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Wheat

Origin

Distribution of species

Wild relatives and forms

Breeding objectives

Major breeding procedures for development of hybrids / varieties



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WHEAT – (*Triticum aestivum*) $2n = 6x = 42$

- Wheat is the most important cereal in the world, giving about one-third of the total production, followed closely by rice.
- In temperate regions it is the major source of food. The chief use of wheat is, the flour for making bread.
- Wheat is grown in all the continents except Antarctica. It is the staple food of the 1/3rd of the world's population.



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Place of origin:

- Diploid ($2n=14$) : Asia minor
- Tetraploid ($2n=28$) : Abyssinia, North Africa
- Hexaploid ($2n=42$) : Central Asia



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Distribution

- USA, Canada, Latin America, Europe, China, Japan, Argentina, Mexico, India, Pakistan
- Every month of the year a crop of wheat is harvested some where in the world. In India extensively cultivated in North West India, Eastern part, Central plain to some extent Southern peninsular zone.



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Fourteen species of wheat according to Vavilov:

- a. *T.boeoticum*
- b. *T.monococcum*
- c. *T.dicoccoides f. T.turgidum*
- d. *T.polonicum,*
- e. *T.timopheevi,*
- f. *T.aestivum,*
- g. *T.sphaerococcum,*
- h. *T.compactum,*
- i. *T.spelta,*
- j. *T.macha .*
- k. *T.dicoccum*
- l. *T.durum,*
- m. *T.persicum,*
- n. *T.turgidum*



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Origin of diploid wheat:

(Wild einkorn) *T.boeoticum* (*T.aegilopoides*)



