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Cotton

PBG-502 (T)

Family - ①
Malvaceae

Introduction: Cotton has been cultivated in tropical and subtropical climates of the world since prehistoric times and is now cultivated extensively in the temperate climates. In India cotton has been an important crop for more than 3000 B.C.

In Pakistan cotton plant is playing a significant role in the economy of the country. A substantial amount of foreign exchange is earned annually through the export of raw cotton and finished products. At home it provides raw material to the textile industry and also edible oil to the growing population. Due to the efforts of local breeders, significant breakthrough has been made in the recent years by the evaluation of numerous high yielding varieties.

There are still many problems with cotton that can be solved best by plant improvement. Diseases and insect pests continue to take large ~~to~~^{tools} for the potential cotton production, a loss that could be reduced with multiple-resistance varieties.

Origin of Cotton

All tetraploid
(4 native of Central America and 1 to Hawaii)

Cotton is classified in the genus "Gossypium" which contains 50 species, ^{with a basic chromosome no. 13} of which 44 are diploid and 5 are tetraploid species. The diploid species ($2n=2x=26$) are grouped in seven genomes designated A, B, C, D, E, F and G. The species with the A, B, E or F genomes are African, or Asian in origin and often are referred to as "Old World" species. The species with the C or G genomes are "Australian" in origin, the species containing the D genome are "New World" species, originated in the Western Hemisphere. The chromosomes in D genome are smaller than other genomes.

Of the ^{five} six tetraploid species ($2n = 4x = 52$), five are indigenous to the Americas and one to Hawaii. They originated as allotetraploid with AADD genome combination and have 26 small and 26 large chromosomes.

Out of 50 species, 4 species are cultivated and 46 are wild. The cultivated species are divided into two groups.

A) Old World Cotton

This group includes two species viz. ~~G~~

- i) Gossypium herbaceum
 - ii) Gossypium arboreum
- $2n = 2x = 26$ } A genome, large chromosomes.
Diploid species

These diploid species are called Asiatic Cotton because they are cultivated mostly in Asian region.

G. herbaceum is generally referred as tree cotton or desi cotton. According to Vavilov (1951) Gandia is the centre of origin of this species.

G. herbaceum is called laven cotton. There is controversy about the origin of this species. Some researchers consider Asia is the centre of origin while others believe that this species has been originated in South Africa.

B) New World Cotton

This group also includes two species, viz.

- i) Gossypium hirsutum
 - ii) Gossypium barbadense
- $(2n = 4x = 52)$ } Tetraploid species } AD genomes, 26 small and 26 large chromosomes.

G. hirsutum is known as American cotton or Upland cotton. South Mexico is considered as the centre of origin of this species. Upland cotton because it was cultivated on higher lands inward from the low coastal areas of Georgia and ~~California~~ Carolinas.

Gossypium barbadense is known as Peruvian Cotton or ~~Barbados~~ Sea Island Cotton. This species originated in Central and South America, and has long, fine fibers.

It was introduced to the Nile Valley of Egypt, where it became known as Egyptian Cotton, currently grown in irrigated areas of Arizona, New Mexico, and Western Texas. It is generally ~~suffered~~ referred as American Pima or more commonly "Pima".

American Cotton (*G. hirsutum*) is the principal cultivated cotton and accounts for about 90% of world cotton production. *G. barbadense* accounts 8% and desi cotton (*G. arboreum* + *G. herbaceum*) accounts 12% of the total world cotton production.

7.3.14 The following criteria are taken into account for tracing the origin of a species.

- i) Ecological considerations
- ii) Archeological observations
- iii) Cytogenetic observations.
- iv) Morphological features
- v) Biochemical observations &
- vi) Molecular observations.

Progenitor of Cotton:-

According to widely accepted theory of origin of cotton, *Gossypium herbaceum* var. *africanum* (Now *G. africanum*) is considered as the progenitor of all the four cultivated species of cotton. Among all the wild species of cotton only *G. africanum* bears lint. This species is still found growing in wild state of South Africa.

Evolution of Old World Cottons:

It is believed that Old world cotton viz. *G. arboreum* and *G. herbaceum* have evolved from *G. africanum*. The species *G. africanum* reached India from Africa through travellers, traders and explorers probably long before 3500 B.C. With the passage of time this species differentiated into two cultivated species viz. *G. arboreum* + *G. herbaceum*. Probably *G. arboreum* originated in India + *G. herbaceum* in Pakistan (Sind)

Fryxell (1979) reported that these diploid species had evolved in parallel but from different wild progenitors. Stebbins is of opinion that old world cotton reached America via China and Alaska.

Evolution of New World Cottons:

It is believed that the origin of tetraploid cottons took place in South America ^{before 3000 B.C.}. The cotton seed can survive floating in the sea water at least for one year without losing viability (Fryxell, 1965). Thus it is believed that most likely the cotton seed of *G. herbaceum* var. *africanum* floated across the Atlantic Ocean from Africa to South America. A cross took place between *G. herbaceum* and *G. raimondii*, probably in Peru, which gave the birth of sterile hybrid. Over the period of time, the chromosome no. of this hybrid got doubled through radiation resulting in the development of fertile amphidiploid (AA^{DD}). It is believed that first *G. barbadense* originated from this cross, which reached to Mexico through travellers + traders and after differentiation gave birth to the Upland Cotton (*G. hirsutum*).

The origin of tetraploid (species) cotton probably took place around 3000 B.C. After their origin, diploid + tetraploid cotton spread to different parts of the world

workers are of opinion that in the tetraploid cottons, 'A' genome is from *G. arboreum* and 'D' genome from *G. thurberi*.

