

# **DOMESTICATION & CENTRES OF ORIGIN OF CULTIVATED PLANTS**

- **Domestication**
- The present day cultivated plants have been derived from wild weedy species.
- The first step in the development of cultivated plants was domestication.
- **Definition:-**domestication is the process of bringing wild species under human management.
- Which began over **11000** years ago, when humans began agriculture.

- The first domesticated plants were cereals, legumes and other species used for their fruits or roots.
- Most of the crops were domesticated by prehistoric humans.
- They knowingly or unknowingly selected the species which has the characteristics they have according their needs.
- Eventually crop plants are diverged from their wild ancestral species so remarkably that they are classified as wild distinct species.
- In some cases their wild ancestors are not easily identifiable.

- Domestication of wild species is likely to continue.
- A notable case of recent and continuing domestication relates to several plant species for the production of biofuel.
- Eg:-*Jatropha curcas*
- A member of Euphorbiaceae family, cultivation is being popularized since oil extracted from its seeds is used to produce biodiesel. This plant also has medicinal value.
- Which is supplemented upto 5% of diesel.

- Almost all the characters of plant species have changed due to accumulation of spontaneous mutations.
- The characters that show more distinct changes are those that have been the objects of selection and are still plant breeding objectives in many cultivated species.
- Some important changes that have been occurred under domestication:-
- Elimination or reduction in shattering of pods, in most of the cultivated species.
- Elimination of dormancy has taken place in several crop species. Lack of dormancy is a problem in barley, wheat etc.

- Decrease in toxins or other undesirable substances has occurred in crops. The bitter principle of cucurbitaceous plants provide an example of this.
- Plant type has been modified. The cultivated plant shows altered tillering, branching leaf characters etc.
- Decrease in plant height, often associated with a change from indeterminate to determinate habit.
- In some species an increase in plant height can be seen. eg:- jute, sugarcane etc.

- Life cycle has become shorter, particularly in crops like cotton (*Gossypium sp.*).
- Increase in size of grains or fruits.
- Increase in economic yield.
- In many crops asexual reproduction has been promoted under domestication.

eg:-*Solanum tuberosum*, *Ipomea batatus*

- Preference in polyploidy, while diploid counterparts are present in nature. eg:-wheat.
- Shift in the sex form under domestication. In many dioecious fruit trees, bisexual forms have developed under domestication. Self-incompatibility has also been eliminated in several crop species.

# Centres of origin

- It is generally accepted that cultivated plants were not distributed uniformly through out the world.
- Even today certain areas show far greater diversity than others for certain cultivated crops and their wild relatives.
- In 1926 Vavilov proposed that, **crop plants are evolved from wild species in the areas showing great diversity** and termed them as **primary centres of origin**.
- Later, the crops moved to other areas primarily due to human activities ;these are areas which generally lack richness in variation which is found in primary centres of origin.

- **Secondary centres of origin:-** areas ,in which plants show considerable diversity of forms although they did not originate there:such areas are called secondary centres of origin.
- The concept of centres of origin was given by Vavilov based on his studies of a vast collection of plants at the institute of plant industry ,Leningrad .

# Concept of centres of origin

- The concept of centers of origin was first proposed by the Russian scientist Nikolai Vavilov (1887-1943).
- Vavilov headed what was to be eventually named the Vavilov All-Union Institute of Plant Industry from 1920 to 1940.
- One of his missions was to collect crop-related germplasm for use in national plant breeding projects.
- During his explorations, Vavilov observed that crop diversity tends to be concentrated around specific regions.

- He proposed that these concentrations of high variability indicated the regions where domestication of these crops began.
- This concept went against the prevailing view that cultivation of plants started randomly all over the world.

### Kinds of evidence that Vavilov used;

- Archaeological
- plant remains
- Living plants
- DNA, proteins, morphology, biochemistry
- Ecology, distributions
- Linguistic:-names of the crop in different languages

- Locating the origin of crop plants is basic to plant breeding.
- This allows one to locate wild relatives, related species, and new genes (especially dominant genes, which may provide resistance to diseases).
- Knowledge of the origins of crop plants is important in order to avoid genetic erosion, the loss of germplasm due to the loss of ecotypes and landraces, loss of habitat (such as rainforests), and increased urbanization.

# N.I Vavilov

- Nikolai Ivanovich Vavilov ForMemRS was a prominent Russian and Soviet botanist and geneticist best known for having identified the centres of origin of cultivated plants.
- Born: 25 November 1887, Moscow, Russia
- Main books: Five continents, Origin and geography of cultivated plants.
- Field: botany and genetics
- Notable awards: Lenin prize, Fellow of the royal society.
- He was director of the institute of plant industry from 1916 till 1936.
- Died: 26 January 1943, Saratov, Russia



# Law of homologous series of variation

- Law of homologous series of variation is proposed by Vavilov.
- Which states that characters found in one species also occur in other related species.
- For example, diploid(2X), triploid(3X) and hexaploid(6x) wheats show a series of identical contrasting characters.
- Similarly genus *Secale* duplicates the variation found in genus *Triticum*.

- Thus a character absent in a species ,but found in a related species ,is likely to be found in the collections of that species made from the centres of origin.