Natural mutation and selection



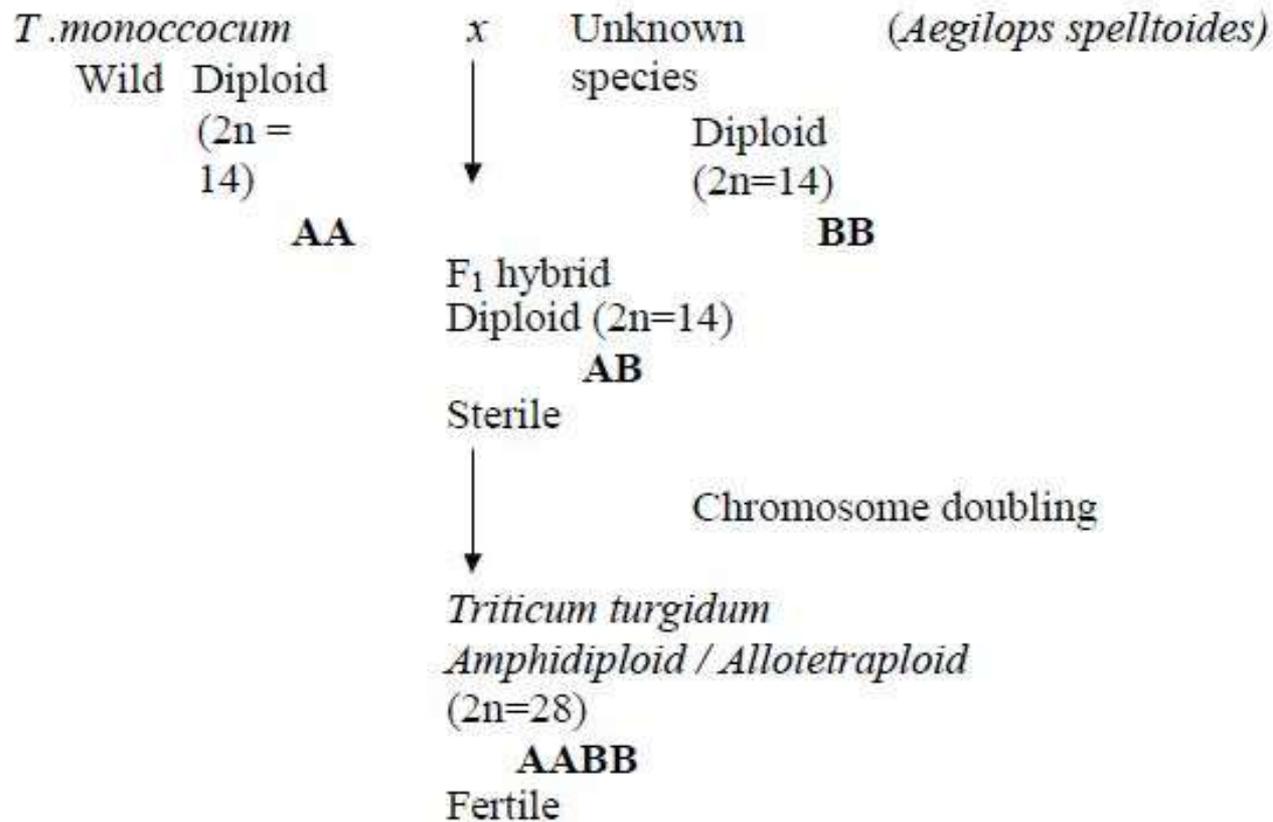
T.monococum Cultivated diploid

($2n = 14$)

T. boeoticum is probably the ancestor for all the cultivated wheats:



Origin of Tetraploid wheats:



Origin of hexaploid wheat

Triticum turgidum

x

T. tauschii

Tetraploid
 $2n = 4x = 28$
AA BB

↓

Diploid
 $2n = 2x = 14$
DD

F1 hybrid
Triploid
ABD
Sterile
 $2n = 3x = 21$
↓ Doubling
the
chromosome

Triticum
aestivum
Hexaploid
 $2n = 6x = 42$
AABB DD
Fertile



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Sugarcane (*Saccharum officinarum*) $2n = 80$

Origin: India

- The word sugarcane is derived from Sanskrit word 'sharkara' meaning sugar. It includes 3 cultivated species like *S. officinarum*, *S. barberi*, and *S. sinense*.

Wild species:

- *S. spontaneum*,
- *S. robustum*.

Cultivated species:

- *S. officinarum* ($2n = 80$)
- *S. sinense* ($2n = 118$)
- *S. barberi* ($2n = 82 - 12$)



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S. officinarum is also known as noble cane. The term noble was given by Dutch scientists in Java to tall, handsome, large bared and colourful canes of this species. The canes of this species have thick stem, soft rind, low fibre, high sugar content, high cane yield, and resistance to smut.



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1. *S. robustum* → *S. officinarum* (New Guinea)
S. barberi and *S. sinense* (North India).
2. *S. officinarum* X *S. spontaneum* → India).

Origin of cultivated species:

The wild progenitor for *S. officinarum* is *S. robustum*

S. officinarum x *S. sponataneum*

Mutation, selection, hybridization

S. spontaneum

S. barberi.



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Distribution : India, Brazil, Cuba, China, USA, Mexico, France, Germany and Australia. In India, Uttar Pradesh, Maharashtra, Haryana, Andhra Pradesh, Tamilnadu, Karnataka, Bihar and Punjab. India stands first in sugar and sugarcane production in world.



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Bengal Gram – Chickpea (*Cicer arietinum*) $2n = 16$

- The most important pulse crop India is the largest producer of chickpea in the world.
- **Origin:** According to Vavilov (1926) – S.W. Africa and Mediterranean region
- Later, Vander Maesun (1984) – Turkey and Syria
- **Distribution:** India, Pakistan, Mexico, Turkey, Ethiopia, Burma and Maynmar. In India M.P., U.P. Rajasthan, Haryana accounts 75-80% of the India's production other states are Maharashtra, Bihar, West Bengal and Andhra Pradesh.

