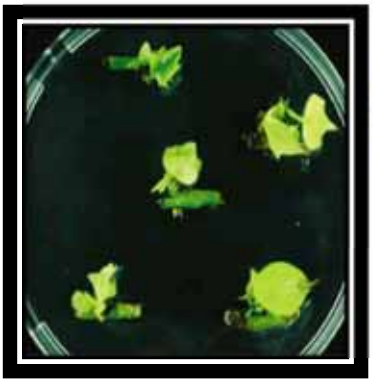
PLANT TISSUE CULTURE TECHNIQUES

Plant tissue culture researches were started in 1960s in our country and private companies that had permission of tissue culture production have preferred to work on crops other than cotton.

Universities have taken the lead in tissue culture studies in cotton and also leaded the establishment of infrastructures of research institutes and centers.

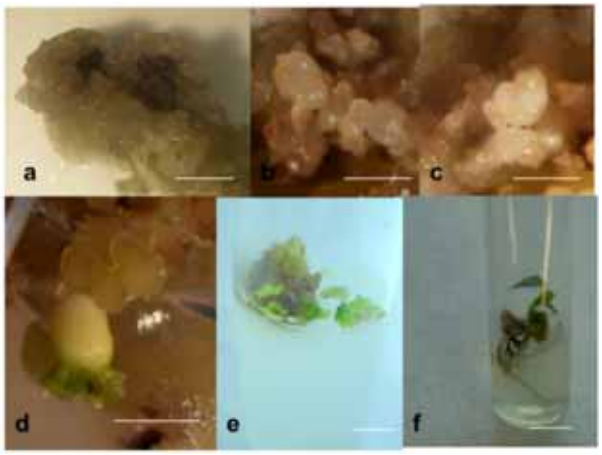
PLANT TISSUE CULTURE TECHNIQUES

Turkey has 20 private companies engaged in the production of certified seed via tissue culture techniques.



However none of them does not work on cotton crop.

PLANT TISSUE CULTURE TECHNIQUES



Somatic embryogenesis and plant regeneration in *G.hirsutum cv.* Nazilli-143. **(a)** Callus induced from hypocotyl explants, **(b)** Globular stage embryoids, **(c)** Heart-shape embryoids, **(d)** Cotyledonary stage embryoids, **(e)** Rooted plantlet. Horizontal Scale Bar=0.5 cm.

TRANSGENIC VARIETIES

It is known that researchers more carefully and prudently deal with developing of transgenic varieties that pose no harm to environment and human health.

Transgenic cotton cultivation tends to increase in the world.

Besides cotton resistance to herbicides and pests, there are also successful researches conducted to increase the fiber yield and quality and improve the fatty acid composition of cotton seeds.

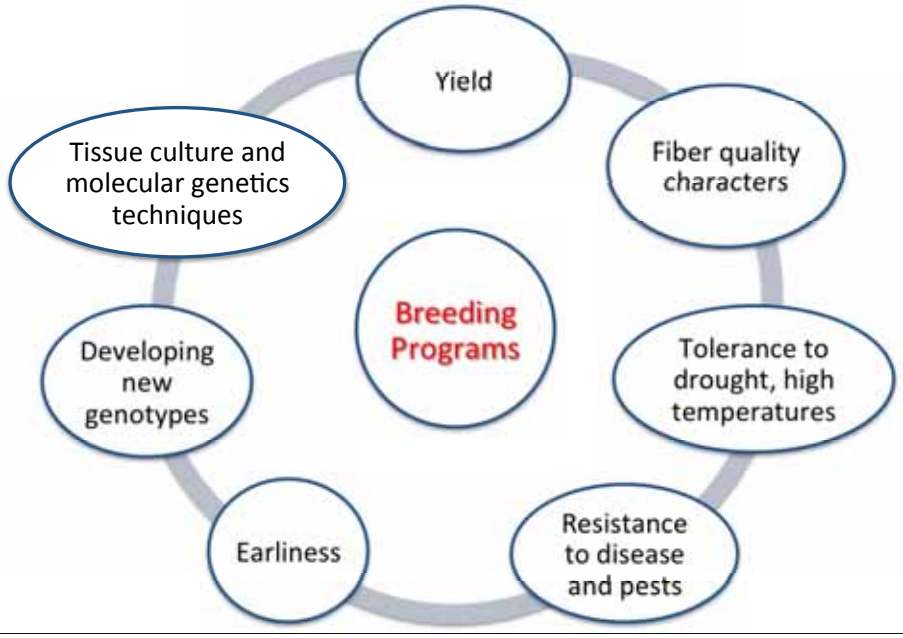
It is evident that this kind of experiments will diversify and continue to increase.