- **Eight main centres of origin were originally proposed by Vavilov in 1926.**

- These centres are;

1)China

2)Hindustan

3)Central Asia

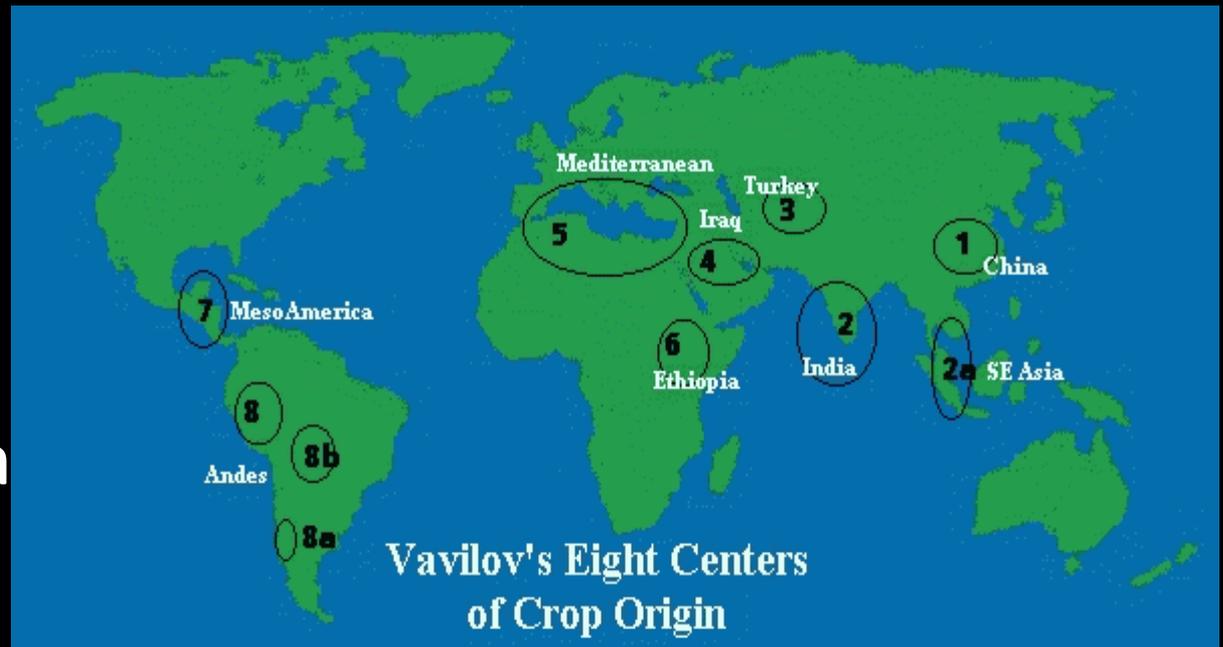
4)Asia Minor

5)Mediterranean

6)Abyssinia

7)Central America

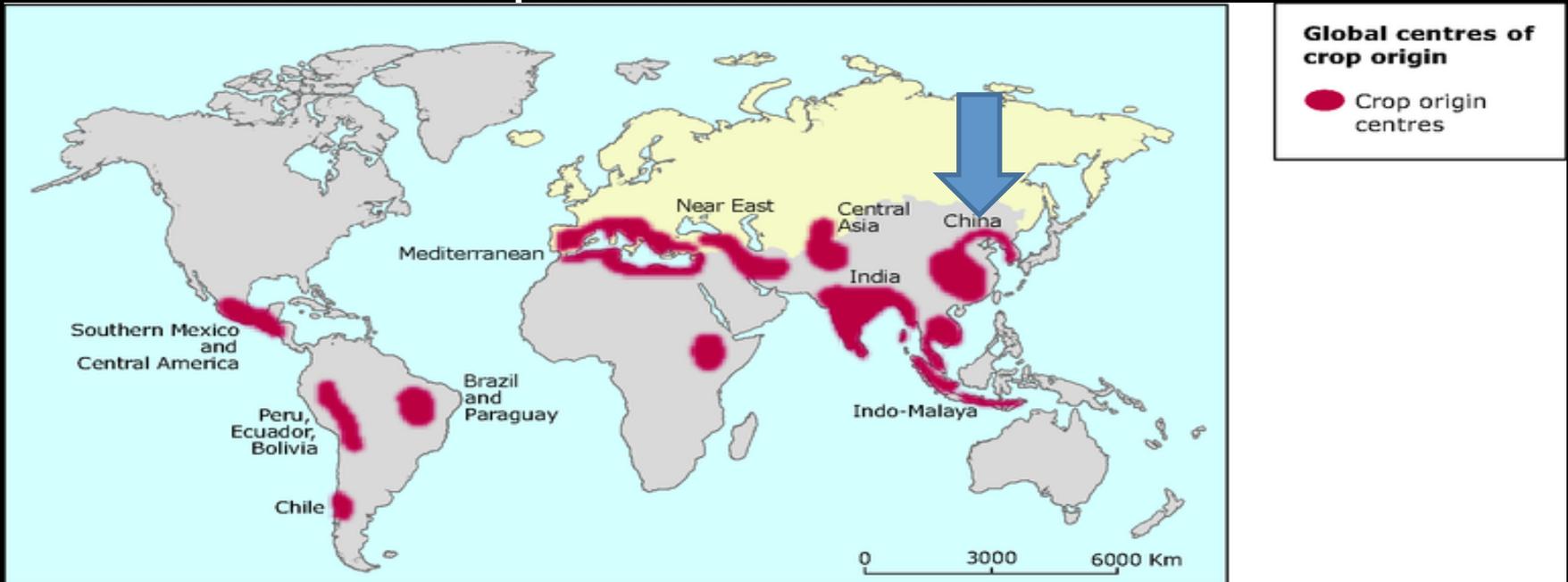
8)South America





# The china centre of origin

- This region consists of the mountainous regions of central and western china and the neighbouring lowlands.
- A total of 138 plants were listed.