Progenitors :

- *Cicer bijugumechinosperrum* *C. reticulatum*
- Genus *Cicer* has 49 species, out of these nine are annual and forty are perennial



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SUNFLOWER (*Helianthus annuus*) (2n=34)

- It is an important oil seed crop. Oil content ranges from 46-52 percent and is of high quality having non-cholesteral properties.

Origin: America

Distribution: USSR, Romania, Canada, USA In India this crop is introduced in 1969 from USSR. In India it is cultivated in Tamil Nadu Karnataka, Maharashtra and Andhra Pradesh, Punjab and Haryana

Progenitors: *Helianthus petiolaris*

- *H . gigants*



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- **Wild species:** *H. hirsutus*
- *H. rigidus*
- The genus *Helianthus* comprises of 67 species. Two species *H. annuus* and *H. tuberosus* are cultivated as food plants genus has basic chromosome number of 17 and diploid, tetraploid and hexaploid species are found.



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MUSTARD (*Brassica nigra*) (2n=16, 18, 20, 22, 36)

- Important oil seed crop grown in cool season sub tropics, higher elevations and winter crops. Seeds contain 40 – 45 per cent oil and 38-41 per cent protein.

Origin: India

Distribution: China, Canada, India, Europe, Pakistan, collectively contribute 90 per cent of the global production. In India Uttar Pradesh, Rajasthan, Punjab, Assam, Bihar and West Bengal.

Progenitor: Exact progenitor is not known. The genus *Brassica* contains more than 3000 species of which 40 are of economic importance.

- Cultivated *Brassica* can be broadly divided in to two distinct types viz.
- **Vegetable type** : cabbage, cauliflower, turnip
- **Oil seed type** - rape seed and mustard.