However, cytological, biochemical and molecular investigations have clearly indicated that 'A' genome of *G. africanum* is closer to the 'A' genome of tetraploid cotton and 'D' genome of *G. raimondii* is closer to 'D' genome of tetraploid cotton.

Thus *G. africanum* and *G. raimondii* are progenitors of tetraploid cotton. This theory is widely accepted.

Major Cotton Producing countries are,

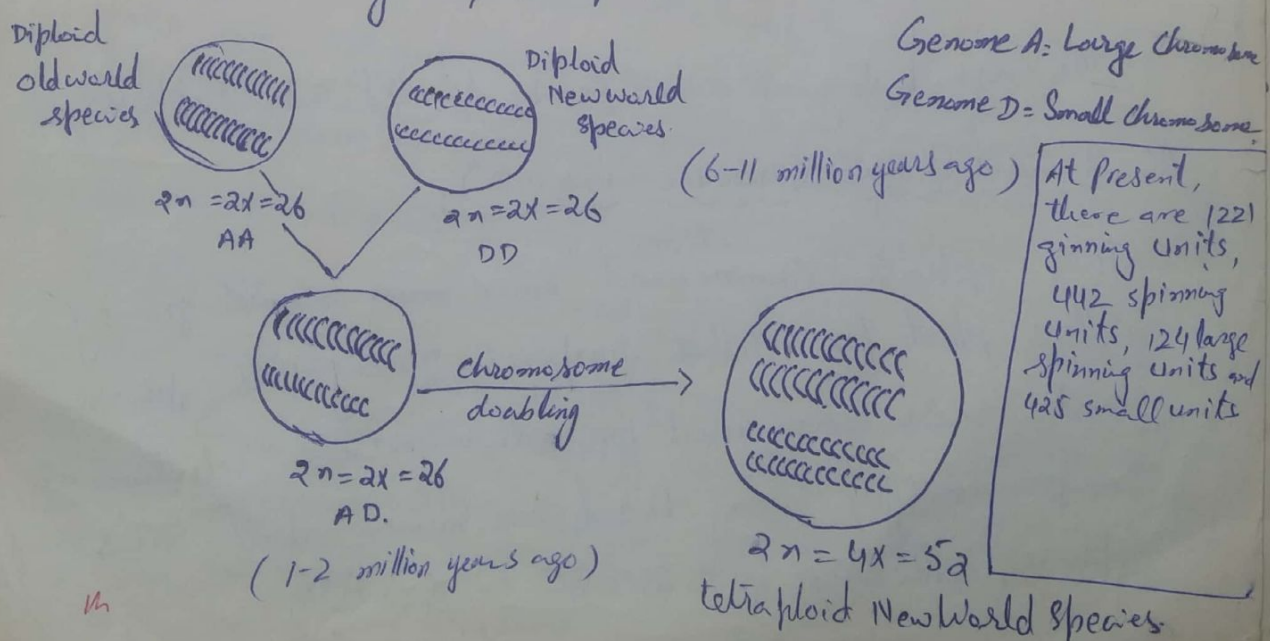
- 1- USA China
- 2- China India
- 3- India USA
- 4- Pakistan
- 5- Uzbekistan
- 6- Turkey
- 7- Brazil
- 8- Greece
- 9- Argentina
- 10- Australia
- 11- Egypt

Pakistan is the 4th largest producer of cotton with 3rd largest spinning capacity in Asia after China & India.

India stands first for area, China for production and Australia for productivity.

=> Cotton is grown in tropical & subtropical regions of more than 80 countries of the world.

Genetic Origin of Tetraploid Cotton



Fibre Crops:-

Fibre crops are those which are grown for their fibre and used to make paper, clothes or rope. These crops are generally harvested after a single growing season as opposed to trees which are grown for many years before being harvested for wood, pulp fibre.

Botanically, the plant fibre may come from the phloem tissue (fuzz of seed, leaf, or other parts of plant) is called bast fibre. The major sources of bast fibres are Jute, flax, Hemp, where as the other sources of fibres are cotton, Bamboo, papaya, coconut and sisal.

Plants producing fibres have the 2nd position just after food plants due to their usefulness to humans and have a significant role in civilization.

2018-19 (Economic survey of Pakistan).

Area of cotton 0.8% in GDP

Production: 9.861 million bales.

decrease: 17.5% from last year.

Area: 2373

-thousand hectares.

(2017-18) 11.946 million bales

- Fibre
- Food
- Feed
- fire

Bale weight 170kg.

1. Cotton : Gossypium hirsutum L. 26
52
- 2- Jute : Corchorus capularis 2n = 14
white Jute
C olitorius Tossa Jute
(Brown) (S. Pollinated)
- 3- Flax : Linum usitatissimum L. 2n = 30, 32
(Self)
4. Hemp : Cannabis Sativa L. 2n = 20
(Cross-Pollinated)
5. Sisal : Agave sisalana Perr. ex. Engelm 2n = 30

Cotton plays major role in earning foreign exchange. Cotton crop production accounts 1.5% in GDP.

(Pak) Area = 2961 thousand Hectares.
 Production = 13.983 million Bales } 2014-15
 10% increase from last year (12.769) 2013-14
million bales

World Ranking of cotton producing countries → (2014-15)

Rank	Country	Production (million tonnes)	Consumption	Lint
1	China	6.44	1 - China	324 kg/acre
2	India	6.77	2 - India	8.11 mounds/acre
3	USA	3.50	3 - Pakistan	
4	Pakistan	2.30	4 - Australia	

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