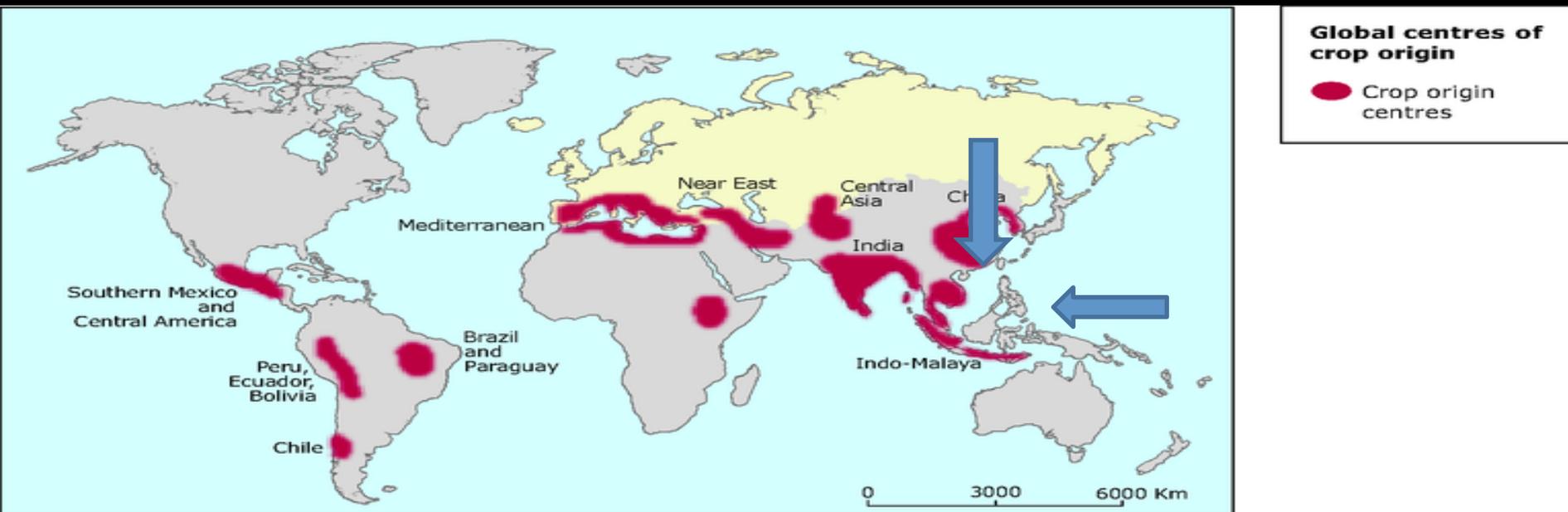


## Primary centres of origin for;

- *Glycine max*
- *Raphanus sativus*
- *Colocasia antiquorum*
- *Panicum miliaceum*
- *Some species of millets*
- *Fagopyrum esculentum*
- *Papaver somniferum*
- *Cammellia sinensis*
- *Avena nuda*
- *Brassica*
- *Allium*
- *Solanum melongena*
- *Prunus armeniaca*
- *Citrus*
- **Secondary centres of origin for;** *Zea mays*, *Phaseolus vulgaris*, *Vigna unguiculata*, *Sesamum indicum*

# The Hindustan centre of origin

- This centre includes, Burma, Assam, Malaya, Archipelago, Java, Borneo, Sumatra and Philippines (excludes north west India, Punjab, and North western frontier provinces).
- Hindustan centre is divided into Indo Burma and Indo Malayan subcentres
- 117 species were listed.