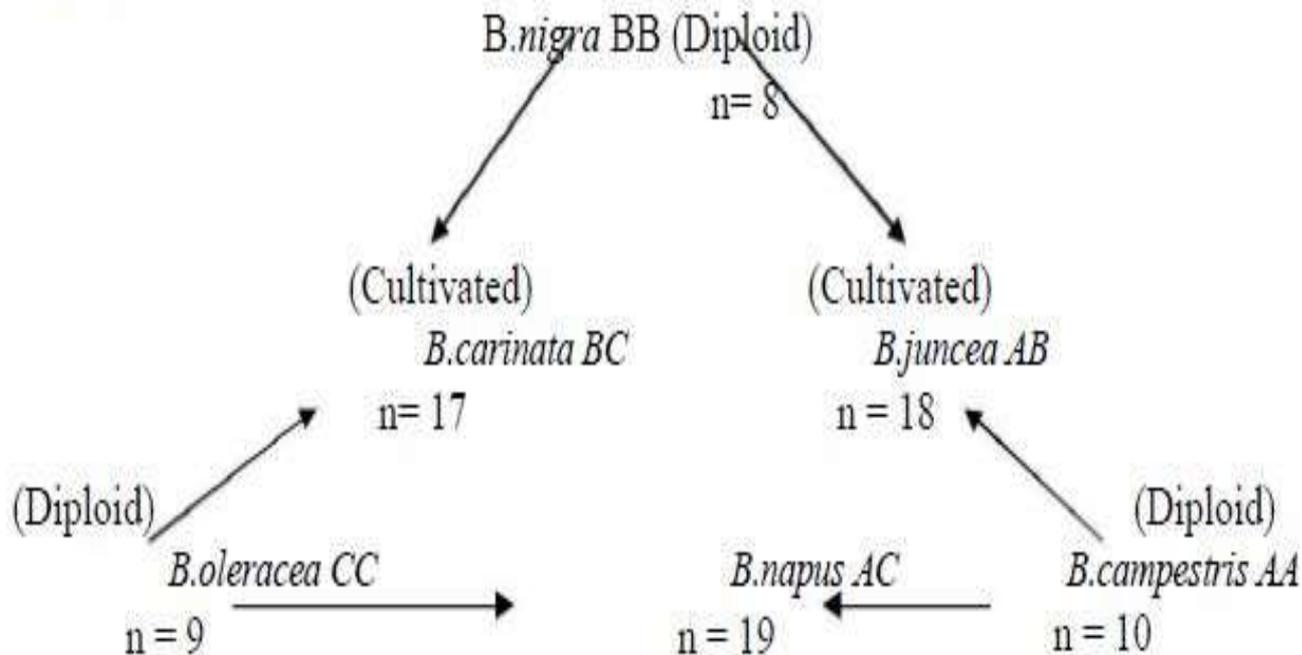


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- **Diploids are :**
- *B.nigra* - Black mustard
- *B.oleracea* - Cabbage
- *B.campestris* - Rape seed.
- *B.tourne froitii* - Wild turnip
- *B.napus* - Rape seed of Europe
- *B.juncea* - Indian mustard
- *B.carinata* - sshipplam mustard (veg / oil seed)



The genetical relationship between the oilseed brassicas are diagrammatically represented as follows.





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BARLEY

- Barley (*Hordeum vulgare* L.), one of the oldest of the cultivated cereals, is widely grown in many climates of the world.
- It grows in the arid climates of the Sahara, the high plateaus of Tibet, and the tropical plains of India.
- The genus *Hordeum* comprises about 24 species. These include diploid, tetraploid, and Hexaploid species.



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Origin

- Barley is probably native to Middle East. The first signs of barley cultivation has been recorded from the Middle East more than 10,000 years ago.
- Now it is widely cultivated in all temperate regions from Arctic Circle to high mountains in the tropics.



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BERSEEM *Trifolium alexandrinum*, $2n = 2x = 16$

- Origin : Egypt
- Karyotypic analysis of Berseem clover showed the presence of $2n = 2x = 16$ chromosome number having **7** pairs of metacentric and 1 pair of sub-metacentric chromosomes.



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Varieties of Berseem:

- i) Diploid - Meskawi
- ii) Tetraploid - Pusa giant

Distribution

- Berseem is mainly valued as a winter crop in the subtropics as it grows well in mild winter and recovers strongly after cutting. It does not grow well under hot summer conditions. It is cultivated from 35°N to the Tropics, from sea level up to 750 m (1500 m in North West Himalaya) (Hannaway et al., 2004; Suttie, 1999). Berseem has some frost tolerance, down to -6°C and as low as -15°C for some cultivars (Suttie, 1999). Berseem can grow in areas where annual rainfall ranges between 550 mm and 750 mm. It can withstand some drought and short periods of waterlogging. It does better than alfalfa in high moisture soils and is very productive under irrigation. It is moderately tolerant of salinity and can grow on a wide range of soils, though it prefers fertile, loamy to clay soils with mildly acidic to slightly alkaline pH (6.5-8).



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Wild Relatives

No.	Scientific Name	No.	Scientific Name
1	<i>T. fragiferum L.</i>	12	<i>T. alexandrinum L.</i>
2	<i>T. resupinatum L.</i>	13	<i>T. medium L.</i>
3	<i>T. tomentosum L.</i>	14	<i>T. lappaceum L.</i>
4	<i>T. patens</i>	15	<i>T. scabrum L.</i>
5	<i>T. campestre</i>	16	<i>T. incarnatum L.</i>
6	<i>T. procumbens L.</i>	17	<i>T. stellatum L.</i>
7	<i>T. philistaem</i>	18	<i>T. formosum</i>
8	<i>T. xerocephalum</i>	19	<i>T. angustifolium L.</i>
9	<i>T. nervulosum</i>	20	<i>T. dichroanthum</i>
10	<i>T. nigrescens</i>	21	<i>T. purpureum</i>
11	<i>T. repens L.</i>	22	<i>T. desvauxii</i>



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Tobacco (*Nicotiana tabacum* ($2n=48$))

- **ORIGIN**
- *Nicotiana tabacum* ($2n=48$) is a native of tropical and subtropical America but it is now commercially cultivated worldwide. Other varieties are cultivated as ornamental plants or grow as a weed.