TRANSGENIC VARIETIES

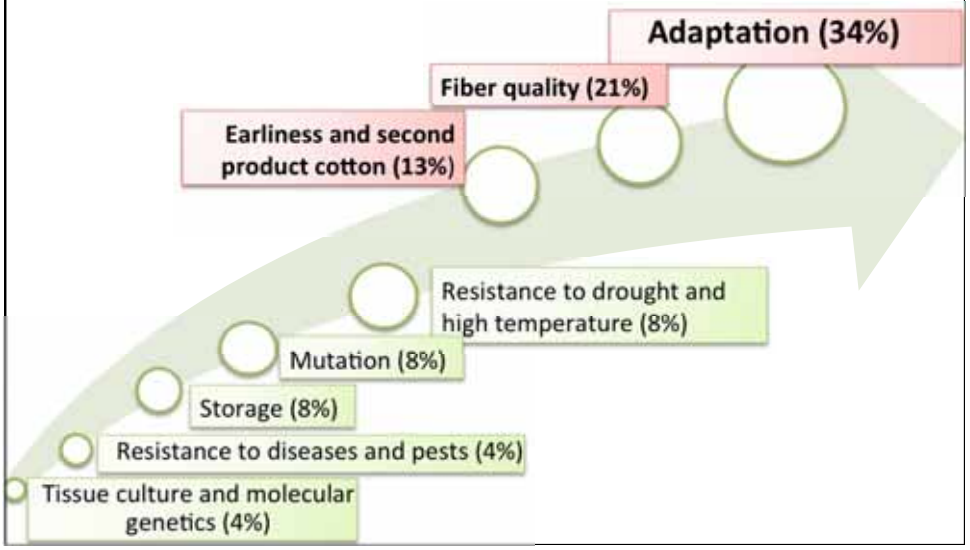
The size of cultivation areas of transgenic cotton varieties has increased throughout the world.
Transgenic cotton varieties are not allowed to be grown in Turkey due to the current biosafety law.

However, some transgenic varieties were tested in field experiments under controlled conditions in research institutes.

OBJECTIVES OF BREEDING PROGRAMS IN TURKEY



Percentage of the research subjects



FINANCIAL SUPPORTS FOR COTTON BREEDING PROGRAMS

TÜBİTAK — The Scientific and Technological Research Council of Turkey

The most important organisation that supports the finance of agricultural researches in Turkey is **TUBITAK** (Turkey Scientific and Technical Research Council).

The projects of public institutes, universities and private sectors can be ***financially supported*** by TUBITAK

TÜBİTAK
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FINANCIAL SUPPORTS FOR COTTON BREEDING PROGRAMS

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BAKANLIĞI

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In addition, agricultural research and development activities are also supported and coordinated by **TAGEM** (General Directorate of Agricultural Research and Policies) of Ministry of Food, Agriculture and Livestock.

FINANCIAL SUPPORTS FOR COTTON BREEDING PROGRAMS

Republic Of Turkey
Ministry of Science, Industry and Technology

- **Industrial Thesis (SANTEZ) program** is direct financial support for new technology adaptation, process development, quality improvement and environmental modification projects to be achieved via university partnerships (**postgraduate student+university + private company+Ministry of Science, Industry and Technology**)

CONCLUSIONS

International seed sector has demonstrated a rapid growth in the last 20 years.

The increasing international seed trade poses an important threat to countries with inadequate seed production capacities.

National cotton breeding programs should be strengthened by using biotechnological techniques in order to develop native varieties.



CONCLUSIONS

Biotechnological techniques should be integrated into conventional breeding methods in order to shorten variety breeding time, increase the efficiency of selection studies and compete with other companies in the world.


CONCLUSIONS

Cotton researchers which have high knowledge continue to conduct successful researches in order **to meet the demands of producers, textile suppliers and consumers by integrating conventional and modern biotechnological techniques.**

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CONVENTIONAL COTTON BREEDING IN TURKEY

Introduction Breeding: Introduction plant materials provided by transferring seed, plant and vegetative plant parts from one ecological region to another contribute to genetic diversity for breeding studies.

Several cotton varieties brought to Turkey from USA as introduction materials in different years have made important contributions to cotton production:

- ✓**Acala-8 (1927),**
- ✓**Deltapine-15 (1948),**
- ✓**Coker (1958),**
- ✓**Carolina Queen 201 (1963),**
- ✓**Sealand-542 (1965),**
- ✓**Delcerro (1977)** etc.

Introduction breeding is continued through commercial companies at present.

CONVENTIONAL COTTON BREEDING IN TURKEY

Selection Breeding: **The selection breeding was the most preferred method in breeding experiments** due to inadequate number of genetic materials **in the initial years of cotton production in Turkey.**

With selection breeding studies, important cotton varieties including

- ✓**Acala-1086,**
- ✓**Coker 100 A/2,**
- ✓**Nazilli 66-100,**
- ✓**Adana 967/10,**
- ✓**Çukurova 1518,**
- ✓**Adana 98,**
- ✓**Nazilli 84-S,**
- ✓**Nazilli 143**
- ✓**Nazilli 954** *were registered.*

CONVENTIONAL COTTON BREEDING IN TURKEY

Hybridization Breeding: **Combination or Hybridization breeding** constituting the basis of global cotton breeding at present is carried out to combine positive sides of two or numerous genotypes in one genotype. Approximately, 40 cotton varieties registered in Turkey were developed by combination breeding technique.