- Primary centres of origin for,

- *Oryza sativa*

- *Cajanus cajan*

- *Cicer arietinum*

- *Vigna radiata*

- *Cucumis sativus*

- *Lactuca indica*

- *Dioscorea*

- *Raphanus indicus*

- *Curcuma domestica*

- *Saccharum*

- *Gossypium*

- *Cannabis indica*

- *Piper nigrum*

- *Indigofera*

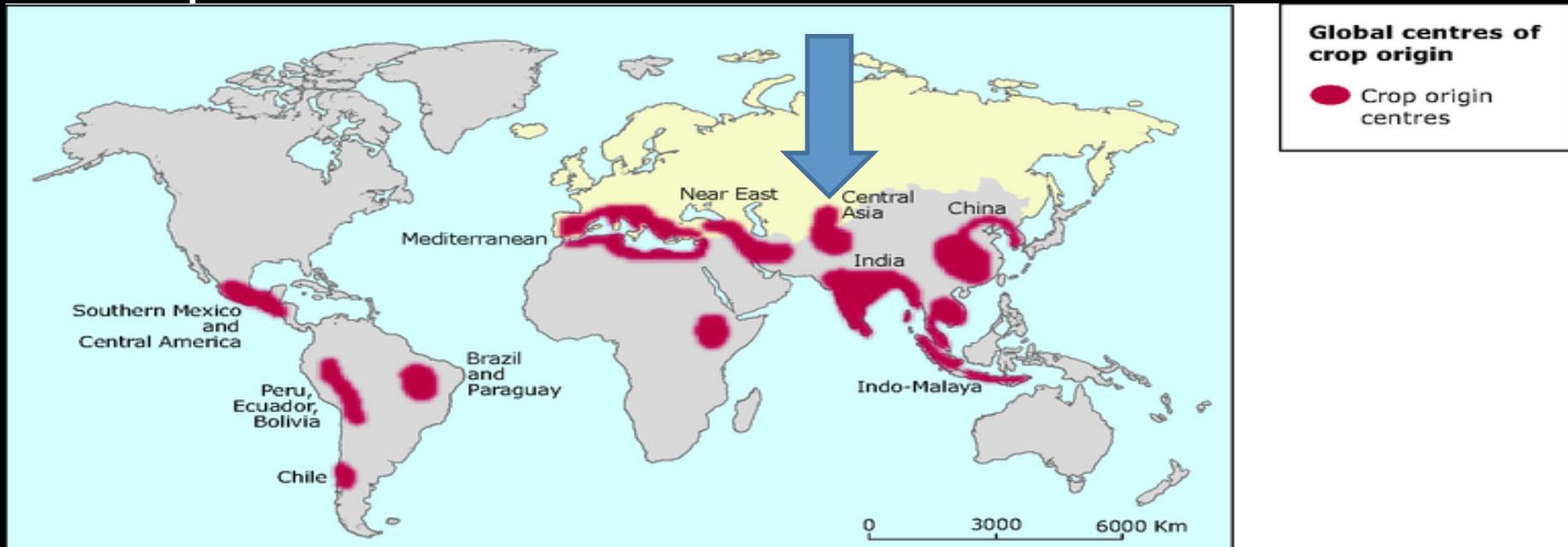
- *Mangifera indica*

- *Cocos nucifera*

- *Musa sapientum*

# The central Asia centre of origin

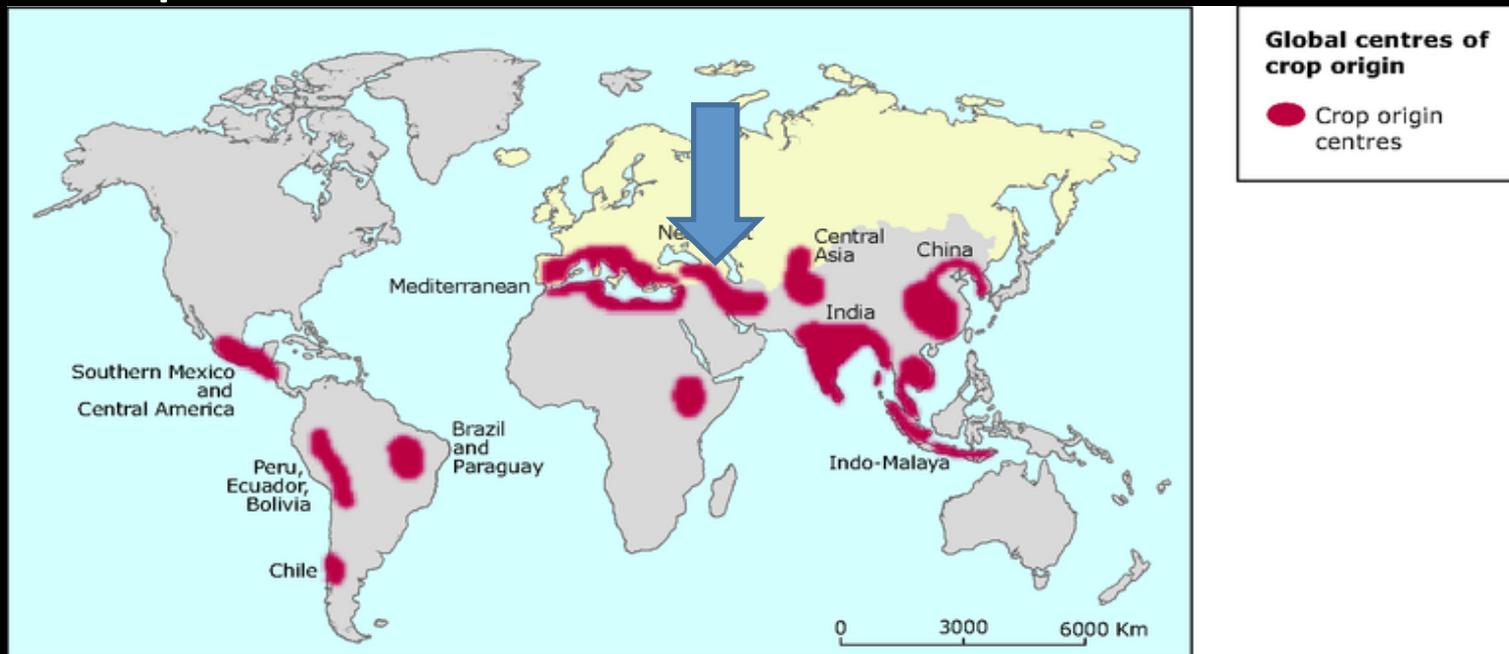
- Includes north west India(Punjab,The north west frontier provinces and Kashmir),all of Afghanistan,The soviet republics of Tadjikistan and Uzbekistan and Tian –shan.
- It also known as Afghanistan centre of origin.
- 42 species were listed.