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Distribution

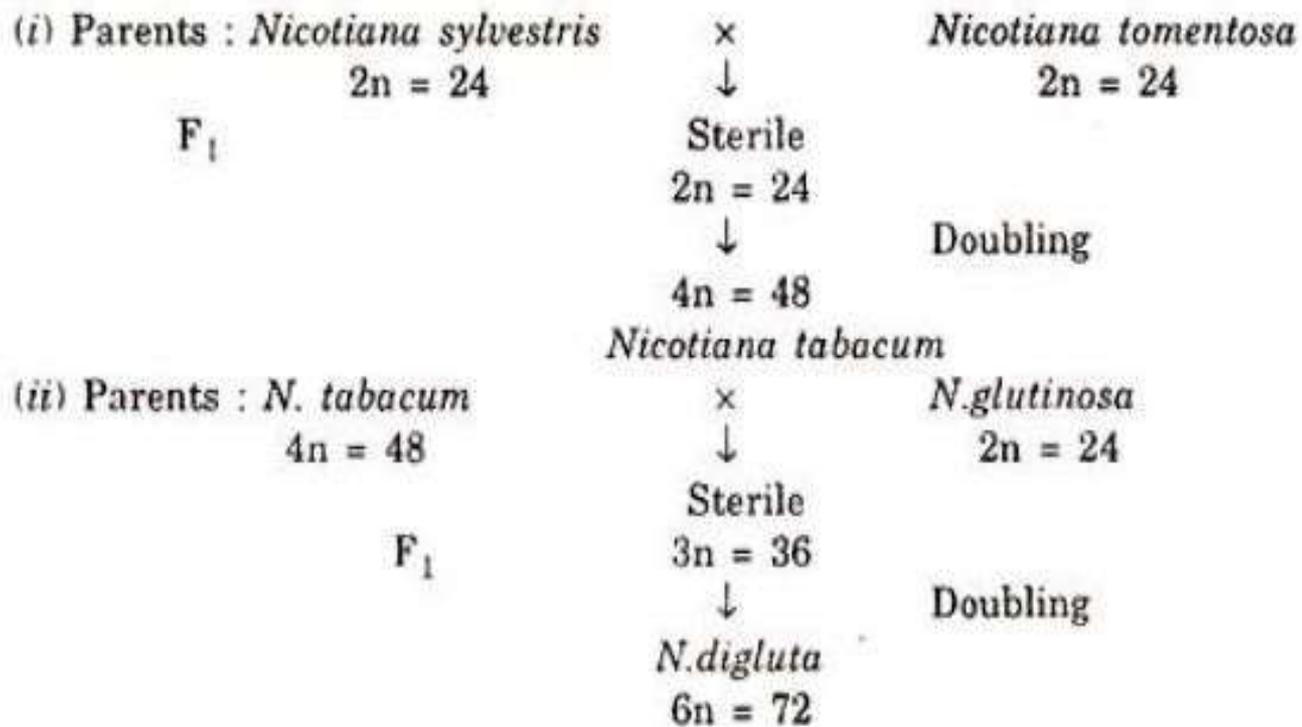
- In the United States, as of 2014 North Carolina was the largest producer of tobacco, with around 1,800 tobacco farms employing 30,000 workers yielding in 400 million pounds of the crop annual.
- While it is the major crop for millions of Chinese farmers, growing tobacco is not as profitable as cotton or sugar cane.
- In Brazil around 135,000 family farmers cite tobacco production as their main economic activity.
- India has 96,865 registered tobacco farmers and many more who are not registered. Around 0.25% of India's cultivated land is used for tobacco production.



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Wild Relatives Of Tobacco

- *Nicotiana benthamiana*, which grows wild in Australia, is widely used for experiments to study the interactions between plants and pathogens and other areas of plant biology.
- Being part of the Solanaceae family, *N. benthamiana* provides a great resource to compare it to its relatives, the tomato and potato.