- Primary centres of origin for,
  - *Triticum aestivum*
  - *T. compactum*
  - *Pisum sativum*
  - *Vicia faba*
  - *Allium sativum*
  - *Pistachia vera*
  - *Linum usitatissimum*
  - *Carthamus tinctorius*
  - *Gossypium*
  - *Cucurbita moschata*
  - *Daucus carota*
  - *Vitis vinifera*
- Secondary centres of origin for, *Secale cereale*

# The Asia minor centre of origin

- This is also known as the near east or Persian centre of origin.
- It includes the interior of Asia minor, the whole Transcaucasia, Iran and highlands of Turkmenistan.
- 83 species were listed.



- Primary centres of origin for,

- *Triticum* (9 species)
- *Medicago sativa*
- *Trifolium resupinatum*
- *Brassica oleracea*
- *Avena sativa*
- *Allium* sp.

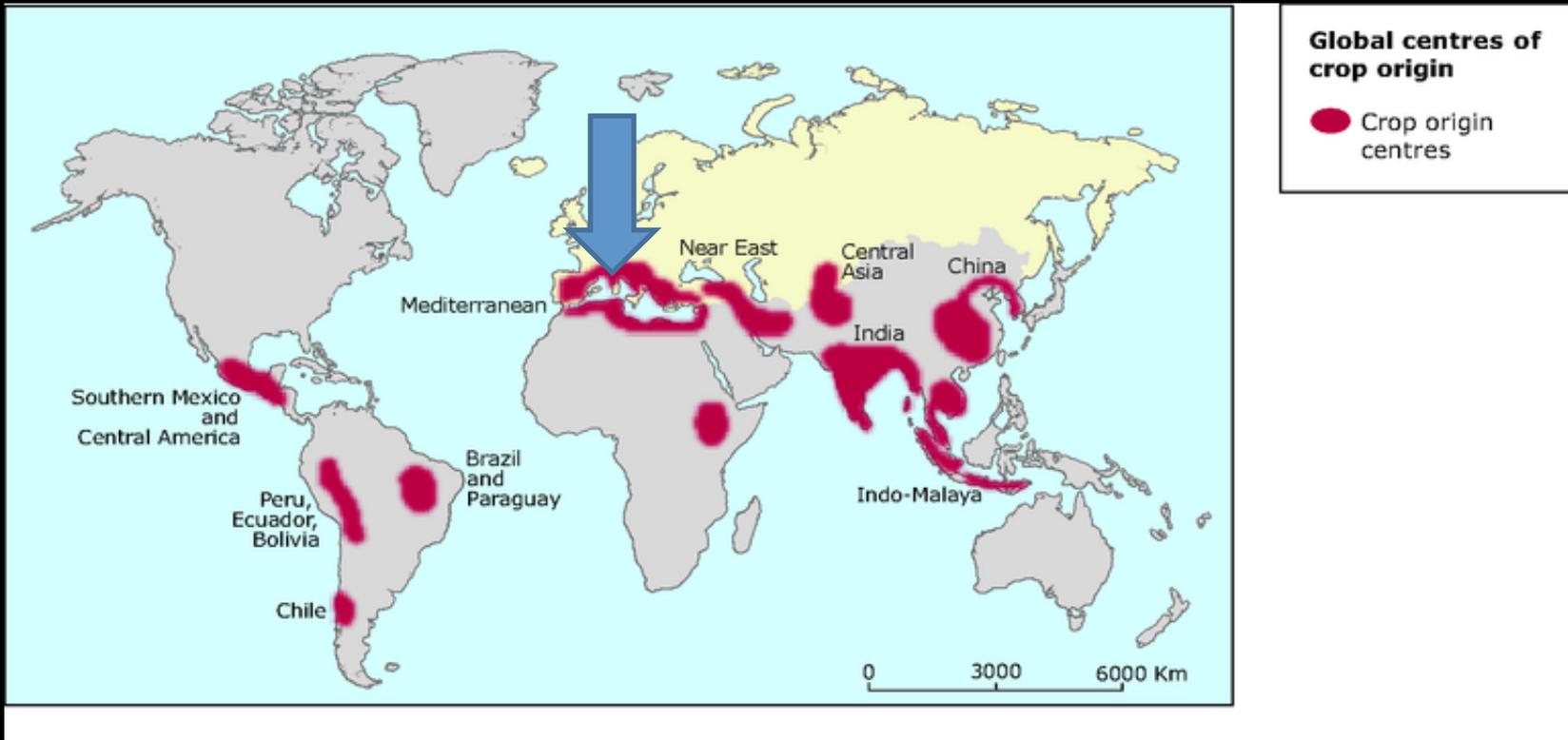
- *Lactuca sativa*
- *Ficus carica*
- *Punica granatum*
- *Malus sylvestris*
- *Pyrus* sp.
- *Prunus*
- *Vitis vinifera*

- Secondary centre of origin for,

*Brassica campestris*, *B. nigra*, *B. japonica*, *B. rapa*

# The Mediterranean centre of origin

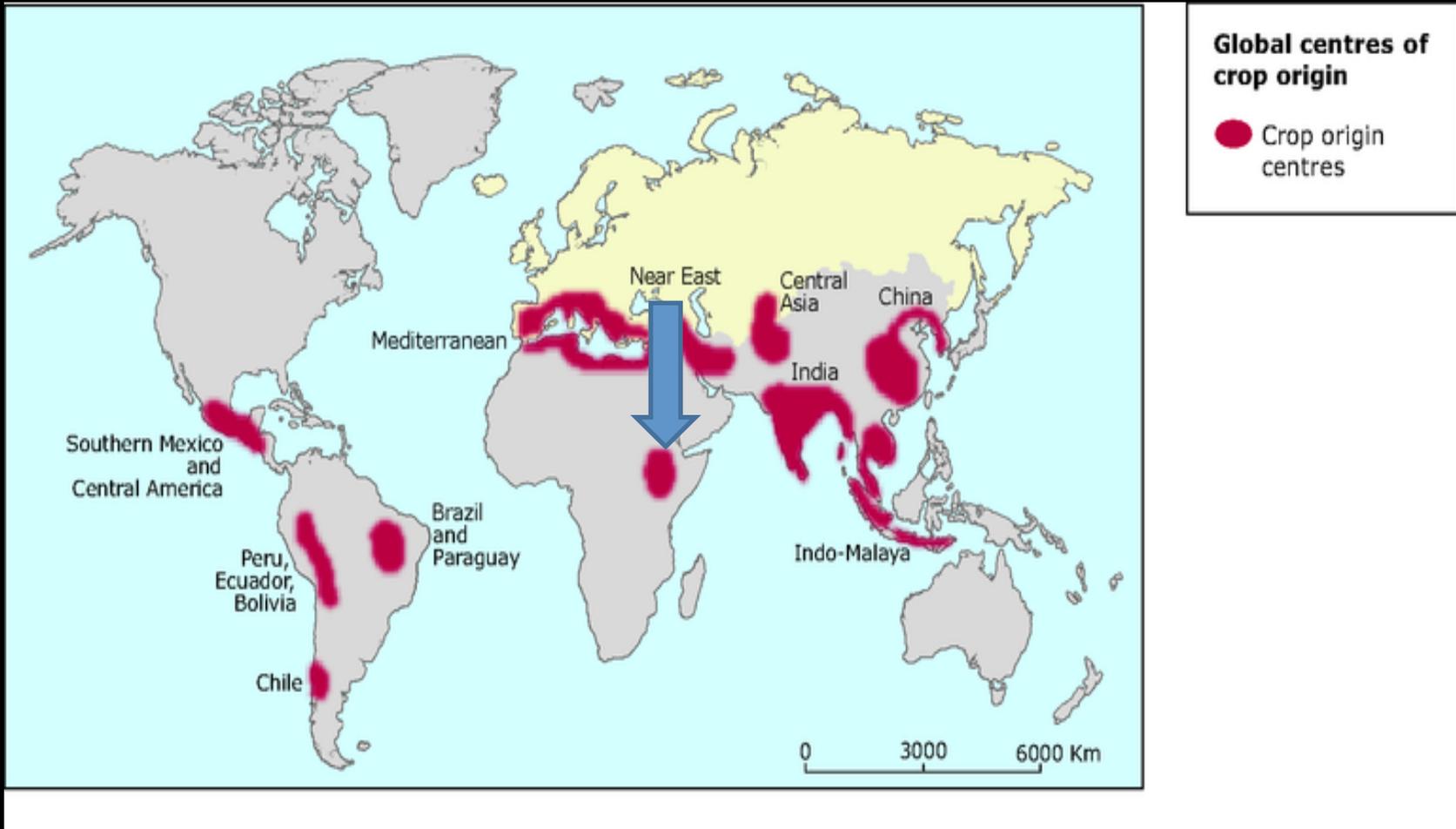
- Many valuable cereals and legumes are originated from here.
- 84 species were listed



- Primary centre of origin for,
- *Triticum durum*
- *Triticum dicoccum*
- *Triticum sp.*
- *Avena sp.*
- *Hordeum vulgare*
- *Lens esculenta*
- *Menta sp.*
- *Lathyrus*
- *Lupinus sp.*
- *Trifolium sp.*
- *Vicia sativa*
- *Asparagus officianalis*
- *Allium sp.*