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OKRA Lady's finger (*Abelmoschus esculentus*) ($2n=130$)

- Okra is a common vegetable crop grown in warmer climate,
- **Origin:** India
- **Distribution:** Asia, Europe, Africa and United States and Brazil. In India it is grown in Gujarat, Maharashtra, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Karnataka, Haryana and Punjab.
- **Species of Abelmoschus**
- *Abelmoschus angulosus*
- *crinitus*
- *ficulneus*



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CHRYSANTHEMUM (*Chrysanthemum moniliformin*) ($2n=36$)

- Florist's chrysanthemum (*Chrysanthemum morifolium*, Ramat) ranks second among commercial flowers in the world. In India it occupies third position, with jasmine and rose standing first and second.



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Origin: China

Distribution: China, Japan, France, USA, Australia, Europe, and Asia. In India all the states.

Species of chrysanthemum : Genus *Chrysanthemum* belongs to the family Compositae which is second largest family among flowering plants comprising about 20,000 species, largest being *Orchidaceae*.

- *Chrysanthemum morifolium*
- *C. sinense*
- *C. indicum*
- *C. japonicum*
- *C. arnatum*
- *C. satsumense*
- *C. boreale*

Indigenous species

- *C. indicum* – Native to India, Florist chrysanthemum



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Wild species : *C. stilliszkai*, *C. rkhtsria*, *C. atkinsoni* and *C. leucanthemum* as wild species in the Indo-Tibetan border

Introduced species / Exotic species

- *C. caronanium* (Garland chrysanthemum)
- *C. carinatum* (Tricolour chrysanthemum)
- *C. rubellum* (for hardiness)
- *C. sagetum* (Corn marigold (or) pot plant)
- *C. boreale* (Evolution of florif, chrysanthemum)
- *C. cinerarifolium* (Used as insecticide)
- *C. coccineum* (Perennial, seed propagated)
- *C. manifoldum* (Florist chrysanthemum)



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MARI GOLD (*Tagetes erecta* L). ($2n = 24$)

- **Introduction**
- Marigold (*Tagetes erecta* L., Asteraceae) is grown as an ornamental crop for loose flowers and as a landscape plant, as well as source of pigment for poultry feed.



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- **Origin:** Mexico
- **Distribution:** USA, Europe India etc. In India Maharashtra, West Bengal, Karnataka, Tamil Nadu and Andhra Pradesh.
- **Species, Types and Cultivars**
- **Species:** There are about 33 species of the genus *Tagetes*. The characters of important species (Bailey, 1963) are given below:
 - *Tagetes erecta* (African marigold)
 - *Tagetes patula* (French marigold)
 - *Tagetes tenuifolia* (Syn. *Tagetes signata*)
 - *Tagetes lucida* (Sweet scented marigold)
 - *Tagetes lacra*
 - *Tagetes lemmonii*



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GUAVA (*Psidium guajava*) (2n=22)

- In guava, most of the commercial varieties are reported to be diploids, the chromosome number being $2n=22$, while the seedless varieties are triploids.
- **Origin:** Tropical America / West Indies
- **Distribution:** America, Canada, Australia, India, Burma, Indonesia, Bangladesh etc. In India Uttar Pradesh, Andhra Pradesh, Maharashtra, Karnataka etc.



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Banana (*Musa paradisica*) – Fruit variety

- (*Musa sapientum*) – Vegetable variety (2n=22, 33, 44)

Origin: Tropical Asia

Distribution: USA, Canada, Europe, Brazil, India, Pakistan, Bangladesh, Indonesia, Burma and China. In India Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and West Bengal.

- The edible cultivated parthenocarpic bananas belong to the section 'Eumusa' which are derived from *Musa acuminata* and *M bulbisiana*.



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THANK YOU