# The Abyssinian centre of origin

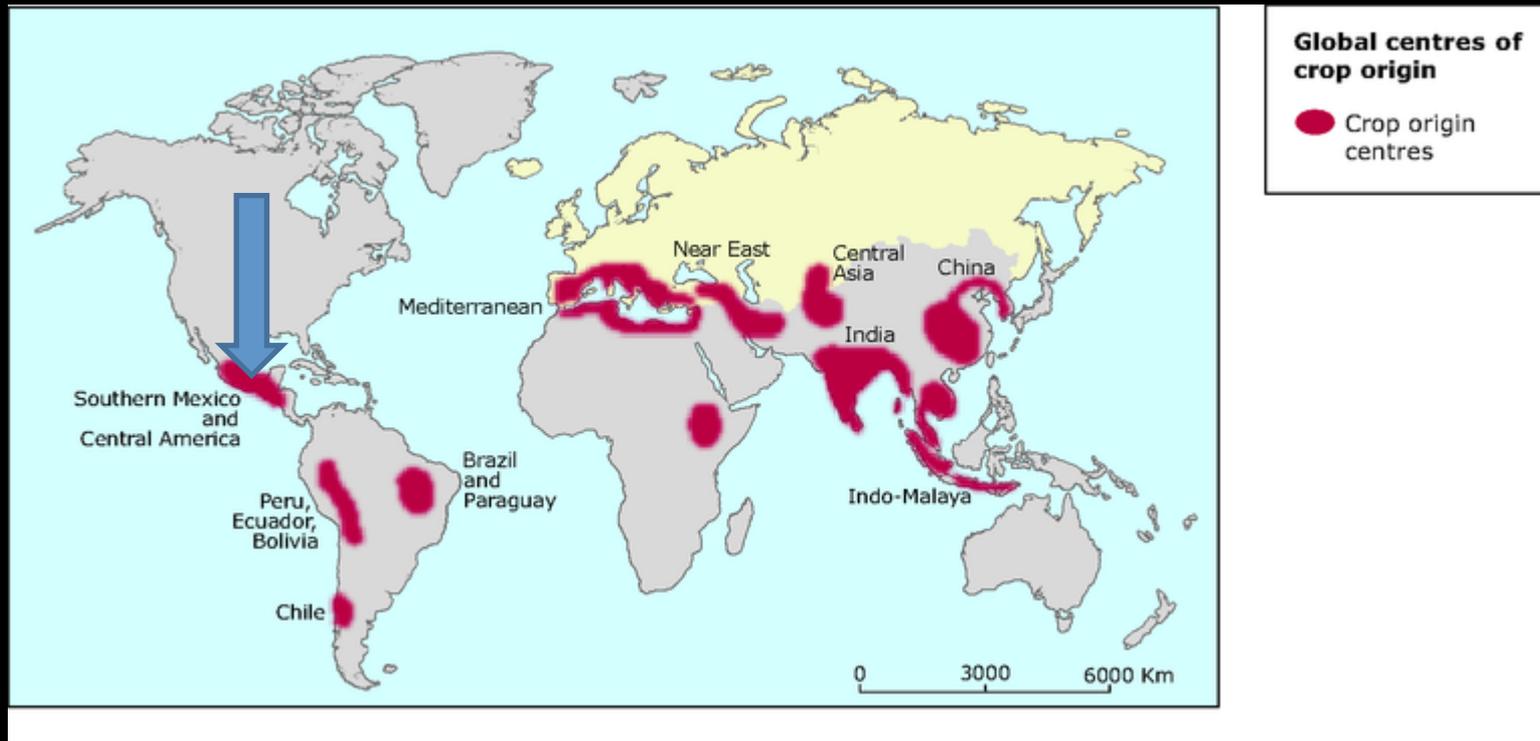
- It includes Ethiopia and hill country of Eritrea.
- 38 plant species were listed .



- **Primary centre of origin for,**
- *Hordeum vulgare*
- *Triticum durum*
- *T. turgidum*
- *T. dicoccum*
- *Sorghum bicolor*
- *Pennisetum glaucum*
- *Dolichos lablab*
- *Lathyrus sativus*
- *Ricinus communis*
- *Coffea arabica*
- *Allium*
- *Abelmoscus esculentus*
- **Secondary centre of origin for, *Vicia faba***

# The central American origin

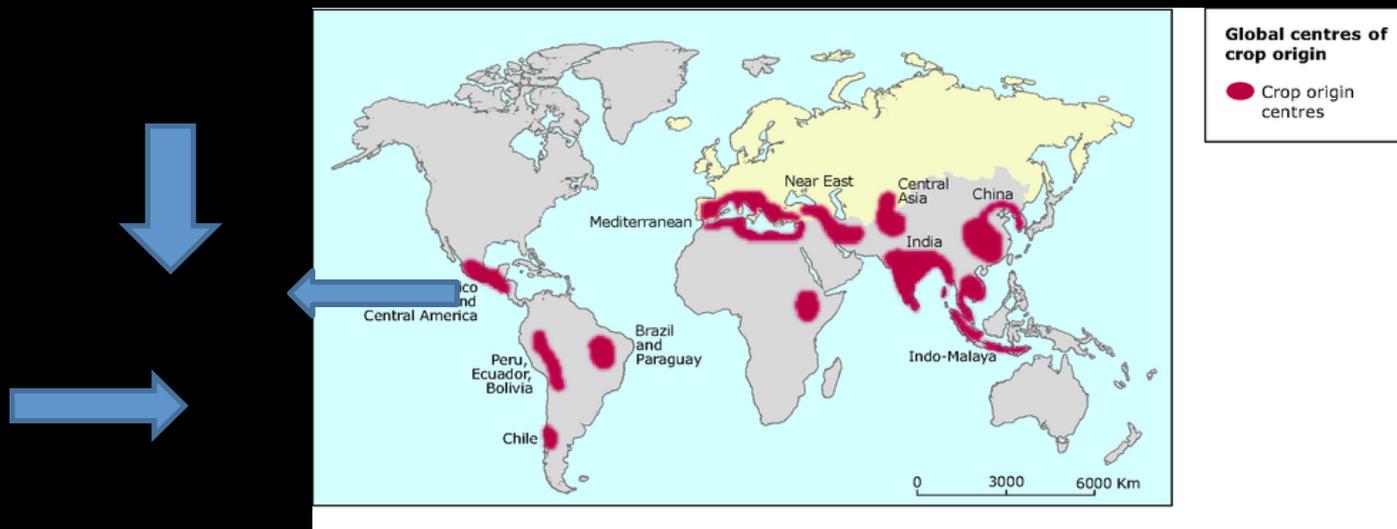
- This includes the region of South Mexico and Central America.
- It is also referred as the Mexican centre of origin.
- 49 species of plants were listed from here.



- Primary centres of origin for,
- *Zea mays*
- *Phaseolus vulgaris*
- *P. lunatus*
- *Cucurbita melanosperma*
- *Ipomea batatus*
- *Canna edulis*
- *Capsicum annum*
- *Gossypium hirsutum*
- *G. purpureascens*
- *Carica papaya*
- *Psidium guajava*
- *Persea americana*

# The south American centre of origin

- The centre includes high mountain regions of Peru, Bolivia, Ecuador, Columbia parts of Chile and Brazil and whole of Paraguay.
- Chile -centre and Brazilian -Paraguay centre are subcentres
- 45 plants were listed from here.



## Centre of diversity

- Plants of a species living in different environment are likely to be different.
- Thus a plant species are likely to show considerable variation in a region with varied climatic and other ecological conditions.
- Areas with mountains and valleys show variation in the prevalent environment.
- So ,plant species also show considerable variation in this area.
- Interestingly centres of origin are situated in mountain-valley areas.

- Thus centres of origin may be more appropriately called centres of diversity.
- Zhukovsky in 1965 recognised 12 mega gene centres of crop plant diversity.
- Indian sub continent have two hot spot of biodiversity in the eastern Himalayas and western Ghats.
- At least 147 agri-horticultural crop species are believed to be originated from India.

# Diversity in potato



# Diversity in *Triticum*



*T. urartu*(A<sup>u</sup>), *aegilopoides* *monococcum*, *T. sinskajae*(A<sup>m</sup>A<sup>m</sup>)

*T. monococcum* ssp. (A<sup>m</sup>A<sup>m</sup>)



*armeniacum* *typicum* *T. militinae* (GGA<sup>m</sup>A<sup>m</sup>)

*T. timopheevii* ssp. (GGA<sup>m</sup>A<sup>m</sup>)



*paleocolchicum* *dicoccoides* *polonicum* *turanicum* *speciosum* *carthlicum* *dinurum* *dicoccum* *T. ispahanicum* (BBA<sup>u</sup>A<sup>u</sup>)

*T. turgidum* ssp.(BBA<sup>u</sup>A<sup>u</sup>)



*spelta* *macha* *compactum* *sphaerococcum* *aestivum*

*T. aestivum* ssp. (BBA<sup>u</sup>A<sup>u</sup>DD)



*T. vavilovii* (BBA<sup>u</sup>A<sup>u</sup>DD) *T. zhukovskiy* (GGAA A<sup>m</sup>A<sup>m</sup>)

# Diversity in *zea mays*



## Sinskaya ,1969

- Scientists who made contributions on centres of diversity.
- He studied on variation in Barley.
- After he concluded that, over centuries and millennia cultivated barley has adapted to different environmental conditions and different human utilisation requirements.
- The gene pool of cultivated barley has thus acquired a very large morphological and adaptive diversity.

# How centres of origin useful in plant breeding

- The study of centers of origin and diversity is helpful in plant breeding and genetic research.
- The genetic variation in these centers often serves as a rich reserve of genetic material for the improvement of cultivated crops.
- Genes for disease, pest and stress resistance, and nutritional quality are just some of the resources that can be found in these reserves.

- Locating the origin of crop plants is basic to plant breeding.
- This allows one to locate wild relatives, related species, and new genes (especially dominant genes, which may provide resistance to diseases).
- Knowledge of the origins of crop plants is important in order to avoid genetic erosion, the loss of germplasm due to the loss of ecotypes and landraces, loss of habitat (such as rainforests), and increased urbanization.

# Conclusion

- Recent centre of origin discovering studies are continuing and it is mainly based on molecular techniques.
- Each and every agro-ecological groups are based on the study of hundreds or thousands of accessions from the world collections.
- Thus these classification of centres of origin provide orientation on the resources of a particular crop.

# Reference

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- [https://books.google.co.in/books?id=JOcsswW0lscC&pg=PA66&lpg=PA66&dq=sinskaya+1969&source=bl&ots=FlidVKGMGq5&sig=VRzEtA\\_IB-iEWoZwnD-Pj3mOr7s&hl=en&sa=X&ved=0ahUKEwin5OeB9Y3WAhUCTbwKHdsyAnsQ6AEILjAD#v=onepage&q=sinskaya%201969&f=false](https://books.google.co.in/books?id=JOcsswW0lscC&pg=PA66&lpg=PA66&dq=sinskaya+1969&source=bl&ots=FlidVKGMGq5&sig=VRzEtA_IB-iEWoZwnD-Pj3mOr7s&hl=en&sa=X&ved=0ahUKEwin5OeB9Y3WAhUCTbwKHdsyAnsQ6AEILjAD#v=onepage&q=sinskaya%201969&f=false)
- [https://www.google.co.in/search?q=centre+of+origin&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj3sp6v9Y3WAhVEbrwKHegUA9MQ\\_AUICygC&biw=1366&bih=662](https://www.google.co.in/search?q=centre+of+origin&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj3sp6v9Y3WAhVEbrwKHegUA9MQ_AUICygC&biw=1366&bih=662)

A close-up photograph of several green wheat stalks with long awns, set against a clear blue sky. The wheat is in the foreground, and the background is a soft-focus field of more wheat.

**THANK YOU**